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Hybrid Learning and Education

Second International Conference, ICHL 2009
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Preface

The Second International Conference on Hybrid Learning was organized by the School of Continuing and Professional Studies of The Chinese University of Hong Kong and University of Macau in August 2009. ICHL 2009 was an inventive experience for the Hong Kong and Macau tertiary higher education. The conference aims to provide a good platform for knowledge exchange on hybrid learning by focusing on student centered education. The technique is to supplement traditional classroom learning with eLearning. The slogan is “Education leads eLearning,” not vice versa. The methodology is that at least 30% of learning activities are done by eLearning. The outcome is for students to learn at any time at any place. eLearning can increase students’ learning productivity and reduce teachers’ administration workload alike. It is a new culture for students, teachers and school administrators to adopt in the twenty-first century. The conference obtained sponsorship from Pei Hua Education Foundation Limited, City University of Hong Kong, ACM Hong Kong Section, and Hong Kong Computer Society.

Hybrid learning originated from North America in 2000, and is an ongoing trend. It is not merely a simple combination of direct teaching and eLearning. It encompasses different learning strategies and important elements for teaching and learning. It emphasizes outcome-based teaching and learning, and provides an environment for knowledge learning. Students are given more opportunities to be active learners and practice practical skills such as communication, collaboration, critical thinking, creativity, self-management, self-study, problem solving, analysis and numeracy.

It was our pleasure to have a keynote speaker for the conference, namely, Timothy Shih from the National Taipei University of Education, whose talk was “Repository and Search Based on Distance Learning Standards.”

We are thankful for the effort of all the organizing committee members for arranging the conference, and also the Program Committee members for reviewing the papers. Special thanks must go to Wen-Jing Shan for the support of University of Macau in holding the conference. The conference attracted about 149 submissions, and only 38 papers were accepted for publication in the *Lecture Notes in Computer Science* series by Springer.

On behalf of the conference Steering Committee members Reggie Kwan from Caritas Francis Hsu College, Philips Fu Lee Wang from the City University of Hong Kong, Victor Lee from The Chinese University of Hong Kong and Joseph Fong from the City University of Hong Kong, we trust you will enjoy these conference proceedings.

August 2009

Joseph Fong
Wen-Jing Shan

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Repository and Search Based on Distance Learning Standards

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Abstract. With the popularity of Internet technologies and the development of search engine, people request various kinds of information through Web-based services. In distance learning (or e-learning), SCORM (i.e., Sharable Content Object Reference Model) provides an efficient way for learning objects to be reused and shared. In order to meet a federated repository goal such that Learning Objects are found, the CORDRA (Content Object Repository Discovery and Registration/Resolution Architecture) provides a common architecture for discovering and sharing these Learning Objects. We follow SCORM and CORDRA specifications to develop a registry system, called MINE Registry, for storing and sharing Learning Objects. As a contribution, we proposed the concept of “Reusability Tree” to represent the relation among relevant Learning Objects. In this paper, we further make a deeper step to collect relevant information while utilizing Learning Objects, such as citations and time period persisted. Through these information, we propose a mechanism to weight and rank Learning Objects. As a new contribution, we provide a mechanism and tool called “Search Guider” to assist users in finding relevant information based on individual requirements.

Keywords: SCORM, CORDRA, LOM, Search Ranking, Search Guidance, Relevance Feedback, Distance Learning, e-Learning.

1 Introduction

In e-learning related research, technologies of distance learning systems include Authoring Tool, LMS (Learning Management System) and Repository, according to system functionality. A repository in distance learning not only provides a distributed storage mechanism but also emphasis on the sharability and reusability of Learning Objects (LOs). Although the issues of common repository for web-based learning were addressed [3, 8, 10], representation of LOs is another key which will affect a repository architecture in general.

In our earlier works [5, 9], we proposed a Metadata Wizard framework for generating metadata automatically. The framework simultaneously lessens the course creators’

work and increases the degree of metadata completeness, which in turn can enhance searchability. After that, as a significant extension, we go further to find out the relations between different LOs. We provide essential information of LOs to assist users in generating their courses. As a short summary, our current research follows the SCORM standard to construct a repository system (i.e., MINE Registry). We provide a search mechanism and a series of search criteria for users to look for necessary information of LOs based on LOM specification (parts of SCORM).

In this paper, based on a systematic re-examination of reuse scenarios, we propose a weighting model and a ranking model to enhance LO reuse and the relevance of the LOs. One scenario is when a LO has been registered in our repository, we can firstly calculate the importance of specific LO based on its relevant information (e.g., the creator, duration time, cited numbers, etc). After that, our system will compare the relevance with other LOs based on their metadata. Through these steps, we can get basic information of LOs and rank them in different importance degrees. Another scenario is when the user searches for some useful LOs, our system will guide them to find the necessary results through altering and suggesting their original input query. We propose a weighting and ranking mechanism for LOs based on SCORM standard and CORDRA architecture. We also utilize the Relevance Feedback as a search path modification rules to guide the users to obtain essential LOs.

The organization of this paper is as follows. Section 2 gives a brief introduction to the researches and technologies related to this paper. The core mechanisms including weighting, ranking, and guiding formula are described in Section 3. Section 4 shows the System Implementation. We conclude this work and address the future works in Section 5.

2 Background Technologies

We separate this paragraph into four sections: IEEE LOM, CORDRA, Reusability Tree, and Data Mining Technologies.

2.1 IEEE LOM and CORDRA

IEEE LTSC (Learning Technology Standard Committee) proposed a five-level architecture to describe the possible information for available learning resources [13]. They also introduced the IEEE LOM (Learning Object Metadata) to provide a unified description of learning resources. Metadata can be considered as a sort of information about information. By using the IEEE LOM, the learning resources can be retrieved and acquired easily among the e-learning society to realize a “standardized diverse world.” The IEEE LOM mainly comprised of 9 categories as follows: General, Life Cycle, Meta-Metadata, Technical, Education, Rights, Relation, Annotation and Classification, to annotate learning contents in a comprehensive perspective. Besides, each category has its own classification to describe the learning resources in detail.

CORDRA is “an open, standards-based model for how to design and implement software systems for the purposes of discovery, sharing and reuse of learning content through the establishment of interoperable federations of learning content repositories” [12]. The architecture of CORDRA aims to provide a way to resolve the conflict in the

name space by means of a unique handler for each LO. It also provides a way to allow discovery and sharing of LOs. However, relations among reusable objects and the history of use of these objects are not maintained. As a consequence, if a course creator obtains a large number of learning objects in a particular search, he/she needs to look at them one by one to find their relations and the usage history. This discourages reuse. A similar situation occurs when one uses an ordinary Internet search engine.

2.2 Reusability Tree

The reusability tree is conceptually similar to a version-derivation tree. It consists of nodes and links, where a node at one level is an LO, and child nodes of the node represent LOs that are created by partially reusing the LO. A child LO thus contains properties copied from its parent LO, and its own properties. When reusing an LO, several types of changes may be made, and the changes are captured in the reusability tree. Taking Fig. 1 As an example, there are four different LOs in this scenario. LO₁ represents the original learning object with three nodes (i.e., N₁, N₂, N₃). LO₂, LO₃, and LO₄ are created by modifying parts of LO₁. The new learning objects, LO₂, LO₃, LO₄, can be considered as the derivation tree from the LO₁. As an example, it is not difficult to find that LO₄ has higher similarity with LO₁ (the original learning object). The similarity degree can assist users to get the relevant information of LOs and to reuse them.

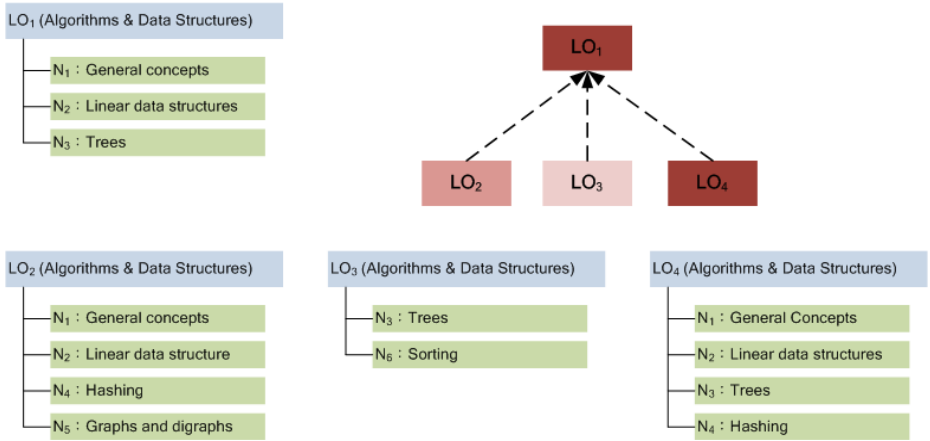


Fig. 1. An Instance of Reusability Tree

2.3 Data Mining Technologies

In this research, we take the time series problems into consideration. We will introduce the relevant data/web mining technologies in this section.

2.3.1 Tilted-Time Window Model

Chen et al. [2] have purposed Tilted-Time Window Model as shown in Fig. 2.

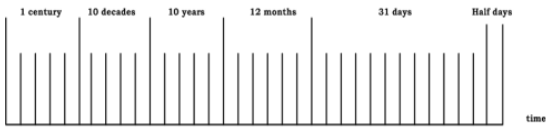


Fig. 2. Tilted-Time Window Model

In this model, time will be divided into different sizes from nearest one to farthest one. The nearer time sections have more details; otherwise it will be more diagrammatic. The data over a long time will be seen through more macro perspective.

2.3.2 Time Fading Model

The data streams are considered as the same in each unit of time in the Landmark Model and the Sliding Window Model [4]. However, Chang and Lee [1] proposed the Time-Fading Model (shown in Fig. 3), mentioning distance of time is also a key point of data mining. It gives different weight values to each data and separates the time line into several blocks. The weight values of data will increase through the movement of time.

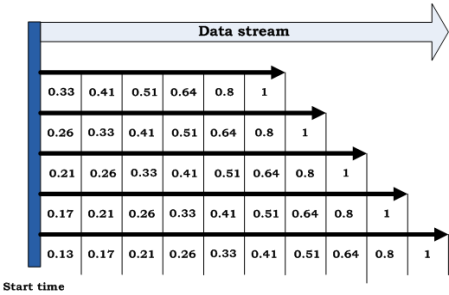


Fig. 3. Tilted-Time Window Model

In this model, different blocks will be assigned with different weight values. It improves the relationship between data and time especially to those timeliness data. The newer data will have a higher reference values.

3 Ranking and Searching

Our proposed mechanisms can be separated into two main parts: A weighting and ranking mechanism and a search guider. We will firstly explain how we calculate the weight for each LO in our repository and how to rank them based on their relations. After that, we will integrate the relevance feedback algorithm with LOM description to recommend appropriate search paths or to assist users in modifying their search specifications.

3.1 Weighting and Ranking Mechanism for LOs

It is useful to use metadata of each learning object in their life cycle to rank and recommend LOs. We propose a mechanism for weighting and ranking the LOs by recording the citation numbers from users (users of authoring tool or users of LMS). For LO_A , we have the citation ($C\_Ref(LO_A)$) and the value is a positive integer. According to this citation value, we could realize the importance of learning objects. The higher citation value the learning object has, the more popularity it is. Then, we further use the following methods:

- **Citation from Author (A_Ref):** System will collect learning objects created by authors and will sum up the citations. That is, we could get the citation numbers from author (A_Ref) according to the relationship between the author and the learning objects through how many times the object is downloaded. The citation number of a newly created learning object must be equal to zero.
- **Citation according to Year (Y_Ref):** This represents the number of citations in a year. If citation numbers of a specific learning objects increase suddenly in a period of time but utilize just a few in the following days after, that means these learning objects could not be evaluated by A_Ref. Hence, we would also record the citation numbers of learning objects in a year to improve the accuracy of weighting of learning objects.

According to the methods above, we could weigh the learning objects in our repository through A_Ref, Y_Ref and C_Ref. It is similar to the search mechanism of Google, which utilizes thousands of rules to make search results more precise. We give the three methods above with different thresholds and form the following formula:

$$Ref(LO_A) = \alpha \cdot C\_Ref(ObjectA) + \beta \cdot A\_Ref(ObjectA) + \gamma \cdot Y\_Ref(ObjectA)$$

$$\text{where } \alpha + \beta + \gamma = 1 \quad (1)$$

However, the formula above has two problems: (a) The value of $C\_Ref(ObjectA)$ might be extreme great (ex. 9999) or extreme small (ex. 1), without standardization of learning objects; (b) We have to withdraw some old data according to the Y_Ref. But we also have to modify the C_Ref and the A_Ref according to the change of Y_Ref.

For this reason, we revise the formula to combine the citation of year to the C_Ref and the A_Ref. So the formula is revised as the folloign:

$$Ref(ObjectA) = \alpha \cdot \frac{C\_Last\_3(ObjectA)}{\sum C\_Ref(ObjectA)} + \beta \cdot \frac{A\_Last\_3(ObjectA)}{\sum A\_Ref(ObjectA)}$$

$$\text{where } \alpha + \beta = 1 \quad (2)$$

- **C_Last_3(ObjectA):** The citation of Object A in three years.
- **A_Last_3(ObjectA):** The citations of learning objects created by the author of Object A in three years.

After that, we also have to take time series into consideration. Thus, we could revise the purposed formula by integrating the Tilted-Time Window Model to separate time in different length. The basic measure unit is half-day (12hours) as shown in Fig. 2.

And we also integrate the Time-fading Model to calculate the weight of learning objects as follows.

$$W_i = \frac{D_{n-i+1}}{\sum_{i=1}^n D_i} \quad (3)$$

- D_i : A period of time
- W_i : The weight of LO in D_i
- n : Number of time period in count

The most important characteristic of the Time-Fading Model is that the smallest unit in each section will be greater than or equal to the sum of previous one. Hence, the weight of the latest learning object should be the greatest one.

According to the citation numbers and weight in a specific period of time, we could define the following formula to get the weight of learning objects.

$$\text{Ref}(\text{ObjectA}) = \alpha \cdot \sum \left[W \cdot \frac{C\_Last\_3(\text{ObjectA})}{\sum C\_Ref(\text{ObjectA})} \right] + \beta \sum \left[W \cdot \frac{A\_Last\_3(\text{ObjectA})}{\sum A\_Ref(\text{ObjectA})} \right] \quad (4)$$

where $\alpha + \beta = 1$

According to (4), the evaluation is based on the citations provided by system. It might be seen as an objective method. However, we also have to take the evaluation from users into consideration. It is like the evaluation of YouTube and the Google Social Search [14] mechanism. Therefore, the weight of each learning object will be:

$$\text{Ref}(\text{LO}_A) = \alpha \sum \left[W \cdot \frac{C\_Last\_3(\text{ObjectA})}{\sum C\_Ref(\text{ObjectA})} \right] + \beta \sum \left[W \cdot \frac{A\_Last\_3(\text{ObjectA})}{\sum A\_Ref(\text{ObjectA})} \right] + \gamma \cdot \frac{\sum \text{feedback}(\text{ObjectA})_i}{N} \quad (5)$$

where $\alpha + \beta + \gamma = 1$

- N : The total number of response from users.
- $\text{feedback}(\text{ObjectA})_i$: The feedback value of item i .

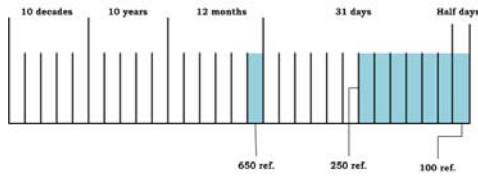


Fig. 4. The life cycle of LO_A

For instance, the age of LO_A is 1 month and 6.5 days. The citations are 650 times in 1 month, 250 times in 6 days and 100 times in last half day (shown in Fig. 4). According to the analysis of Tilted-Time Window Model, we could separate the life cycle into three sections. Through (3), we can get the weight for each time period. If learning LO_A is the only LO created by a specific author, the beta threshold should be 0. We assumed that there are 1000 users who have given responses to systems and half of these responses are relevant to LO_A . Hence, the computing process of LO_A will be:

Weight Value of LO_A

1. Citations number and frequency:

Period	Citations
31 days (1 month)	650
6 days	250
0.5 day	100

2. Weight value for each section:

Period	Weight
W ₁ (31 days)	0.01
W ₂ (6 days)	0.16
W ₃ (0.5 days)	0.83

3. Threshold for our proposed formula:

Beta = 0

Assumed that **Alpha** = 0.5 and **Gamma** = 0.5

4. Use the thresholds and each parameters into our formula, it will be:

$$\text{Ref}(\text{LO}_A) = 0.5 \cdot \frac{(0.83 \times 100 + 0.16 \times 250 + 0.01 \times 650)}{100 + 250 + 650} + 0 + 0.5 \cdot \frac{500}{1000} = 0.31475$$

The weight of LO_A is **0.31475**

After getting the weight value of learning objects, we could rank these learning through the concept of Google PageRank algorithm. However, we also revised the PageRank algorithm. We calculate the similarity between LOs which may have certain relation with each other.

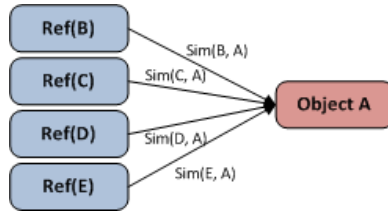


Fig. 5. The measure unit of purposed model

Fig. 5 shows the similarity between LO_A and other LOs. Assuming that LO_B, LO_C, LO_D, and LO_E have certain similarity with LO_A. We revised the Cosine Similarity formula to serve our goal. The main reason addressed in Table 4. The elements that we prepare to match between different LOs are based on IEEE LOM. The similarity formula is:

$$\text{Sim}(\text{LO}_A, \text{LO}_B) = \frac{\sum_{i=1}^n T_{A,i} T_{B,i}}{\sqrt{\sum T_{A,i}^2} \sqrt{\sum T_{B,i}^2}} \quad (6)$$

– **T_A, T_B**: The match elements contained in LO_A and LO_B

According to (5) and (6), the ranking formula for learning objects in this paper will be proposed as follows:

$$\text{Rank}(\text{LO}_A) = \frac{\sum \text{Sim}(\text{LO}_i, \text{LO}_A) \cdot \text{Ref}(\text{LO}_i)}{n} \quad (7)$$

- **LO_i**: Learning objects that have relationship with LO_A
- **n**: The number of LOs that have relationship with LO_A

Formula (6) shows how to weight learning objects. After getting the weight of each learning object, we further rank these learning objects through formula (7).

3.2 Search Guider

In order to get the relevant LOs in repository, the use of similarity is necessary. In the previous paragraph, we mention methodologies to achieve different purposes.

To realize the similarity between LOs, we could use the IEEE LOM. As mentioned above, not all of these elements are useful to the analysis. We selected only elements from the metadata which is essential for our works. The information of selected elements mainly focuses on the “General” and the “Educational” categories of metadata. We adopt the “1.2 Title”, “1.3 Language”, “1.5 Keyword”, and “1.6 Coverage” in General category, and we also adopt “5.2 LearningResourceType”, “5.5 IntendedEndUserRole”, “5.7 TypicalAgeRange”, “5.8 Difficulty”, and “5.9 TypicalLearningTime” in Educational category. We select 9 representative elements above from the IEEE LOM (the total is 77 elements). Through these selected elements, we can find out the relationship between the one searched by the users and the one stored in our repository.

The Fig. 6 shows an example of the search scenario. The red one represents the initial query string that a user uses. The green one represents the revised query based on the original query that the user uses. To derive the revised query is our purpose.

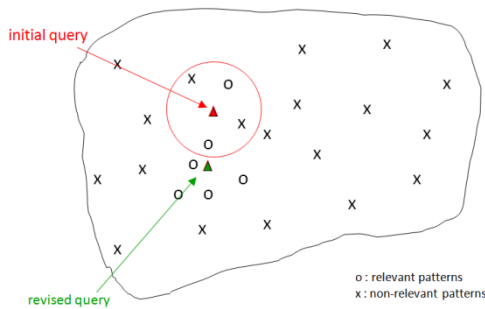


Fig. 6. Illustration of a query scenario

To achieve our goal, we revised the Relevance Feedback algorithm [6, 7, 11] and integrate it with our selected LOM elements. The revised calculation formula is as follows:

$$\overrightarrow{Q_m} = \alpha \overrightarrow{Q_0} + \beta \frac{1}{|P_r|} \sum_{n=1} \overrightarrow{D_j} \frac{|MI_n|}{|ML|} - \gamma \frac{1}{|P_{nr}|} \sum \overrightarrow{D_j} \quad (8)$$

where $\gamma < \beta$

- $\overrightarrow{Q_m}$: modified query vector
- $\overrightarrow{Q_0}$: initial/original query vector
- α, β, γ : weights
- P_r : set of known relevant pattern vectors
- P_{nr} : set of known irrelevant pattern vectors
- d_j : set of query vector
- MI_n : match items between query vector and existing pattern
- ML : list from the selected LOM elements

The value for α, β , and γ can be change dynamically. The only rule that we should follow is the value of β should greater than γ . That is, if γ is greater than β , the query is far from the results that the user really wants.

3.3 Comparison with Other Researches

In distance learning, researchers pay more attention on learning platforms (student side) and the authoring systems (instructor side). There are fewer papers discuss learning objects stored in repository. However, there are lots of companies provide recommendation to customers in e-commerce environment or provide an efficient way for users to search for the products they need. Thus, in this paper, we provide a novel mechanism for repository to calculate the weight of learning objects. Besides, we also provide a search guider to assist users in finding relevant information by revising their initial query. It will make researches in repository more valuable, and it will also make users reuse learning objects efficiently.

4 System Demonstration

This section shows as example of our proposed work. Interested readers are welcome to visit our demo website at <http://www.mine.tku.edu.tw>. In this example, we start from an example that we used in the previous discussion. The course “Algorithm & Data Structure” can be regarded as LO_A . Assuming that, a course designer makes some modification of LO_A and makes it become a new learning object (LO_B). After that, he/she uploads the LO_B to our registry system. The registry system will calculate the similarity and the diversity for LO_B . That is what we do in our previous works.

Assuming that, the age of LO_A is 1 month and 6.5 days. The citations of LO_A are 650 times in 1 month, 250 times in 6 days and 100 times in last half day. The process of formula (weighting and ranking) derivation has just described in the previous section. In Fig. 8, it is not difficult to understand that LO_A has higher ranking than LO_B based on our formula.

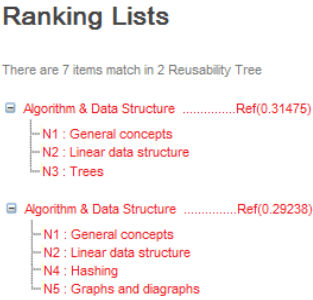


Fig. 8. Illustration of Weighting and Ranking Value

In the proposed Search Guider, we assume that a specific user would like to find some LOs which have certain relation with LO_A . In this scenario, user inputs the keyword “algorithm” as the first query. The first search result is shown in Fig. 9. There are a lot of learning objects founded according to the query keyword. After the user choose a specific learning object here, our search system will calculate the similarity for the first query and the selected learning object. Assuming that, user chooses the first result as the base to revise query. Our system will automatically return the recommend query to user as shown in Fig. 10. The search results are closer to the user’s need.

Search Guider

algorithm

search

More Details...

title: algo

In mathematics, computing, linguistics and related subjects, an algorithm is a sequence of finite instructions, often used for calculation and data processing. It is formally a type of effective method in which a list of well-defined instructions for completing a task will, when given an initial state, proceed through a well-defined series of successive states, eventually terminating in an end-state. The transition from one state to the next is not necessarily deterministic; some algorithms, known as probabilistic algorithms, incorporate randomness.

[Algorithm.html](#) | [Add_to_RPool](#) |

title: Algorithm characterizations

The word algorithm does not have a generally accepted definition. Researchers are actively working in formalizing this term. This article will present some of the "characterizations" of the notion of "algorithm" in more detail.

[Algorithm characterizations.html](#) | [Add_to_RPool](#) |

title: hash table

Hash table, or a hash map, is a data structure that associates keys with values. The primary operation it supports efficiently is a lookup: given a key (e.g. a person's name), find the corresponding value (e.g. that person's telephone number). It works by transforming the key using a hash function into a hash, a number that is used as an index in an array to locate the desired location ("bucket") where the values should be.

[Hash table.html](#) | [Add_to_RPool](#) |

title: Binary search

A binary search algorithm (or binary chop) is a technique for locating a particular value in a sorted list of values. To cast this in the frame of the guessing game , realize that we seek to guess the index, or numbered place, of the value in the list.

[Binary search algorithm.html](#) | [Add_to_RPool](#) |

title: intro to algo

Introduction to Algorithms is a book by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. It is used as the textbook for algorithms courses at many universities.

[Introduction to Algorithms.html](#) | [Add_to_RPool](#) |

title: entropy

In information theory an entropy encoding is a lossless data compression scheme that is independent of the specific characteristics of the medium.

[Entropy encoding.html](#) | [Add_to_RPool](#) |

Fig. 9. First query results

Search Guider

algorithm [More Details...](#)

initial query: **algorithm Sim(0)**

recommended revised query: **algorithm, general concept, introduction, computing Sim(0.48)**

title: algo

In mathematics, computing, linguistics and related subjects, an algorithm is a sequence of finite instructions, often used for calculation and data processing. It is formally a type of effective method in which a list of well-defined instructions for completing a task will, when given an initial state, proceed through a well-defined series of successive states, eventually terminating in an end-state. The transition from one state to the next is not necessarily deterministic; some algorithms, known as probabilistic algorithms, incorporate randomness.

[Algorithm.html](#) | [Add_to_RPool](#) |

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[Binary search algorithm.html](#) | [Add_to_RPool](#) |

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[Introduction to Algorithms.html](#) | [Add_to_RPool](#) |

title: entropy

In information theory an entropy encoding is a lossless data compression scheme that is independent of the specific characteristics of the medium.

[Entropy encoding.html](#) | [Add_to_RPool](#) |

Fig. 10. Secondary query results

5 Conclusions and Future Works

The construction of a federated search and sharing architecture is important for distance learning, and it is particularly important, in such architecture, to provide a mechanism that can assist course creators in find learning objects for reuse. In this paper, we use the reusability tree, based on SCORM and CORDRA. First, we proposed to utilize the concept of data mining technologies for time series data to gather learning objects in different time periods. Citations in different time periods represent different meaning importance of the learning objects. We follow the Time-Fading Model to give each time period a different weight. Through this, we also provide a mechanism to rank these learning objects. The learning objects after ranking will represent as separate reusability trees. To utilize this mechanism can enhance reusability of learning objects. In addition, to assist users in searching, we revised the algorithm of Relevance Feedback and integrate selected LOM elements. We do not provide actual items to users but provide a rule that can revise the initial query and return it to users. We believe that, with the proposed mechanisms and the distance learning standard used (i.e., IEEE LOM), LOs can be searched in an efficient way, which will help the promotion of SCORM and CORDRA specifications in the international community of distance learning technologies.

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Context Aware Multimodal Interaction Model in Standard Natural Classroom

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Abstract. Standard Natural Classroom (SNC) is a real-time classroom based on smart space and e-Learning technologies, which aims at creating face-to-face, interactive and pervasive learning experience for both local and remote students. In this paper, the phrase “interaction” refers to human-computer interaction, teacher-student interaction and student-student interaction in hybrid learning process. The characteristics of these interactions are multimodal and context aware. In this paper, we first draw an outline of SNC and Virtual Interaction Classroom (VIC). Second, we introduce a so called “Context Aware Multimodal Interaction” (CAMI) concept, and the multimodal and context information in SNC. Finally, we describe the implementation of a real-time Context Aware Multimodal Interaction Model (CAMIM) which is universal, extendable and efficient. We will illustrate the architecture of CAMIM, then we will demonstrate the Interaction Task Set (ITS) and CAMI fusion strategy. In particular, automated planning technology Hierarchical Task Network (HTN) is introduced into this model.

Keywords: E-learning, hybrid learning, context aware multimodal interaction.

1 Introduction

In recent years, e-Learning, a new effective way of learning characterized by multimedia, broadband, wireless, real-time and interactive, has achieved a rapid development. Many online colleges such as the UK Open University[1], the Hong Kong Open University[2] and the Network Education College of Shanghai Jiao Tong University (SJTU)[3], have established and deployed their own e-Learning platform and infrastructure based on the guidance of hybrid learning, providing adaptive and pervasive learning experience. Great efforts have been made by SJTU online college to design, develop and deploy Standard Natural Classroom (SNC), aiming at bridge the gap between real-time remote classroom and traditional classroom activities. The SNCs in Shanghai area and across the whole China are equipped with high-tech devices, advanced software platform and good network infrastructure. In SNCs, lecturers are no longer wooden, sitting in front of the camera, and they can move freely, using multiple natural modalities, such as projected whiteboard, laser E-pen[4], feedback screen and speech command, to deliver the lecture and interact with remote students in the same way as traditional classrooms. Students could select to attend the class in the primary SNC with lecturers, in the nearest remote SNC or even in their home. The work of Shen L. and Shen R.[5] describes details about SNC.

Researchers of SJTU online college advance the hybrid learning concepts by launching the Virtual Interaction Classroom (VIC) characterized by mixed reality and emotion monitoring and feedback[4][5]. Every SNC is a VIC, and meanwhile a VIC is an extended version of SNC with virtual seats more than original SNC. Thus, SNC is the physical classroom, and VIC is a virtual platform based on and surpassing SNC. Section 2 will have a brief introduction of its components and facilities.

The key idea of SNC and VIC is that they are just environment, our hybrid learning media, while our focus is the interactions in them, the content happening in every second in real-time learning process. For example, with a student entering SNC, the system will identify him (her) by face recognition. Meanwhile, the lights, air-conditioner, projector or even background music will be turned on automatically because the room is no longer empty. After the student sitting down in SNC and virtually taking a seat in VIC, the emotion monitoring system integrated with technologies: attention detection, facial expression recognition, physiological feature detection and speech emotion recognition will be started. Their real-time emotion will be displayed on the VIC server (the feedback screen that the lecturer could observe). The above scenario contains two parts: the context information such as illumination and temperature, and the four kinds of multimodal information in emotion monitoring process. We can also see the final action is conducted by interaction tasks involving or fused by multimodal information and context information. We define this kind of interaction as Context Aware Multimodal Interaction (CAMI).

We briefly introduce CAMI and the multimodal and context information in SNC in section 3. Then we propose a real-time Context Aware Multimodal Interaction Model (CAMIM), which is universal, extendable and efficient in section 4. We will first illustrate its architecture and components, then we will introduce the Interaction Task Set (ITS) and CAMI fusion strategy in SNC, particularly, the emotion monitoring and feedback of remote students is emphasized. In particular, automated planning technology HTN is introduced into this model.

2 Virtual Interaction Classroom

As stated in Section 1, a related VIC is built over every SNC, which is an enhanced and extended version of SNC. It is a software platform, emphasizing both traditional interactive activities and emotion monitoring and feedback, and meanwhile it provides virtual presence, not only for students in real SNCs, but also for students distributed at home and other places. Thus, a VIC is a virtual class unit. Students feel that they are really studying together, in a class.

VIC software platform consists of two parts: VIC Client and VIC Server, as shown in Fig. 1 and Fig. 2. Students from primary SNC with lecturer, secondary SNC without lecturer or even at home could enjoy services of VIC just by a VIC Client login and a virtual presence. A virtual presence refers to a series of steps like choosing the very live broadcasting VIC with good network access, being virtually seated and starting the emotion monitoring system. Then video of lecturer, full view of the primary SNC and the lecture notes will be loaded, meanwhile the interaction function buttons will be activated. The class with high efficiency begins. You should be active while listening because your current emotion is observed by the system and the lecturer. The

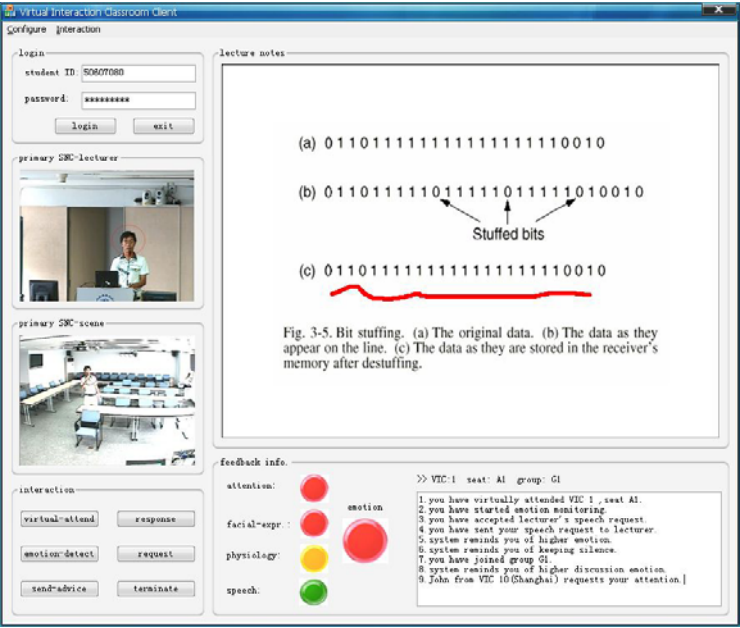


Fig. 1. Virtual interaction classroom client

real-time emotion data is revealed on the feedback panel by some color lights, including attention detection, facial expression recognition, physiological feature detection, speech emotion recognition and the context aware fusion result of the four above channels. The green light denotes your emotion is high and active, while the red one alerts you that you are absent-minded, and the yellow light is between the two. Of course, VIC Client contains common interaction functions such as speech or text interactions between students and lecturers.

The VIC Server is called to a feedback mirror for lecturers and system in primary SNC. From the view of lecturers, the secondary SNCs in other places, combining with the local one, form a class entity, just like one without boundary. As shown in Fig. 2, interaction functions, context information, videos of students, emotion statistics, group and feedback information, interaction tasks are all integrated and revealed on one panel. Lecturer could interact with remote students as natural as the local ones.

3 Introduction of CAMI

Multimodal User Interface (MUI) has become a hot topic in human-computer interaction (HCI) since the late 80's last century. It comprehensively uses new interactive channels such as video, speech, gestures and physiological information in a natural, parallel and collaborative way for an approach of human-computer conversation. Information from multimodal input are always asynchronous, ambiguous and inaccurate. It needs efficient multimodal fusion strategy to obtain interactive intentions precisely. Traditional fusion strategies like melting-pot, task-pot, frame-merging and unification-

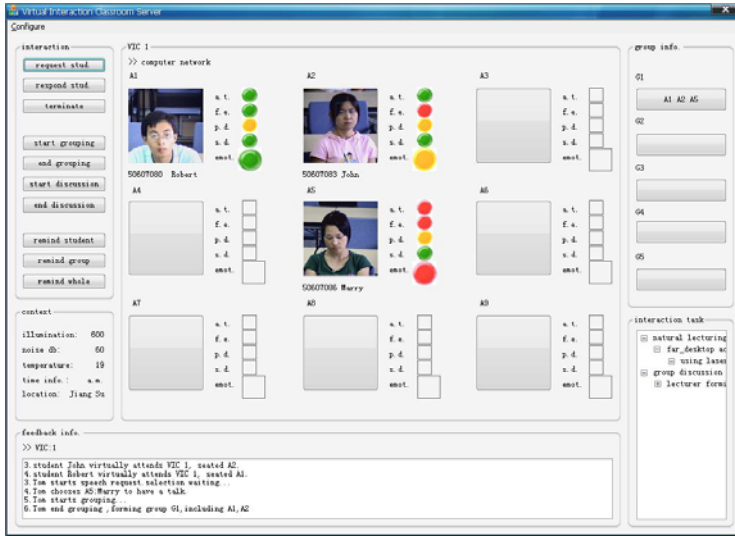


Fig. 2. Virtual interaction classroom server

based method are lack of context information. Context aware is an important way to improve computation intelligence. Multimodal fusion lack of context information is often difficult to express its semantics completely, an obstacle to the perception of interaction task. In smart space like SNC, the meeting room, context information is abundant. They have an essential influence on the result of multimodal fusion, so when we talk interaction in SNC, we often refer to Context Aware Multimodal Interaction[6][7][8].

According to the sources and features of interactive media, we could classify multimodal information in SNC into seven categories, each of which could also be divided into several subcategories. Table 1 is a list of them, just an outline we are using or ready to use.

The context in smart space provides information about the status of people, activities, location, physical environment and computing entities. In detail, it includes seven basic elements: user, activity, time, location, platform, environment and service, and ontology-based context model is used to describe them[6]. In SNC, some elements like illumination, temperature and noise level are obtained directly from sensors with reliable accuracy, while other elements like user, location and some activities are always dynamically obtained from VIC platform. In SNC, however, we just concern about context information physically existed or with high reliability, having impact on the multimodal fusion process. Table 2 shows an overview.

4 Context Aware Multimodal Interaction Model (CAMIM)

4.1 Architecture and Components of CAMIM

CAMIM, as shown in Fig. 3, is an universal and extendable framework, based on modular design principle and C/S architecture. Standard message formats and communica-

Table 1. Multimodal information classification in SNC

Category	Subcategories	Remarks
Keyboard	N / A	Recognize its active state, input and command. e.g., keyboard a at position B is active, the current command is Alt+F4
Mouse	N / A	Recognize its active state and command. e.g., mouse c at position B is active, the current command is double click
Natural Pen	Handwritten devices	Like touch screen, whiteboard. Recognize its active state , command and trajectory. Trajectory includes geometric drawings, numbers, etc.
	Laser E-Pen	Use a laser pen as the pointing and drawing tool. Recognize its active state, command and trajectory. Commands include local magnifier
Video	Face recognition	Detect and recognize human faces, using adaboost algorithm and LBP feature
	Motion tracking	Track multiple moving targets using GMM and the color feature
	Attention detection	Detect student's attention via eye detection. The direction of eyes reveals attention well
	Facial expression recognition	Recognize student's facial expression by LBP feature
	Gesture recognition	Recognize lecturer's gesture commands by fuzzy neural networks
Audio	Speech recognition	Recognize lecturer's speech commands using toolkit HTK or ViaVoice, like last/next page
	Voice detection	Detect whether a audio device has captured valuable voice signal
	Sound source location	Obtain a person's location by finding his/her sound source, using microphone array algorithm
	Speech emotion recognition	Recognize student's emotion based on short-term and long-term features of speech
Physiology	Physiological feature detection	Detect student's emotion using physiological features, such as SC and BVP

tion interfaces are defined between each module. It contains mainly six components: Multimodal Information Capture Center (MICC), Context Information Capture Center (CICC), Registry and Information Handling Center (RIHC), Pipeline Management Center (PMC), Fusion Server and Feedback Center. ITS profile is a formal description of CAMI task set in SNC[13][14].

Table 2. Context information classification in SNC

Category	Subcategories	Remarks
Physical environment	Illumination	Have influence on the credibility of video channels and people's moods.
	Noise level	Have influence on the credibility of audio channels and people's moods
	Temperature	For air-conditioner's automatic adjustment. Have influence on people's moods
	Humidity	For humidifier's automatic adjustment. Have influence on people's moods
Smart device status	Air-conditioner Humidifier/drier Projector/light Camera	The smart devices are those controlled by a set of programs, having the automatic adjustment functions, whose status refers to its running states
Event process status	Event-on/off Event-stage	Event defines a set of interaction rules and responding procedures, which is always a milestone in task planning process.
VIC context status	Users Time Location WIMP states	All interactive information existing in VIC Client and VIC Server. WIMP states refer to the states of UI functional components always controlled by keyboard, mouse, natural pen and speech command
ITS fusion history	Human-computer Teacher-student Student-student	The history fusion results of interaction task set, stored as the knowledge base, are always useful for the current interaction task inference.

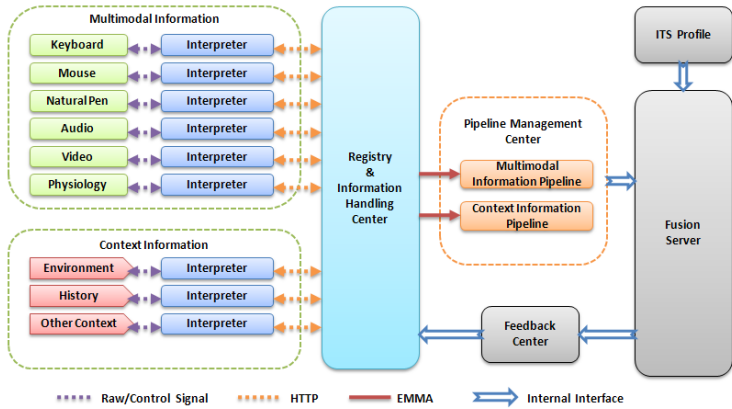


Fig. 3. The architecture of CAMIM

1. RIHC is responsible for handling activities like multimodal registry, multimodal status monitoring, receiving and forwarding multimodal/context messages, forwarding control message from Feedback Center to multimodal/context.
2. Interpreter is responsible for calculating the credibility of each channel, wrapping multimodal/context information into EMMA format, and forwarding control messages between multimodal/context and RIHC.
3. PMC is responsible for time sequence management of real-time EMMA messages from RIHC, and parsing them into internal format that Fusion Server accepts.
4. Fusion Server is responsible for HTN fusion. The HTN planner we use is a real-time automated planning tool based on an open source tool: JSHOP2[12]. The final results or the external calls of fusion process are forwarded by Feedback Center.

4.2 Formal Description of Multimodal and Context Information

Context information is comparatively less complicated, so we just illustrate how to formally describe multimodal information. The description content of multimodal information we propose is as follows:

$$(mod_i, type_i, ifea_i, cont_i, time_i, prob_i, cred_i) \quad (1)$$

mod_i is the name of a channel. $type_i$ is the category of human's interactive intentions. $ifea_i$ is the useful intermediate features, always on the lexical or grammatical level. $cont_i$ is the recognition results of the channel, always on the semantical level. $time_i$ is the time sequence value, that is ,time stamp. $prob_i$ is the probability of corresponding $cont_i$. $cred_i$ is the credibility of the channel. $cred_i(t) = H_i(e(t))$, and H_i is the context influence function and $e(t)$ is the context variable vector where t represents the instant time.

Formal description is an universal management process of information coming from different channels, unifying those data having the same meaning but having different forms. The formal description is not only the input mode of multimodal fusion process, but also its output mode, so it must be structured and have certain semantics, providing device-independent and cross-platform interactive information. Existing methods include semantic pot, typed feature set, interactive primitive, semantic structure based on HNC ,and Extensible Multimodal Annotation markup language (EMMA) proposed by W3C ,among which only EMMA is cross-platform and well standardized[9].

4.3 Interaction Task Set (ITS)

Here, the term ITS refers to the CAMI task set. A task set is a formal description of all executable interactive missions in specific areas. This kind of description must also be structured and support reasoning. Hierarchical Task Network (HTN) is used to formally describe ITS. HTN decomposes an upper task into a series of subtasks executed in a parallel or sequential order. Each subtask could also be decomposed into subtasks recursively until the subtask is a primitive task,as shown in Fig.3[8][10][11].

In SNC, every interactive action is considered as a task, primitive or compound. ITS contains most of interactive activities in SNC and VIC in hybrid learning process:

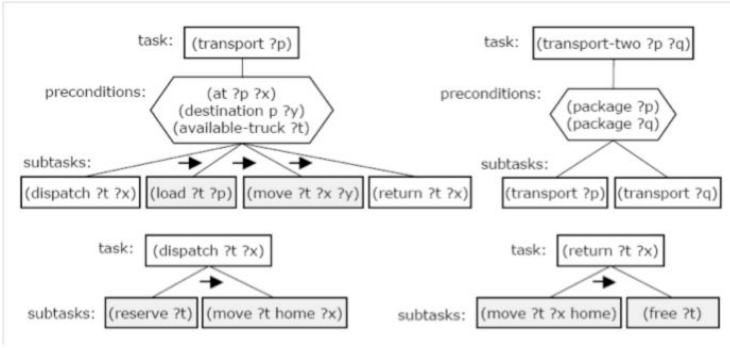


Fig. 4. HTN Methods for transporting a package ?p, transporting two packages ?p and ?q, dispatching a truck ?t, and returning the truck. Arrows are ordering constraints. The shaded subtasks are primitive tasks.

human-computer, teacher-student and student-student. According to the above three modes, we divided ITS into three subsets: Natural Lecturing of Teachers, Mutual Dialogues and Group Discussion in VIC, Emotion Monitoring and Feedback of Students in VIC, each of which could also be divided into subsets recursively. There are two ways of division of an upper task: grammatical way and semantic way. A grammatical way implies a task is decomposed by its natural sentence elements while a semantic way by its internal logical or transcendental order.

For example, a task instance “Lecturer Tom asks John to answer the question” implies the grammatical structure “who ask whom to do something”. In SNC, we may decompose it into the following subtasks: A: “confirming the lecturer Tom”, B: “Tom chooses one student John”, C: “Tom-John speech conversation”. Recursively, task B can be decomposed into two subtasks: D: “Tom tells system he will do “choose” action”, E: “Tom selects the target student John”. Task D could be implemented several ways such as a single click by mouse or by laser E-pen in VIC Server, or just by speech command. Task E could be implemented by just drawing a circle on the head of target student using laser E-pen in VIC Server, or by speech command, such as student’s name, seat No. and so on. Task C could be implemented by the loop of speech conversation.

Another example is an abstract task “Obtain lecturer’s position in SNC”. It may be decomposed into the following subtasks: “Check the active status of keyboard, mouse and natural pen”, “Check the sound source location”, “Check the positions of motion targets”, “Make a strategic decision combined with the context inference”.

Table 3 lists some core tasks in SNC.

4.4 CAMI Fusion Strategy

HTN, an automated planning method, as shown in Fig. 4, is used for context multimodal fusion process. Our design pattern complies with the following principles[10][11][12]:

1. World State: a set of states in SNC. Every piece of information from multimodal and context input is considered as states in SNC, described by a series of predicate symbols.

Table 3. Some core tasks of ITS in SNC

Upper task	Core subtasks	Fused channels
Natural Lecturing of Teachers	1. Obtain lecturer’s position in primary SNC, and automatically track the lecturer with camera 2. Obtain student’s position in primary SNC, and automatically reflect him with camera while he interacts with lecturer 3. Sense the real-time valuable teaching behaviors of the lecturer. Analyze and estimate lecturer’s mental states	Keyboard, mouse, natural pen, video, audio
Mutual Dialogues and Group Discussion in VIC	1. Student’s virtual presence 2. Lecturer’s selection and announcement of remote students 3. Lecturer’s grouping and system’s grouping advice 4. Mutual Dialogues between lecturer and remote students via voice or text 5. Group discussion activities of students	Keyboard, mouse, natural pen, video, audio
Emotion Monitoring and Feedback of Students in VIC	1. Single student emotion monitoring without/with group discussion 2. Group emotion monitoring ,analyzing and estimating 3. System/lecturer reminds single/group to raise emotion status	Keyboard, mouse, natural pen, video, audio, physiology

- 2. Operators: primitive tasks in SNC. Primitive tasks are associated with query or change actions of the world state, triggering external events.
- 3. Methods: a compound task chooses an appropriate method for its decomposition process.
- 4. Precondition: logical expressions containing a subset of world state or internal axioms, component of a method, denoting a method could be available if the current world state satisfies its precondition.
- 5. Axioms: an axiom is a series of logical preconditions. Axioms in SNC are always used for reasoning process.

The design of different methods and operators, especially their preconditions supporting reasoning, embodies the idea “context aware”, while subtasks in a method executed in a planned order embodies the idea “multimodal fusion”. Hence, the design of methods is essential.

5 Conclusion

This paper has introduced basic concepts of SNC and VIC proposed by Education College of SJTU, of which SNC is the physical entity while the VIC is the software platform based on SNC, providing interactive services between lecturers and remote students.

Through the analysis of interactive activities in SNC, we draw a conclusion that context multimodal interactions are generally applicable and more effective. Then, we reflect our multimodal and context information in SNC, which could be extended in the future, and give them a formal description. Tasks are everything in SNC that cover all the interactive activities, and ITS is proposed, in which mutual dialogues between lecturer and remote students, emotion monitoring and feedback of remote students are emphasized. Automated planning strategy HTN is introduced into SNC for ITS description and context multimodal fusion process. In order to put our theoretical work into practice, an universal model CAMIM is proposed, aiming at providing real-time information capture, fusion and feedback services.

The ultimate goal of our efforts is constructing a generally applicable hybrid learning platform, where all the multimodal interactions are effectively used, as natural as the face-to-face learning experience.

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Attentiveness Detection Using Continuous Restricted Boltzmann Machine in E-Learning Environment

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Abstract. Attentiveness is one of the key factors in human intelligent behavior. Especially, we are interested in the attentiveness states of learners. In recent years, lots of methods were proposed for attentiveness assessment, including computer vision, speech recognition, physiology and other approaches, and some of them already shown exciting results. We believe that physiological approach is very suitable to detect learners' attentiveness. However, till now the performance of these methods were measured on the single testee in their experiments, which means their conclusions may not be generally valid. Although it is reasonable to restrict test subjects in early stage of research, generalized experiments involving multiple subjects are much more important to study. In this paper, we conducted a series of experiments that collected physiological data from 20 different subjects. Based on the experimental data, we revealed the huge individual differences of physiological features among those subjects. In order to smooth down such differences, we adopted continuous restricted Boltzmann machine to extract features from the original data. Finally we compared the method we used with other algorithms. The experimental result shows positive support towards generally applicable attentiveness detection by physiological approach.

Keywords: Attentiveness detection, auto-encoding, physiological feature, E-Learning.

1 Introduction and Background

Psychological research shows that attentiveness is one of the key factors in learning, cognition and other important intelligent behaviors[1]. It would be convenient for teachers if they could grasp the attentiveness states of learners in their classes precisely so that they could try to improve the way to deliver the course material in a manner that could attract more learners. It's easy for teachers in real classrooms, where attentiveness states could be understood by looking at learners' faces or listening to their voices. However, in an E-Learning environment lacking of interactions between teachers and learners, catching learners' attentiveness seems to be "mission impossible". Thus we are interested in attentiveness detection in learning process so as to provide teachers the attentiveness state information of learners to improve the efficiency of E-Learning.

Large amount of researches have been conducted to seek ways to detect attentiveness. Mercedes has already integrated the so called "Attention Assist" into their cars. It

monitors the driver's speed, steering wheel movements and braking for signs of exhaustion. Other methods including facial emotion analysis[2], speech emotion analysis[3], etc. have shown remarkable experimental results toward attentiveness detection. However when facial expression is not significant or no voice is involved, these methods suddenly lost their power.

With the development of wearable computing technology, accurate physiological signals could be easily acquired by small sensors. Researches in affective computing[4][5] show that, the emotional states of human beings are closely related to the physiological signals. Physiological signals are able to reveal the inner state of human beings and can not easily be disguised so that they are much suitable for attentiveness detection in situations where facial or vocal expression is not significant, which is just the case in learning process.

Recent studies show promising results for building classifiers for attentiveness detection by physiological signals[5][6][7]. There is a big flaw in these studies, however, that most of them restricted their subjects to the special one in the experiment, which means that their methods might be not generally applicable. Although it is reasonable to restrict test subject in early stage of research, generalized experiments involving multiple test subjects are much more important to study.

In this paper, we describe the series of experiments we conducted that collected physiological signals from 20 different subjects when they were taking a specially designed course. And then we labeled these data to 3 kind of attentiveness state, *Attentive*, *Neutral* and *Inattentive*, and calculated 32 features of raw physiological signals. We use continuous restricted Boltzmann machine (CRBM)[8] to get an encoding of the raw features of these signals.

The contributions of this paper include the carefully designed experiment that we conducted in which multiple subjects were involved, the experimental data we gathered that are valuable for further study, the analysis result which shows large individual differences between subjects and the way we used to smooth down such differences. Finally, this paper compares different pattern recognition algorithms on the data set and shows a possible way to use auto-encoding network to improve classification performance of classifiers.

2 Experiments

In attentiveness and other affective computing research, obtaining good experimental data is the most important and difficult step, especially when physiological signals are used. Compared with other methods, such as computer vision or speech recognition, in which cases reliable data could be easily obtained, physiological signals are difficult to collect. Non-experts could not easily tell whether the quality of the recorded signals is good or not. Even worse, electronic noise, not properly cleaned skin, motion artifacts are all possible sources that could interfere the physiological signals. In order to gather high quality experimental data, we have done plenty of considerations.

2.1 Experiment Instruments and Signal Channels

In our experiments, we use ProComp 5 Infiniti multi-channel biofeedback encoder from Thought Technology, which is the leader company in biofeedback research. ProComp

5 Infiniti is widely used in research and clinic, which provides us expert and reliable signal sources.

Because of the fact that our experiments involve multiple people and span a couple of weeks, we require the signal source to be robust and highly reliable. Among the available signal channels, *Skin Conductance* (SC) and *Blood Volume Pressure* (BVP) are the best choice, which are easier to collect and more stable compared with other signal channels, such as EEG or EMG.

2.2 Test Subjects Selection

We invite 20 people as our testees whose ages range from 22 to 32 years old, which is the most common distribution of learners in our college. And we choose equal numbers of male subjects and female subjects so that our experimental data are representative for either gender. To make our test results even more reliable, each subject only takes part in the experiment once so that we can avoid the subject being influenced by the psychological hint of the previous experiment.

2.3 Experimental Environment

Since we are still in early stage of attentiveness research, controlling the experimental environment is necessary. We set several constraints to the environment of our experiments.

First, we control the time to conduct experiments. As is shown in [4] and [9], the differences of physiological data sampled from the same subject in multiple days could be smoothed down using techniques such as day matrix or baseline subtraction. In our research, we want to limit the difference between physiological data caused by time factor as small as possible so that we can focus on dealing with the individual differences between multiple subjects. Thus we arrange that all the experiments are conducted from 8:00 a.m. to 12:00 p.m. Another reason to choose this period of time is that people are fresher in the morning so that the external influence to the subjects is even smaller.

Second, in order to minimize the interference of changing temperature, humidity, environmental noise and other disturbance to our experiments, the experiments are placed in a close recording studio, which is sound proof and kept in constant temperature and humidity.

Third, we fix the testees in a comfortable seat when experiments are conducted, which eliminates the artifacts caused by movement.

2.4 The Design of Experimental Procedure

In our experiments, we need to record physiological data of our subjects when they are in different attentiveness state. Generally speaking, there exists two different paradigms to elicit subject's attentiveness, *self-elicited* or *event-driven*. We consider that event-driven would be more suitable and natural in learning environment. It gives us more control to learners' attentiveness states by using exterior stimuli rather than let themselves to change their attentiveness state on purpose. Under such consideration, we choose to elicit our subjects' attentiveness in an event-driven way.

To stimulate the required states of attentiveness, we design a special tutorial video. During the experiments, subjects are asked to follow the instructions provided by the tutorial just like taking a real class. The contents of this video include two pieces of lecture delivering, one joke, one small quiz and two pieces of music. We label the states of learners' attentiveness to be one of "Attentive" (A), "Inattentive" (I) or "Neutral" (N). Total duration of a complete experiment is 40 minutes, which is accord with the length of a real class. We choose the content of the special course to be an English course in order to avoid the need of specific knowledge to understand the course. Details of the content are shown in Table 1.

Table 1. Phases of the special course designed for the experiment

No.	Phase	Activity	Emotional Orientation	Expected State	Duration
0	Warm up	Listening Music	Relaxing	N	5 min
1	Joke	Watching Video	Interesting	A or I	10 min
2	Quiz	Reading	Thought Extensive	A	10 min
3	Tutorial	Watching Video	Boring	A or I	10 min
4	Rest	Listening Music	Relaxing	N	5 min

In Phase 1 – "Joke", the teacher tells the subjects an old joke. We expect our subjects to express high attentiveness. However, some subjects might also show inattentiveness because they may already know the ending of the joke.

In Phase 2 – "Quiz", the subjects are asked to complete reading comprehension of 2 short passages. The time is limited and the questions are fairly difficult so that we expected high attentiveness of our subjects.

In Phase 3 – "Tutorial", the teacher explains an English test to the subjects and teaches them the skills to pass the examination.

In Phase 0 and Phase 4 – "Warm up" and "Rest", two peaceful and relaxing pieces of music are played which are intended to relax and neutralize the subjects' attentiveness state.

2.5 Self-report of Attentiveness States

We adopt a "self-report" method to obtain classification information for the data we gathered. Although we have designed the course content carefully to stimulate subjects to elicit the expected attentiveness states, we are not sure whether they would really react as we expected since people behave differently. And even if the subjects react according to our expectation, we don't know the exact time point when their attentiveness state changes. Because of the above two reasons, self-report is necessary in our experiments.

Introducing self-report to the experiments, however, creates a lot of new difficulties. Three main concerns are:

- When shall subjects report their attentiveness state?
- By what means self-report is carried out?
- How to make sure self-report won't interfere the learning process?

Based on the design of the course content, which has a main topic in each phase, and a quite reasonable assumption that human attentiveness state changes gradually, we could assume that the attentiveness state of the testee is stable in the middle of each phase. Under such assumption, we choose to let our testees report their state when each phase proceeded to 3/10 and 8/10 time point.

To make it easy for our subjects to make self-report, we developed a “self-report” program. Figure 1 shows the GUI of the program. This simple GUI accepts mouse click on the “attentiveness gauge”, which is in the right side of the panel. Clicking on the red side of the gauge means you are in high attentiveness state, on the middle means neutral state and on the blue side means you are low. After our subjects click on the gauge, the time-stamp and the corresponding state will be recorded. When report time points arrive, the program gradually moves down from the top of the screen. In this way, the emergence of the self-report program will have little impact on the learning process of our subjects.



Fig. 1. GUI of the “self-report” program

3 Attentiveness Detection Method

In this section, we describe the way we preprocess the original data and then we try some traditional methods to build classifiers. Finally, we use CRBM to improve the classification accuracy.

3.1 Deriving Physiological Features

Raw signals cannot be used for training classifiers, physiological features are hidden in the wave form of raw signals. According to [10], we calculated 32 features from raw signals, which are commonly studies in physiology researches. Table 2 lists all the features derived from raw signals. In the list, each epoch refers to 20 seconds.

3.2 Labeling Classification Information

The original physiological features are not labeled with classification information, we need to associate them with information recorded by the self-report program. It seems to be trivial, but actually there is one subtle question we must consider: *What is the range of data corresponding to one self-report record?*

Apparently, we cannot use the data right at the report time since self-report could interfere the learning process, which may probably change the attentiveness and physiological data of our subjects. Based on the course content and report time points we described in the design of the experiments, we assume that *the state of our subjects are*

Table 2. List of physiological features calculated from raw signals

Signal	Feature	Explanation
SC	Amplitude	Amplitude of SC
	Mean	Mean of amplitude in 1 sec
	Epoch mean	Mean of amplitude in 1 epoch
	First derivative	First derivative of SC
	Second derivative	Second derivative of SC
BVP	HR	Heart rate
	HR std. dev.	Standard deviation of HR
	HR mean	Mean value of HR in 1 sec
	HR epoch mean	Mean value of HR in 1 epoch
	IBI peak freq.	Inter-beat-interval peak frequency
	IBI epoch std dev	Standard deviation of IBI in 1 epoch
	IBI peak freq. mean	Mean value of IBI peak frequency in 1 sec
	VLF % power	Percentage of VLF power
	LF % power	Percentage of LF power
	HF % power	Percentage of HF power
	VLF % power mean	Mean of VLF % power in 1 sec
	LF % power mean	Mean of LF % power in 1 sec
	HF % power mean	Mean of HF % power in 1 sec
	VLF % power epoch mean	Mean of VLF % power in 1 epoch
	LF % power epoch mean	Mean of LF % power in 1 epoch
	HF % power epoch mean	Mean of HF % power in 1 epoch
	LF/HF means	(LF % power) / (HF % power) in 1 sec
	VLF total power	Power of VLF component
	LF total power	Power of LF component
	HF total power	Power of HF component
	VLF total power mean	Mean of VLF power in 1 sec
	LF total power mean	Mean of LF power in 1 sec
	HF total power mean	Mean of HF power in 1 sec
	VLF total power epoch mean	Mean of VLF power in 1 epoch
	LF total power epoch mean	Mean of LF power in 1 epoch
	HF total power epoch mean	Mean of HF power in 1 epoch
	LF/HF epoch mean	(LF % power) / (HF % power) in 1 epoch

stable and consistent in the previous 35 seconds before each report. By this assumption, we select the feature data between 35 and 5 seconds before the report time as the corresponding data for each report record. In this way, we gather 240 sets of labeled data from each subject.

3.3 Data Normalization

Huge individual differences exist among the features we derived. It's common practice to unify such high variant data before use them to train the classifier.

We first calculate the mean value of the features in the first and last 5 minutes of each experiment. As described in the design of experiment, this value is regarded as the physiological baseline of the testee. Then we subtract this baseline from each piece of data.

To clamp the value of features in the range of $[0, 1]$, we use (1) to normalize them.

$$NormalizedFeature = \frac{Feature - \min(Features)}{\max(Features) - \min(Features)} \quad (1)$$

3.4 Method for Model Selection

Because there is no public data set available for attentiveness detection based on physiological signals, our analysis could only be performed on the experimental data we gathered. In this case, it is important to clarify the model selection and performance testing method we use, otherwise any conclusion would be arbitrary and meaningless.

We conduct an experiment to test how individual differences would affect the classification result. In the experiment, we separate all the data into training and testing part in two ways. In the first way, we choose 10 subjects' data as training data and the other 10 subjects' as testing data. In the second way, we randomly choose 2400 pieces of data, which are just half of the total data, for training, and the other for testing. Then we use LibSVM[11] and do a grid search to find best parameters by 10-fold cross validation. To speed up the parameter searching, we set a stopping criteria to stop searching when CV accuracy is higher than 90%. Table 3 shows the CV accuracy and accuracy on testing data of the trained classifier.

This simple experiment shows a critical problem, why we can get such a good result by separate training and testing data in the second way, while the classifier fails (32.50% is just random) on the testing data generated in the first way?

We find out that when there are data gathered from the same subject in both testing and training data set, the classification accuracy will be very high, and otherwise the trained SVM just becomes a random classifier. We think it may be caused by the huge individual differences between different subjects.

In order to make our classifier generally applicable, it has to work on data that has not been seen during the training process. Thus when we test the performance of different models, we must use strict test data generated as in the first way described above. In the rest of this paper, all classifiers are trained on 12 subjects' data, validated on another 4 subjects' data and tested on the rest 4 subjects' data. Considering the fact that different partitions of training, validating and testing set would generate different results, we always average the model performance on 15 predefined partitions.

3.5 Restricted Boltzmann Machine and Continuous RBM

G. E. Hinton et. al. proposed a method[12] for encoding text and image using restricted Boltzmann machine (RBM)[13] which leads to remarkable improvement to classification accuracy. In this paper, we adopted RBM in processing the physiological features.

Table 3. A simple experiment shows the false accuracy produced by using bad testing data

	CV Accuracy	Accuracy on test set
First Way	90.35%	32.50%
Second Way	94.60%	97.11%

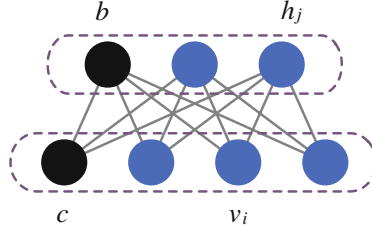


Fig. 2. The structure of RBM. Each circle represents an expert. The black ones refer to bias units. v_i is an visible unit and h_j represents an hidden unit. Lines between hidden and visible experts represent the connection between them.

RBM is a kind of stochastic neural network, which is composed of a visible layer and a hidden layer. Each layer of RBM contains several units called *Experts*. Figure 2 depicts the graphical model of the structure of RBM. Each connection between two experts defines a weight.

“Minimizing contrastive divergence” (MCD)[14] is a fast algorithm which is an approximation to gradient descend to train RBMs. Applying MCD to RBM, the weight update rule is

$$\Delta w_{ij} = \eta (\langle v_i h_j \rangle_0 - \langle v_i h_j \rangle_k) , \quad (2)$$

where $\langle * \rangle$ denotes an expectation with respect to the data distribution and $\langle * \rangle_k$ is an expectation with respect to the distribution the k -step reconstructions of the data.

One limitation of RBM is that it can only handle binary data, which is not the case in our experiment. The continuous restricted Boltzmann machine (CRBM)[8] solved this problem by introducing a continuous stochastic unit which replaces the binary unit of RBM by adding a zero-mean Gauss noise. The state of one unit, s_j (for both hidden and visible unit), in CRBM is defined as

$$s_j = \phi_j \left(\sum_i w_{ij} s_i + \sigma N_j(0, 1) \right) , \quad (3)$$

in which

$$\phi_j(y) = \theta_L + (\theta_H - \theta_L) \frac{1}{1 + e^{-a_j y}} , \quad (4)$$

where θ_H is the upper bound of state of experts and θ_L is the lower bound of state of experts.

MCD can be applied to train CRBM as well. To summarize, the training rules are:

$$\Delta w_{ij} = \eta_w (\langle s_i s_j \rangle_0 - \langle s_i s_j \rangle_k) \quad (5)$$

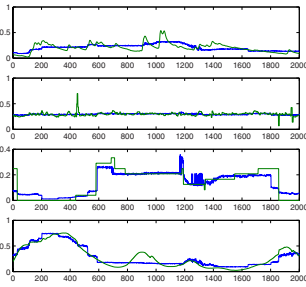
$$\Delta a_j = \frac{\eta_a}{a_j^2} (\langle s_j^2 \rangle_0 - \langle s_j^2 \rangle_k) , \quad (6)$$

where $\langle * \rangle_n$ refers to mean over n -step reconstruction of data if $n > 0$ and the original data if $n = 0$. η_a and η_w are learning rates for a and w .

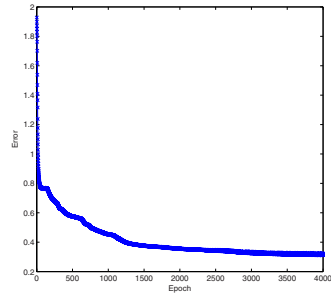
4 Experimental Results

In our analysis, we construct a CRBM with 21 hidden experts, including the bias units. When training the CRBM, we set $\eta_w = \eta_a = 0.2$, $\sigma = 0.2$ and a 0.6 momentum is added to each update to increase the convergence speed. We set the reconstruction step $k = 5$ in the first training epoch, then k increases by 1 after every 100 epoch to increase the approximation precision.

Figure 3(a) shows the reconstructed features generated by the trained CRBM comparing with the original ones, in which the green curves refer to the original features and the blue ones are the reconstructed features. As we can see, CRBM smoothes the original features and reduces some noise components. The training error is shown in Fig. 3(b). It decreases quickly in the first 1000 epoch and then gradually converges.



(a) 4 representative original features and their reconstruction by CRBM. Green curves refer to the original features and the blue ones refer the reconstructed features



(b) CRBM training error vs training epoch

Fig. 3. CRBM reconstruction and training error

We call the hidden layer’s states as the “hidden encoding” of the original features. For each training set, we train a CRBM on these training data, then we calculate hidden encoding using the trained CRBM for all data. After that, we train SVM on the hidden encoding. Table 4 compares the classification accuracy of CRBM+SVM and other regular methods on 15 different partitions of the data. As we can see from this table, CRBM+SVM outperforms in almost all cases.

The hidden encoding of CRBM provides new representation of the original data in the subspace defined by the weight matrix. Our experiment shows that such representation gives much useful information for classification. Moreover, using the hidden encoding stabilized classification accuracy. Compared with other methods, the worst case of CRBM+SVM is 42.22%, while the worst case of other methods, such as SVM is as poor as 29.17%. Further more, CRBM+SVM gives us the best accuracy, 73.89%, which is quite an optimal result.

We are interested in the reason why the hidden encoding of CRBM brings us so many advantages over other methods. We think there are two possible reasons.

Table 4. Comparison between other regular classification methods with CRBM+SVM

Part.	k-NN(%)	PCA+kNN(%)	LDA+kNN(%)	SVM(%)	PCA+SVM(%)	CRBM+SVM(%)
1	27.36	22.91	42.63	62.50	62.50	62.50
2	46.38	28.33	50.83	47.36	22.08	52.22
3	34.72	28.88	32.08	45.83	45.83	51.80
4	42.91	43.47	55.97	45.00	41.67	42.22
5	30.28	28.47	31.53	38.89	37.50	45.56
6	34.58	36.67	39.86	41.94	33.33	49.72
7	49.86	51.94	29.72	40.69	40.42	73.89
8	31.25	24.03	36.67	39.03	46.39	47.08
9	40.14	50.97	46.53	29.17	29.17	45.56
10	55.97	48.75	37.22	49.58	34.44	70.83
11	37.22	45.28	45.14	33.33	29.17	51.78
12	44.58	39.58	48.47	37.64	25.00	47.06
13	45.14	49.44	42.36	43.19	41.67	44.58
14	41.39	33.47	24.17	48.06	15.14	47.47
15	38.89	28.89	46.94	48.19	17.64	56.81
Avg.	40.04	37.40	40.67	43.36	34.79	52.60

First, as we could see from Fig. 3, CRBM reconstructs very close data distribution as the original data, while it smoothes some of the steep pitches and turbulence of the original data, which are mainly noise signals. This is possible the reason why CRBM could stabilize the classification performance of SVM.

Second, the reduced-dimension subspace is a good sparse representation of the original space, the quality of which is guaranteed by minimizing the reconstruction error. The new representation of the original data catches the main features in the data distribution thus increases the discriminant ability of the hidden encoding.

To conclude, our experimental result shows that there exists huge individual differences in the physiological data we gathered, which is difficult for regular method to handle directly. However, we have shown a promising way to eliminate such difference by finding a new representation of the original data, which is automatically done by training a CRBM. The average performance of CRBM is higher than 50% which means it can classify more than half of the testing data correctly. Although it is still a low performance, it gives us the hint that there might be a better encoding of the raw physiological features, which could bring better performance to the classifier.

5 Conclusions

We conducted a series of experiments that collected physiological data of 20 subjects in learning environment in order to study the generalization ability of current attentiveness detection methods. Based on the data we collected, we made a simple test to reveal the large individual differences of physiological features among multiple subjects. Such great individual differences make it difficult for regular algorithms to find classification boundaries for the 3 attentiveness states. To solve this problem, we introduced CRBM

to find a hidden encoding for the physiological features. Experimental results shows that such encoding has more discriminability than the original data. The final experimental result shows that CRBM+SVM outperformed other regular algorithms in almost all cases. Although the classification accuracy is still not good enough for any practical use, CRBM+SVM works much better than random, which is a strong support that there is information hidden in the physiological signals that can be used for discrimination of attentiveness state of learners, in spite of the large individual differences.

Acknowledgment

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EGameDesign: Guidelines for Enjoyment and Knowledge Enhancement

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Abstract. We believe that an effective e-learning game can encourage the learners' enjoyment and catalyst their learning initiative, so as to cumulate their learning experience, and to improve their knowledge. However, challenges remain in terms of what tasks included and arranged in a "complexity" game design for the knowledge level enhancement. Thus, this study presents the design guidelines based on the Freitas and Oliver four dimensions game-design evaluation framework and stressed the Bloom six levels of knowledge within the cognitive domain to interpret game tasks arrangement. These guidelines was applied to design a e-learning games VIEW (Virtual Investment Education World) which includes the investment tasks of virtual stock market, financial news, investment course, forum, and so on. By employed financial textbooks, the VIEW knowledge pool was built. In order to increase the complexity of the game, the embedded levels of knowledge were testified by some faculty iteratively.

Keywords: Web-based game, educational game design, Knowledge level.

1 Introduction

Web-based learning provides a new environment of learner-centred learning where has attracted instructors and developers to create and design electronic games for educational purposes [3]. However, there are two challenges in developing game-based learning materials for education. Firstly, the challenge of game needs to provide incentives for learners to accumulate their learning experience. The knowledge level enhancement has to be embedded in game task design. Secondly, compared to the leisured-based computer games, the development of skill-based educational gaming has one more challenge. In order to achieve the goal of knowledge enhancement, it must be a "complex" game [11]. Thus, the design of an educational game that is interesting enough for these "e-generation" of learners who have grown up with computer games to immerse themselves in [14] and frequently reflect upon is the main challenges in the field of e-learning [8].

According to experience theory, game-based learning provides an enjoyment learning surrounding and is considered to be a possible solution to keep the learners' intention, so as to promote their knowledge level. Therefore, to develop game-based courseware, one must not only consider the process of how the teachers' constructed their curriculum, but also the learners' viewpoint on learning motives and flows. The main purpose of this study is to prompt useful guidelines of an effective educational game design, including the goal, style, task, and interface of the game that provides comprehensive considerations on design processes of Web-based educational games to motive the players' flows to enhance their knowledge.

2 Perspectives on a Web-Based “Complex” Educational Game

In the knowledge creation process, knowledge is accumulated through the learner's exposure to societal contexts. The learner internalizes the knowledge he or she obtained in the classroom through integrating the knowledge with his or her life experiences. Continuous stimulation from the learning environment will encourage knowledge growth. This results in a knowledge spiral shown in Figure 1 [10]. A Spiral curriculum is iterative revising and successive increasing the level of knowledge of the course material [7].

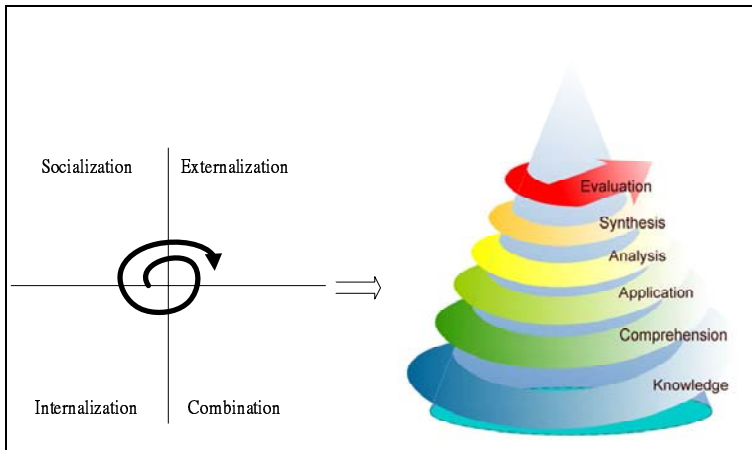


Fig. 1. Knowledge spiral and evolution

Games are deeply engaging, visually dynamic, rapidly paced, effective tools for exposing students to knowledge [11]. They more efficiently increase the players' experience than any other type of material because the interactive immersion component has already been strongly developed for the players [6]. However, a good game-based educational material design is very complicated work; it should take into account the interactions from three perspectives: (1) the Game goal and game style considerations in the particular context in which learning takes place; (2) the Game interface considerations for the characteristics of learners, (3) the internal representational task arrangement of the game [4]. We discuss these perspectives below:

style design should match the preference of the e-generation of university students. They are considered to have sufficient skills and background to use the Internet as well as play digital games.

2.2 Game Interface Considerations for the Characteristics of Learners

Educational Games interface needs to provide an efficient and effective means for the learners to interact with the program just like other types of software. But, how to keep them “in play” as long and as deeply as possible is the main concern of the interface design. In another study, researchers used self-made online e learning game as an instrument along with 120 college students in an experiment. The study has shown that e-learning games help students to devote longer periods of time to their studies and to perceive more interesting [5].

Game players in Web-based learning can easily obtain physiological pleasure through animations, sounds and other stimuli provided by the multimedia. A framework of pleasure by the anthropologist Lionel Tiger consists of four types of pleasure that motivate usage: physiological, social, psychological and ideological [1]. Physiological pleasure is derived from the sensory organs. It consists of pleasure connected with touch, taste, and smell as well as feelings of sexual and sensual pleasure. Social pleasure is derived from the company of others, such as having a conversation or being part of a group. Psychological pleasure is gained from accomplishing a task. Ideological pleasure is derived from the user’s perception of the importance of the task itself. Ideological pleasure is only experienced by students taking important courses that are perceived to be highly difficult [5]. The criterion of concentration implies that games should provide stimuli that quickly grab the players’ attention and maintain their focus throughout the game [13]. Interfaces such as tutorials, online support, and feedback are important to a game’s usability [13]. Players should be able to start playing the game without reading the user’s manual. They should receive feedback on their progress toward their goals. Multimedia presentations encourage learners to engage in active learning by making mental connections between the story and structure of the problems. In accordance with the complexity of the game’s storyline, the game can be labelled as well-structured or ill-structured. The importance of the storyline depends on the complexity of the game. Generally, the more complex the game is, the more important the storyline tends to be [8].

The main purpose of educational game is to enhance players’ skills or knowledge. There are multiple paths in which to achieve the game goal and different learners have vary determination of what path is accurate in obtaining the goal. Therefore, in order to create immersion in an interactive environment we must make the user actually forget they are participating through a medium. Thus, the instructors who design the game with pedagogy should consider the players pleasure and their development community interfaces which are satisfied by the context of the online multimedia learning platform.

2.3 Internal Representational Task Arrangement of the Game

Fun relates to more than just the user interface of a game; it also relates directly to game play. Siang & Rao [12] suggested seven levels in a hierarchy needs that game players demonstrate. At the bottom level, players are seeking information to understand the

rules of game. Then they need to know how to gain control over the game. After that, they will expect more challenges (to meet esteem needs). The subsequent aesthetic need involves players demand for good graphics and visual effects, appropriate music, sound effects, and so forth. In game-playing, the aesthetic need is a higher ranking need than esteem needs. Therefore, a good game should be sufficiently challenging and match the player's skill levels [13]. Game players experience flow, or addiction to the game, only when the challenges offered match his/her skill [8]. The player performs the learning activities required by the games and focuses on playing in order to achieve the required learning outcomes [4].

In order to support knowledge enhancement, increase communication, and help the community development, the game tasks should enable to apply the Swan's interactions factors to enhance students' performance in the e-learning environment [12]. The key features on task arrangement based on the design instruction should include the functions are listed as follows:

(1) Database-driven materials: The knowledge-centred design indicated that the curriculum is only partially fixed and result from a negotiation process between the learners and instructional agents. The learners can store all their history records, so as they could browse, search and download them easily. They can start a new game based on their previous experience. Learners could share their task with others or interact with each other through online messages.

(2) Fully modularized user customization management: The learners could choose and arrange the modules, such as to set criteria for group members, to send e-mails or messages, and to facilitate their learning.

(3) WWW supported: User-centred design meant that students controlled more of his/her learning process. Extracurricular resources on the internet could be easily linked into the teaching materials or text communications among colleagues.

(4) Flexible discussions forum arrangement: Community-centred design shows that technology can drastically alter the social structure of schools. The functions on the forums not only supported team collaboration, but also could secure team workspaces and private discussion.

(5) Multimedia supported: For sharing ideas or information efficiently amongst members, every tasks provide multimedia document views, such as graphical or video.

3 The Guidelines of the EGame Design

Since the steps of designing a useful educational game are too complicated to be explicated through a cognitive process, we listed the guidelines from these perspectives:

(1) the Game goal and game style considerations in the particular context in which learning takes place; (2) the Game interface considerations for the characteristics of learners, (3) the internal representational task arrangement of the game, and are as follows:

(1) Game goal and game style considerations: The different knowledge level should have different game style design (Table1). For example, at the knowledge application level, the game style such as an adventure games could allow learners to acquisition knowledge by the action of applying, changing, computing, constructing, demonstrating,

and discovering, etc. At the knowledge analysis level, the detective games could provide learners an environment to analyze, break down, compare, contrast, so as to find the results progressively.

(2) Game interface considerations for the characteristics of learners: Tiger suggests four types of pleasure that motivate usage: physiological, social, psychological and ideological. All these elements of pleasure should be considered to the usability of interface, including the tutorials, online support, and feedback are important to learners' involvement.

(3) Game task arrangement: Database-driven materials, fully modularized user customization management, WWW supported, flexible discussions forum arrangement, and multimedia supported are all the important components to arrange the game tasks.

4 Validating the Model: VIEW

In order to explain how the above guidelines is useful in developing of educational games, an prototype investment games VIEW(Virtual Investment Education World) which includes the investment tasks of virtual stock market, financial news, investment course, forum, and so on, were built. We illustrated the design detail parts and discuss its perspectives below:

4.1 Game Goal of VIEW

VIEW is a virtual stock investment simulation game. The novice learners get started to play investment, set their own goal progressively, and enhance their investment knowledge through "learning by doing". The goals of the game are:

- (1) To acquisition knowledge progressively from previous learning experience.
- (2) To have pleasure and immerse by the interactive game tasks arrangement.
- (3) To control the game and improve the learning flow

4.2 Game Style, Task and Interface Design

VIEW provides a spiral investment game play. Learners could revise their learning topics, and their new investments are related to previous learning experience. As the level of difficulty increases, the learners can easily obtain eextracurricular resources, go to forum, or browse online information to enhance their knowledge and make the decisions. The logical design concept of VIEW knowledge level is shown as fig2.

At the knowledge level, learners could define, describe, identify from VIEW basic investment knowledge. At the comprehension level, the learner can go father study by system provided some cases study to let them comprehend, convert, and estimate. At application level, based on previous learning experience and knowledge accumulation, they can surf the Internet stock market information to change, to compute, and to construct their discoveries. At analysis level, official news and announcement can give learners to analyze, to break down, and compare more detail financial information of their portfolios. At synthesis level, they can change, combine, compile, or compose their knowledge form the experts in the professional forum. At evaluation level, learners make their invest strategy from all their alternatives.

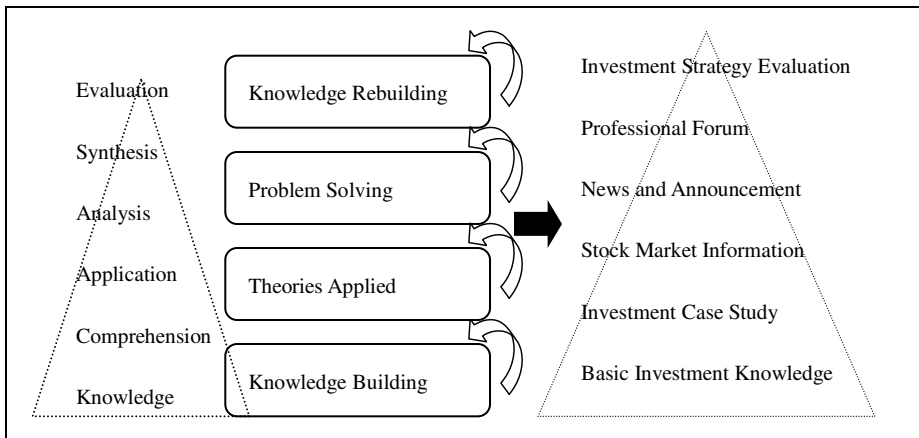


Fig. 2. Knowledge level of VIEW

4.3 Skill Enhancement Design

Pedagogic considerations focus on whether the curriculum goals are attainable by means of game goals, and whether the game style matches the Bloom's knowledge taxonomy level. The pedagogic method in the game designs in this study was the experiential theory mentioned in [4]. The earliest, initial learning process in computer games is behavioral learning. Players learn by trial and error as well as stimulus associations. When the basic knowledge are understood, learners start to think cognitively about how they should respond to a new situation and actively update existing knowledge to fit the new things they are confronted with in the game environment [12].

4.4 Challenge Design

The games create scenarios and provide challenges to invoke the learners' curiosity and keep them involved. Players immerse themselves in the game when the challenge provided by the game matches the skills they have [8]. VIEW simulates real stock market trade and provides different structured problems. The different levels of challenge are given to the players progressively. The players become anxious to search new knowledge for enhancing their skill to overcome the challenge.

4.5 Pleasure Design

The physiological pleasure comes from the graphics, sound, as well as the interaction with the systems. The psychological pleasure comes from positive feedback, such as score and/or applause. VIEW has included all the elements of satisfactions to encourage the player's engagement in playing.

4.6 Concentration Design

The context factors of VIEW involved in the design of educational games included the physical environment, equipment, technical support personnel, and so forth. The

level of concentration is determined by the stimuli and the workload the game provided. Storylines and activities are considered as the stimuli while heavy demands on the player's memory capacity are regarded as a high workload [13]. VIEW is considered to have the factors hampering players' concentration.

5 Conclusions

Designing a "complex" Web-based educational game is a complicated task. In order to enhance learner's knowledge level, the spiral curriculum must be included in game design. One must consider numerous factors such as "reinforcement" to remind the learners continually; the task arrangement should be "from simple to complex"; the "integration" of different knowledge and approaches is required; all the task arrangement has to be in "logical sequence"; allocating "higher level objectives" to enhance learners' knowledge progressively, and so on. Much effort exerted in the designing of educational games should also be targeted at achieving the curriculum goal through relevant learning theories, contexts and learners' characteristics.

The primary intention of this paper is to present design guidelines that make designing and evaluating Web-based educational games less complicated and more effective. These guidelines based on Bloom knowledge taxonomy stresses the importance of focusing on the purposes in each game design perspectives and their relationships to achieve of skill enhancement, challenge, concentration and pleasure.

An empirical study- VIEW (virtual investment Educational World) was conducted to validate these design guidelines. Curriculum goals can be reached using different game styles, game tasks and interfaces that produce separate results in terms of the players' perceived challenge, concentration, pleasure and developed skills. Empirical results of the guideline contribute to the "complex" game design could have easily solutions and detail suggestions. The players' levels of engagement are consistent with the expectation of their enhancing knowledge level to overcome the increasing challenge.

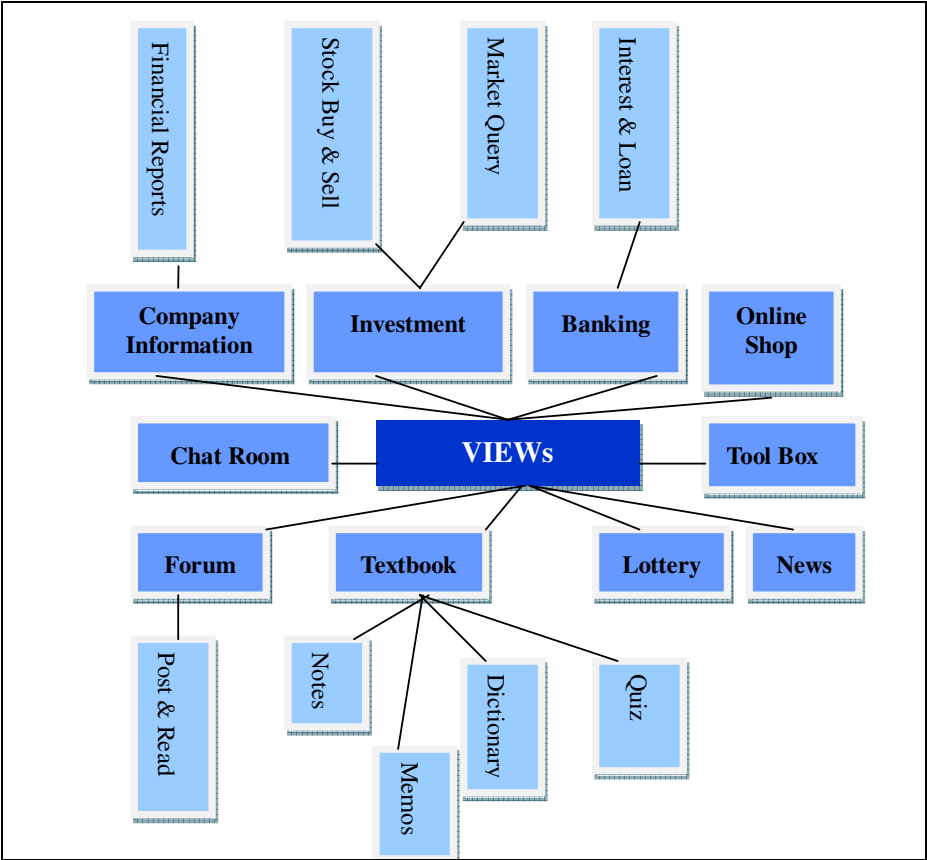
Due to the constraints imposed by the budget and the learning platform, there still remain some ambiguous phases on "complex" educational game design. Currently, leisure, social games are very popular online and could have multi-users play together. We expect that in the future, this paper's guidelines can be further illustrated into operational procedures to help instructors apply their EGame design.

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Appendix: VIEW System Structure



Hybrid Learning Experiences with a Collaborative Open Source Environment

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Abstract. The paper illustrates a methodology for the design of courses, which can be offered as traditional classroom-based, hybrid or distance courses. It is based on collaborative learning environment realized by means of Web 2.0 technologies, aimed at fostering an effective and engaging users' cooperation. The paper presents three examples, implemented on top of the collaborative environment DIEL, which extends the Moodle web portal.

Keywords: Hybrid learning, web 2.0, open source software.

1 Introduction

The purpose of this paper is to illustrate a methodology for the design of courses, to be offered in a traditional classroom based setting, as distance learning, or with a hybrid approach. Courses are supported by the DIEL (Dynamic Interactive E-Learning) system, a collaborative environment, based on Web 2.0 technologies, which has been developed as an extension to the Moodle e-learning portal.

The environment has been more extensively described in [1, 2], here we recall that DIEL is based on the concept of social translucence [3]. The next section will provide a short description of DIEL.

In the following we shall illustrate, from the teacher's point of view, how contents and learning paths can be organized inside DIEL, by describing three experiences of its use, each one involving a different learners group: high school students, University students, in-service teachers. The paper concludes with some qualitative considerations emerging from the three experiences.

2 A “Web 2.0” Environment for Collaborative Learning

The concept of social translucence denotes, within a given application, the creation of a graphical representation of a virtual space containing the users of such an application.

The virtual environment should be organized so to help in understanding how the community, which is currently using the application, is interacting at any given instant. For example, in an on-line auction system, the virtual space may be shown as a circle, where users are located closer to the center, proportionally to the “distance” of the respective bid with respect to the current highest bid (which was placed by the user shown in the center).

Modeling a virtual space as a sequence of rooms, in our opinion, represents an immediate metaphor for representing a path (the learning path), composed by different activities, and structured as a sequence of places where such activities develop. The immediate understanding of this metaphor is due to the real life experience, where different activities are usually done in a variety of contexts, require specific tools and are based on different knowledge and background.

The DIEL system integrates the two above concepts inside a plug-in for Moodle, in order to allow to view courses as organized along virtual rooms (in addition to the chronological or ‘by topic’ default views). Exploiting new technology capabilities (Flash applications and AJAX, the engine of Web 2.0 paradigm), DIEL creates a virtual environment where interactions are welcomed and eased, and where every community service contributes to the creation of a common knowledge as part of a structured learning process.

There exists other software projects that have some similarities with DIEL. For instance, CLear [4,5], Sloodle¹, and the Wonderland project². Especially the latter two share technical points with our solution; Sloodle aims at integrating Second Life with a Moodle instance, allowing a coherent interaction between a virtual environment hosted in Second Life with resources hosted in Moodle. The project Wonderland, instead, aims at providing a 3D secure world in which organizations may do business, or allow employees to collaborate online.

DIEL distinguishes from these projects by simplifying its use, being directly embedded into Moodle, thus appearing especially suited for teaching purposes. Moreover, with respect to Sloodle, DIEL uses a virtual environment which shares the same security restrictions as the Moodle server where it is installed. This feature greatly increases its possibility of adoption, within schools and companies, since they could ensure that their users and data are protected by external accesses.

Each involved person, students as well as teachers, is free to operate and move in a virtual classroom: it is a place where to put opinions or contents, to meet the classmates, even to find amusement, without a fixed interaction stereotype. In such virtual environment, everyone is free to find his way to learn, in conjunction with the others and under teachers directions. Every user is associated to an avatar, which is free to move in a web page, where logical proximity of activities is naturally mapped into physical proximity of the avatars in the virtual space. A set of possible actions is associated to all the elements of the virtual environment, to allow interactions between avatars and other elements (for instance, rooms, selected regions in virtual spaces connected through special passages rendered as doors), and also among avatars and avatars, such as the opening of a private chat session. Each user may see where she/he is, whether there are other users in the same room, and what are they doing: in this

¹ http://slisweb.sjsu.edu/sl/index.php/Sloodle_Home_Page

² <https://lg3d-wonderland.dev.java.net/>

way, interactions on specific problems may take place, focusing on actual context, and the presence of other users using the system improve the users' engagement in the participation to the learning tasks. Users within rooms may access course materials, and may perform collaborative learning activities, taking advantage of existing Moodle resources, like forums and wikis, and of additional tools, provided by DIEL: textual chats, both collective or private, a videoconferencing system based on the Flash technology in a client/server architecture, and an AJAX whiteboard, shared among the community. They are browser independent and do not require additional software installation at client side.

As mentioned, DIEL doors are connecting virtual rooms, so they are used to move from one activity to the next. The concepts of rooms and doors allow to organize learning paths, and corresponding contents and activities, along a graph-based model, more flexible than the linear model made available as default within Moodle. In the following case studies, we will show how modeling course needs may be straightforwardly mapped into room organization.

3 Experiences

Introducing new technologies (like Web 2.0 and the interaction possibilities that they allow between website users) inside an educational/training activity has a potential risk to concentrate on the technological aspect only, forgetting the impact that such a new technology may have with respect to learning strategies and objectives. Teenagers are attracted by new technologies, showing a clear preference with respect to traditional learning tools like books and blackboards. On the other hand, adults can be discouraged by the additional perceived complexity given by the use of a new technology.

Taking into account these facts, the authors have planned a series of experiments, with different groups of users, in order to evaluate what educational situations can better exploit collaborative learning strategies, based on Web 2.0 technologies. Each experience is based on the creation of a specific structured learning path, and the structures employed in the experiences significantly differ from each other. The flexibility of DIEL is thus exploited for creating the most effective learning path, depending on the situation at hand.

3.1 A Virtual Treasure Hunt, in a High School

The first experience, described in more details in [6, 7], involved 18 students aged 17-18 from a technical high school, competing in a virtual "treasure hunt" [8, 9]. A series of closed answer quizzes (much like those in a "Trivial Pursuit") was proposed to the students through the path, and in order to answer them, all facilities presented by DIEL should be experienced. The purpose of this experience was mostly to verify ease of understanding and use of the interface metaphors. The approach recalls proposals by various other authors, for example [10, 11, 12]. Quizzes did not require any specific disciplinary knowledge. Each quiz was presented in a room, and once the answer was chosen, the student should open the corresponding door to reach the next room. Correct answers lead to the room of the next quiz (or to the room of the winner's prize!), while wrong answers corresponded to doors to the "error room". Students could exit from the error room only by giving a correct answer.

In this example no particular collaboration was requested to the student to achieve the goal, but spontaneous interactions were not forbidden. Social translucence allows to view whether other users are in the same room, and to see what doors are they opening. So a student might simply follow friends, without reasoning on quizzes. Students might also open a private chat and ask a friend for the correct answer, so to “cheat”. Given the nature of the experiment, these actions are allowed, and the system is any way tracing interactions [13]. So, the teacher can check, when evaluating students activities, whether each individual contribution is sufficient, based on the actions which the student really performed, and on interactions with peers.

Figure 1 presents the “map” of the virtual rooms in the treasure hunt. Boxes represent the set of rooms created, connected by doors (the arrows). The ovals represent link to Moodle resources.

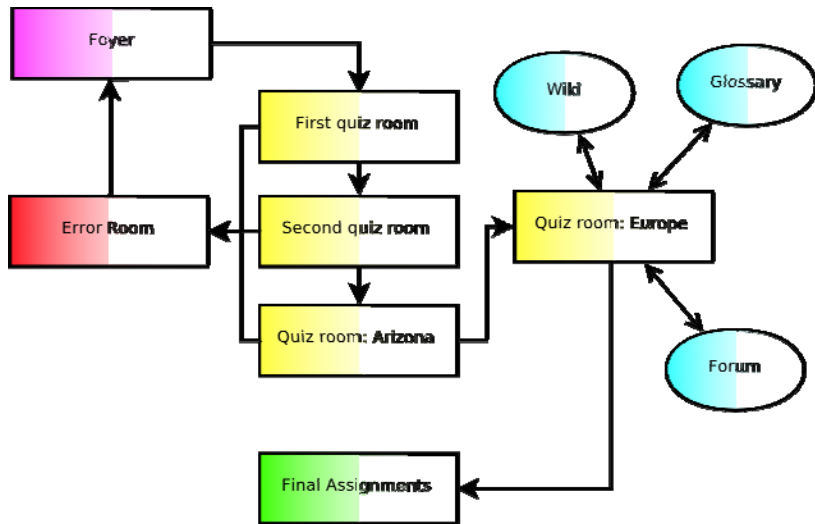


Fig. 1. Example of an interaction between an avatar and course material

3.2 A Course at University: The Linux Scheduler

The second experience was a part of the Advanced Operating Systems course, given at the Msc in Computer Science of the University of Genova. A module (one Credit Point) was delivered about the scheduler in the Linux Kernel, as a distance learning experience. Students were already experienced in the use of Moodle as educational portal, as it hosts all educational materials of the Bsc and Msc in Computer Science. They were also given access to DIEL, where materials on Linux Kernel was placed. Some video chat were organized, so to have a synchronous way to ask questions to the teacher, whom the students never met in person. Besides these chats, activities were organized along the asynchronous and collaborative model: students were divided in groups of three people, and all exercises, discussions and evaluations took place on wikis.

In this example, the course was designed along three main topics, conceptually independent from each other, which the student may follow in any order. For each topic, the corresponding learning path starts from the “prerequisites room”, containing various sources of information about Linux; it continues with a thematic room, and it concludes in an “exercise room”, where three wikis are contained, to deliver written exercises. Each group has a different exercise on a private wiki page, so cooperation outside group members has little significance. Inside each group, the wiki keeps track of the accesses and versions, so the teacher may decompose and evaluate separately each student's contribution.

Figures 2 and 3 show the two visualization options, as 2D or 3D rooms, where DIEL displays the same course contents.

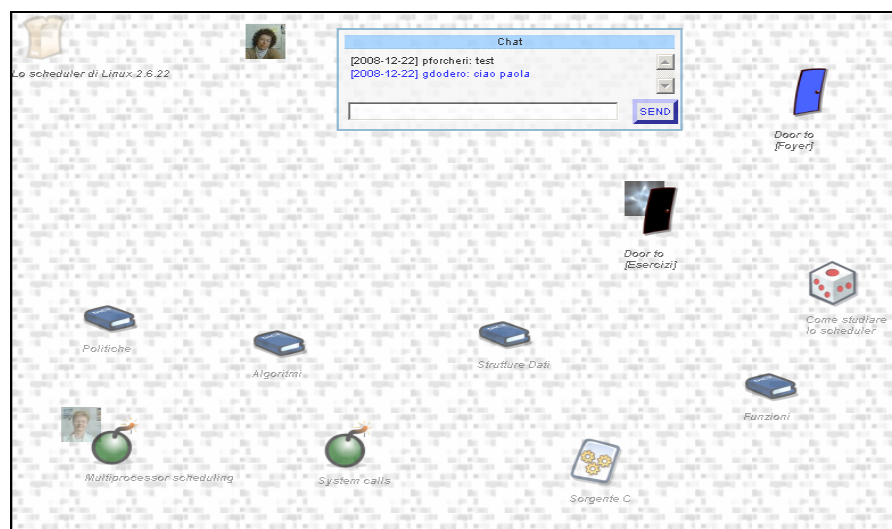


Fig. 2. 2D visualization of the academic course setting

3.3 Training in-Service Teachers on Multimedia in Education

As third example, a course has been organized with the aim of training in-service teachers of humanities, to improve their skills in the development of multimedia for educational purposes. 15 teachers took part into the course. The project is a joint effort of researchers on educational technologies, belonging to IMATI, an Institute of the Italian National Research Council, and IRRE Liguria, the regional Agency for Educational Research. From the pedagogical point of view, the course is based on a participative, project-based, approach, including activities, individual reflections on the work performed, comparisons and discussions with colleagues. The activities to be performed during the course include development, management and reuse of learning objects. Such activities are mostly of synchronous type: they are undertaken during lab sessions; and they may be completed at home after the labs. The work is oriented towards the development of multimedia projects, referring, as to both the topic and the educational organization, to the pedagogical needs of the classrooms in which

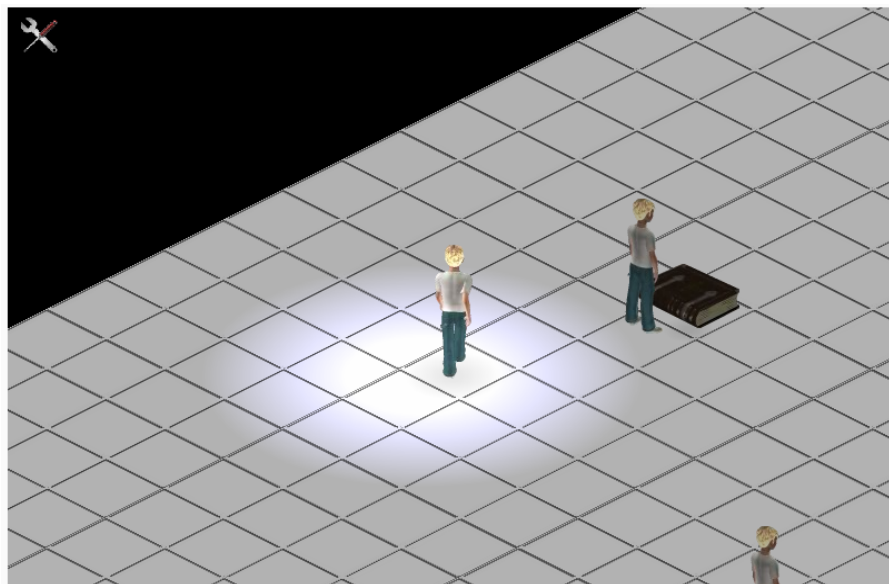


Fig. 3. 3D visualization of the academic course setting

participants to the course are teaching. The activity is carried out by combining an individual with group and classroom approaches, and comprises: 1) the analysis of the main learning problems observed by participants in daily school practice; 2) the discussion on the role that could be played by technology in their solutions; 3) the design, implementation and discussion of a corresponding proposals. These choices aim to operatively stimulate the individual and collective reflection on the concepts introduced, and on their effective use in practice, by connecting past experiences to new teaching objectives.

The methodological organization and the relationships between course topics are illustrated in Figure 4.

Each topic focuses on a methodological aspect of the production of educational multimedia (Building materials, Sharing with colleagues, Re-using multimedia, or, more generally, electronic material). Topics are independent but semantically linked. Each of them integrates study, activities, personal reflections and collective discussions, in order to achieve both learning of course content and operative awareness of problems. The set of problems includes, for example, obstacles to technology integration in the school realm and the aspect to consider in order to realize a pedagogically sound technology enhanced educational proposal, that are still at the core of the debate in the field of educational technologies. The organization into rooms, which is shown in Figure 5, allows a straightforward implementation of the conceptual schema of Figure 4, by connecting with doors the various topics of the course. For each topic, the learning path starts from an 'Entrance' including the theoretical material, it continues with an Activity room including a group wiki, to deliver the scheme of the project, and an assignment to upload the multimedia realized, and doors directing to the Personal reflection and to the Discussion room respectively. The Reflection room includes a material to be used as a

guide for the reflective activity and a private wiki to draft own ideas. It also includes Doors to the Discussion and to come back to the Activity. The Discussion room comprises a Guide to the discussion, a Forum and a public wiki to deliver the results of the Discussion itself. From the Discussion room users can come back to the Activity and the Reflection Room, or move to another topic.

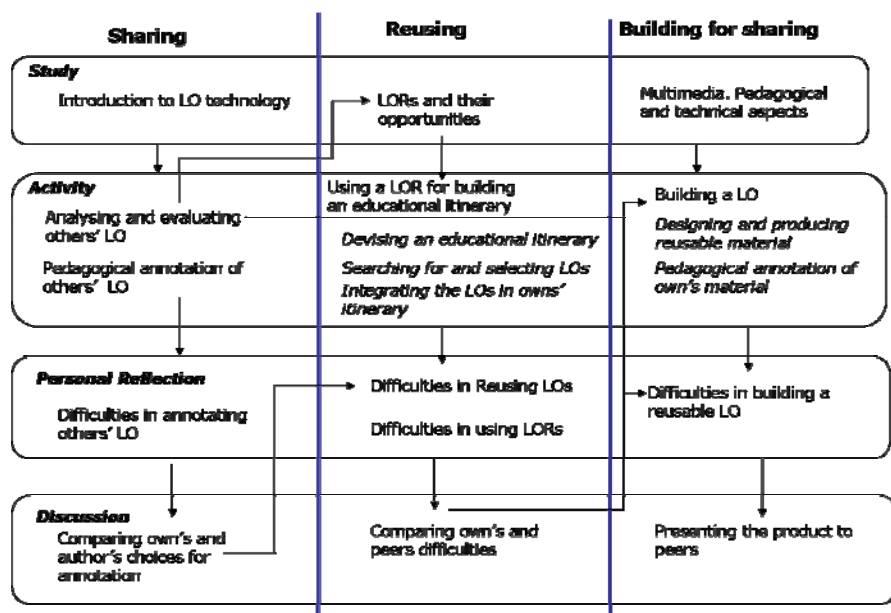


Fig. 4. Methodological organization of the course on multimedia in education

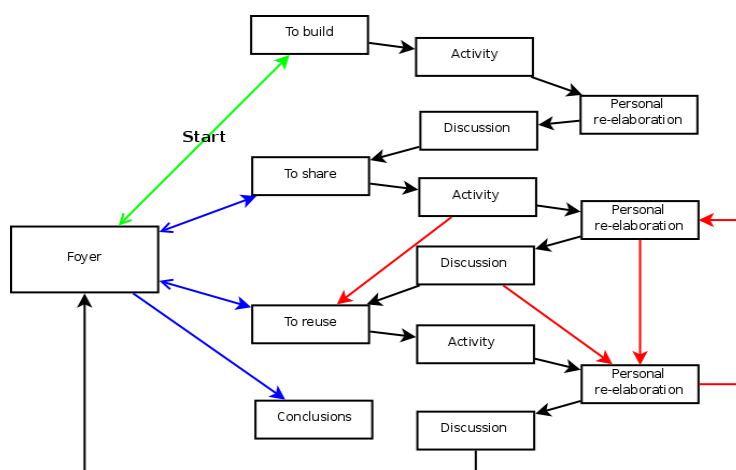


Fig. 5. Methodological organization of the course on multimedia in education

Given the flexibility of such a structure, DIEL may be adapted to particular needs of the teacher in a large number of different educational contexts.

4 Lessons Learned from Case Studies

We have illustrated three experiments where a collaborative learning environment, based on Web 2.0 technologies, has been fruitfully employed. Context, aims and audience of such experiences are extremely varied, ranging from high school teenagers to in-service teachers, and course modality ranges from in-presence to distance to hybrid learning.

Social networking websites and web collaboration portals are gaining an increasing interest from the educational communities. In particular there are several experiences based on the use of Second Life. In our opinion, the approach which we employed with a tool like DIEL has several advantages over the use of Second Life or similar sites. Just to mention a few, in DIEL and in Moodle we can achieve better security, implement the desired authentication policy, and therefore grant the teacher confidence in the individual evaluation of the activities. The simple user interface, which may provide both 2D and 3D views of the learning path, is encouraging us to explore its use in contexts where the Moodle portal is not yet widely experienced, as for primary and secondary schools.

As regards the evaluation of the work, high school students have filled a questionnaire; the results show that they enjoyed the experience in the DIEL environment. Those with greater expertise in video-games have criticized as “too elementary” the graphical interface features (this consideration goes well beyond the intended design of 3D graphical interface in DIEL, which was never conceived to be a competitor of video-games!). However they all believe that, by substituting current classroom activities with others based on the portal, probably the same learning objective may be achieved with more personal satisfaction.

The other two experiences are still on-going, thus we can only report on preliminary observations and “live” comments collected among students. Many among the university students appreciated especially the 2D interface of DIEL, considered more participative with respect to the linear organization of Moodle. Spatial arrangement and movement in the virtual environment correspond to the visual and physical activities that many students enjoy, and then stimulate curiosity towards the subject to be learned. Other students, maybe because of a more “passive” attitude, reported an occasional lack of orientation, especially with the 3D view. They would probably appreciate the insertion of a new function, the “map” of the learning path, to clarify the spatial relationships and improve the orientation. This functionality is now taken into account for an implementation in a next release.

As for the third experience, the limited technological knowledge of the humanities teachers is a challenging issue, to evaluate the suitability of the educational metaphors and the ease of navigation and use of the 2D and 3D views. These teachers only had a previous experience in the use of web tools in education, that is the use of a Content Management System (CMS) such as PLONE³, for access and individual study of educational materials. These users so far did not report difficulties in the use of the 2D

³ <http://plone.org/>

interface. On the other hand, the majority of the participants in the course believe that the strict relationship between the methodological organization of the course, and the spatial arrangement of the learning path may help in understanding course content and intentions, reducing the initial difficulties in a novel approach, increasing engagement and motivation. In fact, both course contents (multimedia in education) and its presentation over DIEL are new for them. DIEL, as participants observed, may facilitate orientation in the course and favor a reflection on semantic links among course portions, by giving a visual representation (the doors) of such links. Collaborative features and social translucence help in meeting with colleagues who share similar problems and interests, and allow to start collaborative activities, which would otherwise be organized based on different criteria, like previous personal contacts or geographic proximity. This aspect is particularly interesting in our case: in fact, at least in Italy, in-service teacher training is usually organized on regional basis, thus participants in a course come from a variety of locations distant from each other. This situation requires a combination of in-presence and distant activity: considering the teachers' background, habit, and generally limited technological knowledge, however, the choice of the distant work environment to use is a quite delicate problem. As already observed, at the moment we cannot draw general conclusions from our experience. However, results obtained till now seem to show the validity of the approach embedded in DIEL to support a smooth transition from traditional to on-line activities in teacher training.

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Development of *VisuaLexs* for Hybrid Language Learning

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Abstract. The aim of this paper is to describe the development and evaluation of the video-based language database called *VisuaLexs* and examines its potential benefits for students to learn a foreign language in hybrid learning environments. The paper firstly explains the importance of providing students with video-based activities in the language classroom. The paper then outlines the research background of electronic language database and text retrieval systems, followed by details of *VisuaLexs* and its educational benefits and limitations with regards to hybrid language learning. Although the biggest challenge that students face using dictionaries is the fact that not enough highly specific examples and meaningful contexts are provided, *VisuaLexs* is effective in discovering various linguistic features and language expressions which are associated with their context information.

Keywords: Language learning, hybrid learning, visual information.

1 Introduction

The recent development of information and communication technology (ICT) has offered enormous potential for language learning and teaching. In many Japanese tertiary institutions, this technology, such as computers, iPodsTM, digital video and audio contexts, to name a few, has become a prerequisite for language learning. For example, computer assisted language learning (CALL) systems, which employ multimedia, hypermedia, and interactive technology to promote various skills [1], have already been introduced into many language classrooms. Similarly, web-based or hybrid language learning environments have been dramatically developed since the proliferation of the World Wide Web and other Internet technology. Various e-learning instruments and techniques for these methods include self-access learning support programs [2], web-based drill exercises [3], computer-mediated communication [4], podcasts [5], corpus consultation [6], and multimedia materials Websites [7], etc. The benefits of these computer-based environments are enormous for Japanese EFL (English as a Foreign Language) students who have had few opportunities to be exposed to authentic language used in English outside the classroom. In addition, since in Japan most of the students' primary motivation to learn English is to pass English entrance exams to get into universities [1]. This technology, blended into the traditional classroom, provide

students with ample opportunities for their independent English studies. However, not much research has been done concerning how to develop hybrid learning technology for these students to enhance their critical thinking and problem solving skills for their life-long learning. These students are accustomed to teacher-directed classroom structures where the students are merely passive recipients of knowledge and information given by an instructor [8]. Therefore, various combinations and applications of this technology should be implemented for the purpose of enhancing their self-confidence in technology-based environments and making students autonomous participants of the language learning process.

2 Video Resources for Language Learning

With the recent popularity of online visual resources, a wide variety of video materials, including TV clips, movie excerpts, Internet-delivered news broadcast, as well as video sharing sites, have become valuable language learning resources which are easily accessible by students [9]. Since computer-based systems utilizing video editing has become widely available, different kinds of educational computer software containing Flash-based exercises have also been introduced into the classroom [10]. The benefits of integrating visual images to English language education have long been appreciated as an educational tool. The major advantage of these video instructions is that the videos contain a rich source of authentic language examples of everyday English and provide students with the practical and realistic images to improve their language skills [11]. These visual and auditory stimuli encourage students to predict and deduce necessary information from various sources [9] and, consequently, help students immerse themselves in a real situational context [12]. This cannot be created in the regular classroom setting. These visual resources also contain cultural elements of the target language [9] including accents, stress, and dialects, etc. [13]. Research has indicated that students are more receptive to structural comprehension exercises if videos can present information in an organized manner [14].

In spite of these benefits of using videos in the language classroom, there are some major challenges. Firstly, authentic videos make it difficult for students to practice particular grammar structures and to understand how words and expressions are actually used in real life situations [11]. Instructional video clips are often too short to provide students with opportunities to focus on the linguistic structures and the language forms. In addition, students tend to watch these videos without absorbing anything and have problems even in comprehending the main ideas in the videos [15]. In order for students to cope with a real communicative setting where a high level of students' involvement is required, these materials should be devised for students to actively engage in language tasks and to encourage them to increase their awareness of words and expressions in the visual materials. For the purpose of enhancing students' active involvement in the language learning, more comprehensive approaches to incorporate visual materials into the hybrid language learning should be developed. Focus should be placed on examining how to utilize these video clips for achieving specific learning goals and objectives [10].

3 Electronic Language Database and Text Retrieval Systems

The accumulation of both spoken and written language data in the electronic form is called “corpus” in linguistic fields. The language data has long been used for the language analysis and the compilation of dictionaries. A “concordance” is an analytical computer program that enables text data to be searched for all language examples matching a particular search word. In combination with this program, various applications of corpus have given foreign language students various options to understand lexical, grammatical and structural patterns of language [16]. A variety of word combinations, such as fixed expressions and collocations, have played a significant role in effective language teaching [17] [18] [19]. Studies have indicated, based on ‘data-driven learning’ (DDL) as defined by Johns [20], these corpus linguistics have been widely introduced into language teaching methodologies in the classroom [21] [22]. Creating a ‘pedagogic corpus’, which is a corpus consisting of all texts to which a learner has been exposed [23], is also regarded as effective in providing students with ‘focus on language form’ activities based on the findings of their language analysis [24]. Having students access various corpora and drawing their attention to language forms and expressions provide them with a more objective view of language [6] [23] [25] [26]. Recent studies have also suggested that it is effective for students to create their own small language data from the Internet and to understand various language terms [27]. In addition, the successful application of a commercial web search engine for locating pages relevant to the target word and retrieving collections of written texts has been highly valued [28] [29]. Similarly, web-extracted corpus data can be used as an effective way to enhance students’ learning and its potential benefits and advantages have recently been discussed [30] [31].

Although these studies have displayed the positive characteristics of language based learning, there have been few studies on corpus data being used as a valuable resource for independent learning [32] [33]. The potential problem of this text-retrieval approach is the fact that the focus is primarily on structure and it lacks realistic, situational, and communicative contexts for language examples [34] [35]. The present language-based teaching methodologies are still unlikely to provide students with reasonable opportunities to learn these recurrent features of language use. In order for students to have better insight into language use, it is necessary to develop effective approaches for them to become more self-reliant and confident in understanding the relationship between the meaning of a word and the context in which it is presented.

4 Program Design and Development

The computer program developed in this study is an online video-based language database, called *VisuaLexs*. This system is based on both text and video data which are synchronously recorded with each other [36]. The text and video data are tagged, and then each word and its synchronous video data are labeled in regards to location and duration. *VisuaLexs* is a server side JAVA™ application. The system consists of both a web server and a database server which stores information on the texts and video files. As shown in Figure 1, the database server is divided into the video files

and the database. The database includes the <files.tbl> and the <wordtime.tbl>. The video ID, the genre, the location of the file, and the script are included into the <files.tbl>. The video ID, individual word, and onset time are included into the <wordtime.tbl>.

Server contents

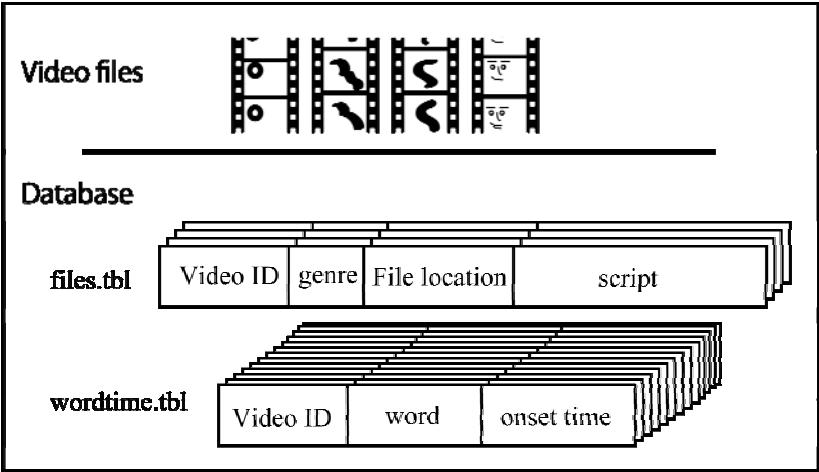


Fig. 1. Server Contents

As shown in Figure 2, when first accessing the system by entering a specific URL in the address bar of a web browser, the users first come to the introduction page of *VisuaLexs*. Here the users click on the name of the video clips they want to use for their study. By clicking on the 'send' icon, the users combine the individual text data selected, and then the combined text data will be displayed in the separate window of the screenshot.

From this screen, the users can access a user-friendly concordance. This concordance is based on the computer program called *Lex* which was created by the authors [31]. The users can write up to five key words for the purpose of searching for their word combinations, and examining how these words are used in different situations. *Lex* performs the simple function of searching and extracting all the occurrences of a certain key word or phrase in a language file. This is in order to find word combinations and lexical patterns which are associated with the key word. The search results can be displayed in Key Word In Context (KWIC) mode. Figure 3 shows 16 retrieved lines of the key word 'take' with its word combinations. Key words are displayed with approximately seven words on either side. The basic rules about the way the word 'take' works is easy to be retrieved. The retrieved results are sorted into the order in which the examples occur in the text data. The letters and the numbers on the left-hand column provide the original source of each retrieved line. At this stage, users focus on various language features such as the use of prepositions, verbs and pronouns, and to examine lexical combinations.

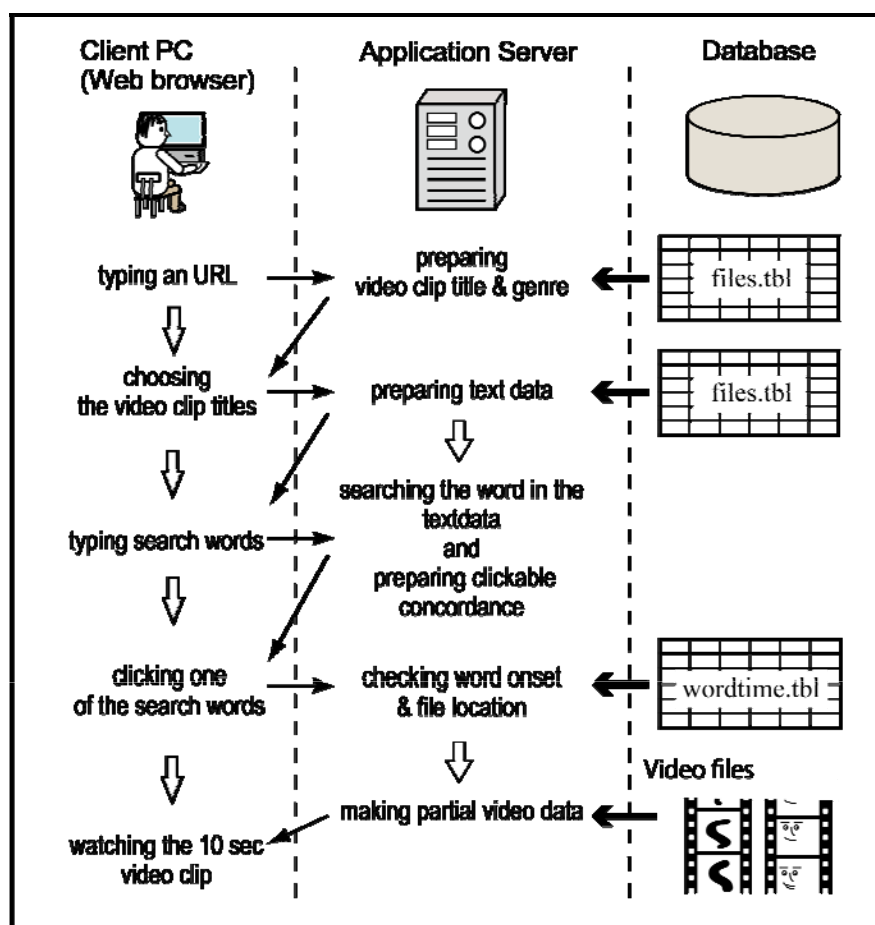


Fig. 2. Flow diagram of data processing for *VisualLexs*

When one of the key words displayed is clicked on by the users, the corresponding video clip, which is limited to 10 seconds, is automatically retrieved from the server and displayed in the separate window of the screenshot (see Figure 4). The users can identify in what type of situation the key word is used. Users can fast forward or rewind the video clip on their own and the video provides the repetition that they need. In addition, when the beginning of each example line is clicked on by the users, the corresponding script is automatically retrieved from the server and displayed in the separate window of the screenshot. The users can identify what type of context is associated with the key words the users selected. *VisualLexs*, with a simplified easy-to-use interface, has been designed specifically for users without any language investigation experience. This program neither requires students to have any specific knowledge nor skills in this field.

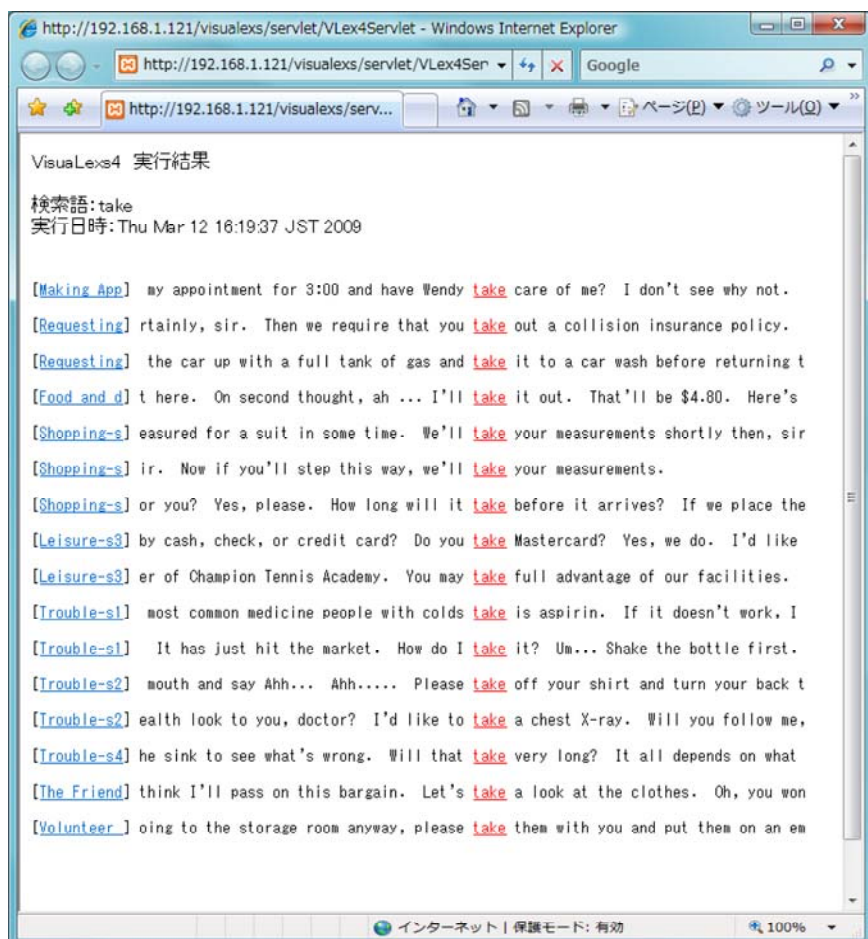


Fig. 3. An example of search results by *VisuaLex*

The video material used as a video-based language data in this study was an excerpt from an ELT video series, L.A. Beat [37], which was designed to be used in a traditional language classroom. The video clips were originally in analog format on video tapes, so they were transformed to a digital format. The series is based on a notional-functional approach to language learning. This instructional video also deals with communicative strategies and survival English skills that are designed to help students adapt to English speaking situations. Important notions, ranging from 'making excuses and complaining' to 'making requests and apologizing', are included in order for students to understand the target language and culture. The video transcripts and their synchronous video data were in the server and were compiled as a video-based language file. The process which is required of the instructor to compile the language file is to select the video and text materials.



Fig. 4. Screenshot of *VisualLexs*

5 Benefits of *VisualLexs*: Preliminary Evaluation

Although *VisualLexs* is still an ongoing research product, there seems to be substantial educational benefits of this computer system. The major innovative feature of this system is that each of the video excerpts addresses particular topics and contains a wide range of visual information which is directly relevant to the target words or expressions. *VisualLexs* shows the user how language is actually used in realistic settings. The process of browsing and analyzing language use allows even untrained students, by themselves, to develop their awareness of the features of different conversation types and to identify various language patterns [38]. By watching facial expressions, gestures, and cross-cultural situations being performed in the video, users are able to draw feasible conclusions about in what context the target word or expression is actually used [39]. These characteristics of *VisualLexs* will increase the users' confidence in the English language skills and help them make their own discovery about authentic language use. Unlike 'decontextualized language' [40] which is a major limitation of language studies, the language examples retrieved by *VisualLexs* are fully contextualized for students.

The second advantage is that *VisualLexs* is designed to assist users in taking control of their own learning. Although there are a number of approaches regarding the use of analytical computer programs or concordancers, *VisualLexs* offers students a considerable amount of freedom in examining lexical patterns and expressions with visual aids. This multiplicity of language examples available is particularly beneficial for users in independent language learning environments. In addition, this system could help students enhance what they have learned through the text-based activities in the traditional language classroom. This system provides a rich source of language activities even including writing and speaking component through pronunciation and dialogue practice while watching a video excerpt. Further, the combination of textual

and visual information is effective for the instructor to determine if the materials provide students with enough exposure to English in an authentic situation and “whether the organization of materials is consistent with the objectives of a given English language curriculum.” [41]. Although, in the educational context where the student’s role is passive rather than active, it is difficult to change the student’s attitudes towards learning [42], this system requires users to actively construct and interpret information [43].

6 Future Developments of *VisuaLexs*

Despite the benefits highlighted in the previous section, several challenges have been identified. The major challenge of using *VisuaLexs* for the instructor is how to build a video-based language database efficiently. In order to construct a video-based database, both the text and its synchronous video data have to be manually compiled. This process, which involves tagging every word, its location, and duration, is tedious and laborious. In order to avoid this daunting procedure, language tagging will need to be done automatically. This automatic tagging system will make it easier for the instructor to compile any video-based language database.

Secondly, although the present study uses an instructional video and script to compile a video-based language database, other various authentic materials, such as TV programs and movies, should be compiled into the language database and incorporated effectively into the English language curriculum. The selection of the video clips that are served for understanding both contextual and paralinguistic information is crucial in determining the successful language course [39]. Authentic and real language videos should be closely related to the instructional goals and objectives. In addition, hybrid language classes require a high degree of self-motivation and independent work skills [44]. Although the idea of using various kinds of video-based materials has still not been fully explored, various kinds of language database with specific genres and topics need to be created if users intend to develop an awareness of variations within various language situations [45].

Lastly, since *VisuaLexs* was installed in a standalone computer, further research on developing networked applications of *VisuaLexs* is important for its implementation in the classroom. In order for students to be able to access a richness of language and to work on it in a self-directed way, implementing *VisuaLexs* in which students work within networked computers is vital. In order to deepen our understanding of the use of *VisuaLexs* in hybrid language learning, future studies will need to look more closely at how students make use of *VisuaLexs* in hybrid learning environments.

7 Conclusions

The purpose of this study was to demonstrate the innovative development of the video-based language database called *VisuaLexs*. Although using traditional text retrieval tools often seem challenging to students who have no prior language analysis experience, *VisuaLexs* has enormous potential for hybrid language learning. The system is intended to raise students’ awareness of actual examples of language and to

promote their independent language learning. There are a number of issues which require further development, but because of its simplicity and flexibility, there is no doubt that *VisualLexs* will be an effective language educational tool to promote students' self-motivation and self-direction in their language learning.

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A Combined Virtual and Remote Laboratory for Microcontroller

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Abstract. This paper describes a web-based combined laboratory for a 8051 microcontroller-related experiment which is composed of a virtual lab and a real time remote laboratory. Authorized users are allowed to have access to both labs using a web browser. The virtual laboratory cooperates with the remote laboratory to help learners easily understand the principal concepts and the process of complex experimental operations about the 8051 microcontroller. The former is implemented by Java applets and Flash animations, and the latter network technologies such as web-based compilation and socket communication, which enables remote experimental devices to be controlled by local learners, compensating for the lack of reality in the virtual experiment. The proposed laboratory provides learners with almost all the same advantages as a real lab environment.

Keywords: 8051 microcontroller, virtual laboratory, remote laboratory, combined laboratory, Java Applet, FLASH animation.

1 Introduction

The worldwide web provides new opportunities for distributing all learning materials over the internet. The worldwide web enables anyone to have easy access to all learning materials over the internet anytime, anywhere. Various web-based contents are implemented and developed in the engineering fields [1], [2]. Web-based engineering laboratory systems are largely divided into a virtual laboratory system and a remote laboratory system. The web-based virtual laboratory provides virtual experimental environments similar to real experimental environments. Due to the cost of the experimental laboratories at universities with a large number of students, much interest in the web-based virtual laboratory has been drawn. Since these interactive virtual laboratories are implemented to describe the actual on-campus laboratory, the learners can obtain similar experimental experience through them [3], [4].

A virtual laboratory is mainly for training in instrumentation, method development and data processing of instrumental methods of analysis, completing and even replacing traditional laboratory training. However, it appears that virtual laboratories significantly contribute to better understanding of the fundamental principles and theories of each

experiment. An usage of Flash animation and Java applets in a virtual laboratory result in better understanding of the experimental theory and procedure. They provide students with opportunities to run equipment without cost, risk and time limitation. It builds experience in each method, allows flexibility in time schedules, and does not require much time and isolated laboratory space [5], [6], [7], [8].

The Power electronics laboratory offered in San Francisco State University is designed for distance learning such that students can conduct an experiment through Internet using a web [9]. A web-based virtual laboratory on a frequency modulation experiment for the teaching of an undergraduate course on communication principles in the National University of Singapore. The laboratory requires only a common web browser to access and incorporate schemes for reducing data traffic and authenticating users. It enables students to have a natural hands-on experience of using an expensive spectrum analyzer on a one-to-one basis and provides a solution for distant engineering education. The system uses a double client-server structure where access to the experiment is via two rounds of client-server processing [10].

In [11], Mohammed E. Haque has implemented a virtual laboratory having the design concept visualization techniques for flexural and shear behavior of reinforced concrete beams. It can be adapted to various other civil/construction engineering/science courses that will certainly promote and enhance students' subject visualization and conceptual understanding.

In [12], The web-based virtual laboratory system for elementary electrical experiments is composed of four important components: Principle Classroom, Virtual Experiment Classroom, Assessment Classroom and Management System. Through this virtual laboratory system students can study effectively the concepts and theories related to the engineering experiments and how to operate the equipments such as multimeters, function generators and digital oscilloscopes. It has interactive multimedia contents to get the learners exact understanding of the concepts and theories of circuit operation, and the learners can build their own circuits and measure all information about the status of the circuits on virtual space by simple mouse manipulation. Every activity done in the virtual laboratory is recorded on database and provided to the learners as a printout form including experimental information and results.

In [13], Computer simulations of pilot-scale process plants in the Department of Chemical Engineering, University of Sydney, have been packaged to provide a suite of virtual plants suitable for web-based navigation. It is intended that these simulations be used for student training before operation of the physical plants.

Although many studies for virtual laboratory in various fields have implemented and used, there are still some drawbacks that the virtual laboratory lacks in reality and can not reflect the precise operations of real experiment devices. The web-based remote laboratory system compensates for the drawbacks of the virtual laboratory. This system located conceptually in the middle point as shown in figure 1 enables students to experiment on the remote actual devices by remote control, and to feel more realistic.

In [14], distance real laboratory system is called Advanced Learning and EXperimental system (ALEX) consists of three parts, ALEX server, ALEX management server, and ALEX client. ALEX server is connected to the experimental circuits using GP-IB board and the A/D converter board, which control experimental devices and acquisition of experimental data. These experimental circuit and devices are taken by

CCD controlled camera. ALEX management server can manage several ALEX servers and ALEX clients via the Internet. ALEX client is able to control the experimental circuits and the CCD controlled camera on ALEX server.

In [15], With the aid of the LabVIEW® software, http-based client-server systems for the remote control of experiments were developed, built and tested, for example: a complex experiment using ultrasonic sensors. Both Liverpool John Moores University in England and Hochschule Wismar University in Germany are using the remote-controlled experiments within the context of the ongoing internationalization of electrical and electronic engineering studies.

As mentioned above, A real Laboratory helps reduce equipment breakdown (due to improper operation) and reduces the associated maintenance costs. And It has optimum use of the limited time and resource available. In addition, Owing to share experiment resources, the cost of experiment can be significantly reduced.

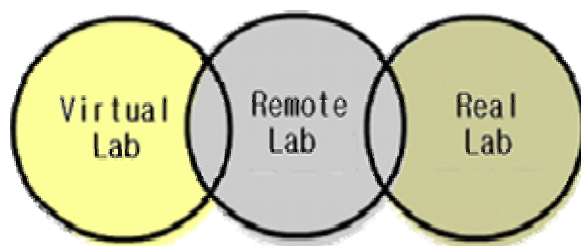


Fig. 1. Relation of remote laboratory

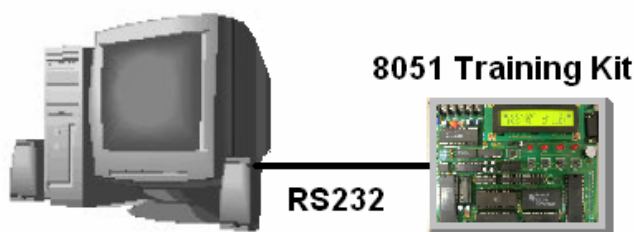


Fig. 2. Real laboratory for microcontroller

Considering the benefits for virtual and remote laboratory, we have implemented a combined laboratory for microcontroller in Soonchunhyang university. In general students have practiced microcontroller experiment within the laboratory as shown in figure 2. If students want to get familiar with microcontroller programming and deployment, they must have access to a software development environment and a training kit. Therefore it is impossible that they practice any microcontroller experiment without training kit at other place. In order to provide these facilities the students should be able to connect via the Internet to a real target microcontroller system located on the Schoonchunhyang University, i.e. they use a *remote* laboratory. When a student is confident that his program works, then he accesses the remote lab, uploads his program to the target system, and conducts this experiment on real hardware. If an

error occurs or the real-time behavior differs from what is expected or required, he corrects the program until he is satisfied.

In this paper, we propose web-based combined laboratory composed of a virtual laboratory and a remote laboratory for 8051 microcontroller as shown in figure 3. The virtual lab cooperates with the remote lab to help learners easily understand the principal concepts and the process of complex experimental operations about the 8051 microcontroller. The former is implemented by Java applets and Flash animations, and the latter network technologies such as web-compilation and socket communication, which enables remote experimental devices to be controlled by local learners, compensating for the lack of reality in the virtual experiment. In the remote laboratory, 8051 C compiler, assembler, linker and experimental equipment are installed in the server side and web-compilation and socket communication techniques are used to connect clients to the server. Although clients can not physically touch any equipment, they can confirm the operation process of the 8051 microcontroller by observing the result of experiment transferred through the web camera[16], [17].

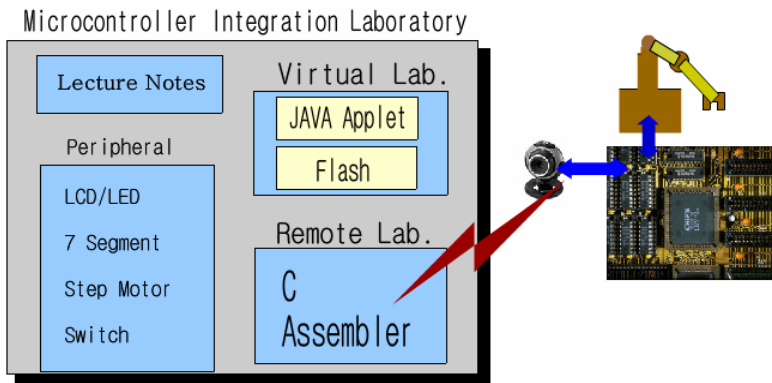


Fig. 3. Schematic of proposed combined

The remainder of the paper is organized as follows. In Section 2, we detail the requirements and constraints of a microprocessor lab in distance education and describe the implementation of our lab. In Section 3, we present an usability of a web-based laboratory. In Section 4, we give a conclusion and future work.

2 Configuration of Combined Laboratory

The combined lab is composed of a virtual lab and a real time remote lab. The virtual lab includes lecture notes and creative multimedia contents which help learners easily understand the principal concept and the operation of program codes for 8051 microcontroller. The remote lab supports web-compilation of source programs (assembly or C language) which learners edited through the internet. Java Web Start technology is used to implement the web compilation. Learners can execute and observe their programs on the remote 8051 microcontroller, which enhance education achievement, compensating for the lack of reality in the virtual experiment.

2.1 Introduction of 8051 Microcontroller

A microcontroller is an combined chip that is often a part of an embedded system. A microcontroller includes CPU, RAM, ROM, I/O ports, and timers like a standard computer, but because it is designed to execute only a single specific task to control a single system, it is much smaller and simplified so that it can include all the functions required on a single chip. A microcontroller differs from a microprocessor, which is a general-purpose chip that is used to create a multi-function computer or device and works together with other chips to handle various tasks. A microcontroller is meant to be more self-contained and independent, and to function as a tiny, dedicated computer. 8051 is one of the most popular 8 bit microcontrollers and combines an instruction set that allows tight coding of small I/O-intensive applications with enough power and a sufficiently large program space that can be used with C. Despite its relative old age, 8051 is still the most commonly used microcontroller at present. Thus, we choose 8051 microcontroller and developed a virtual laboratory. The virtual laboratory contains experimental contents related with each program using Java and Flash. Learners can learn in a quick and easy way how to program a 8051 microcontroller in the virtual laboratory [18].

2.2 8051 Microcontroller Virtual Laboratory

Lecture notes shown in Figure 4 include general contents for the 8051 microcontroller such as architecture, instructions, addressing mode and interrupt. To enhance the learners' comprehension, Flash animation or Java applets are provided. The Virtual Laboratory for peripheral includes LCD/LED, 7 Segment, Step motor, switch. The entry point of the virtual lab is principle lecture notes written in HTML , FLASH, Java applet program. Lecture notes includes general contents for 8051 microcontroller, such as architecture, instructions, addressing mode, interrupt, etc. To enhance the learner's comprehension, FLASH animation or Java Applets are provided. Figure 5 shows the process of operation of MOV among 8051 instruction set and the learner

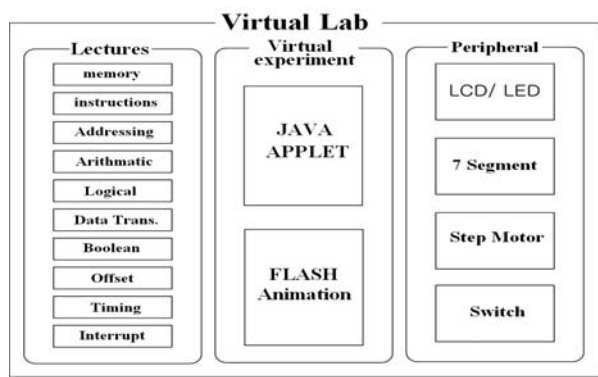


Fig. 4. Configuration of virtual laboratory

can easily understand the meaning of the separate instruction. The format is MOV operand1, operand2. MOV copies the value of *operand2* into *operand1*. The value of *operand2* is not affected. Both *operand1* and *operand2* must be in the internal RAM. No flags are affected unless the instruction is moving the value of a bit into the carry bit in which case the carry bit is affected unless the instruction is moving a value into the PSW register (which contains all the program flags). The learner can easily understand the MOV instruction through animation.



Fig. 5. FLASH animation of MOV Instruction

To teach how to program the 8051 microcontroller, sample programs are provided. The left lower part in figure 6 shows an assembly program for printing characters on the LCD. Learners can trace the program step by step by just clicking the line and then observe the execution results through the simulated memory region and stack region shown in the right part of figure 6, and the simulated LCD in left upper part of figure 6. Figure 7 shows comprehensive multimedia content for controlling LED. When a learner clicks the 6th line in the source code, the first LED turns on.



Fig. 6. Comprehensive guide for outputting characters to LCD



Fig. 7. Comprehensive guide for lighting LED using assembly language

2.3 Microcontroller Remote Laboratory

The remote lab enables remote experimental devices to be controlled by local learners, compensating for the lack of reality in the virtual experiment. The block diagram of the remote lab is shown in Fig. 8. The Server system is composed of Compile module, 8051 Execution Module, 8051 System, Telnet Server and FTP Server, etc. The functions of major modules are as follows.

a) Program Input Module

It is composed of a text editor module and a dialog box for saving the edited file. Students edit a program and save it in their computer.

b) File Transfer Module

It uploads a source program edited in the source input module using FTP to the server.

c) Compile Module

It compiles the uploaded source program, links, generates an execution file, and then save the files in server. It support 8051 assembly language and C program using macro assembler(A51.exe) and C compiler(A51.exe) respectively.

d) 8051 Execution Module

In order to run the execution file on the 8051 microcontroller quipped in server side, Clients request the server to execute the file by using telnet and then the 8051 execution module takes control over the 8051 system connected to the server computer by RS-232, executes the code, and return execution results (Fig. 9) to the clients through web camera.

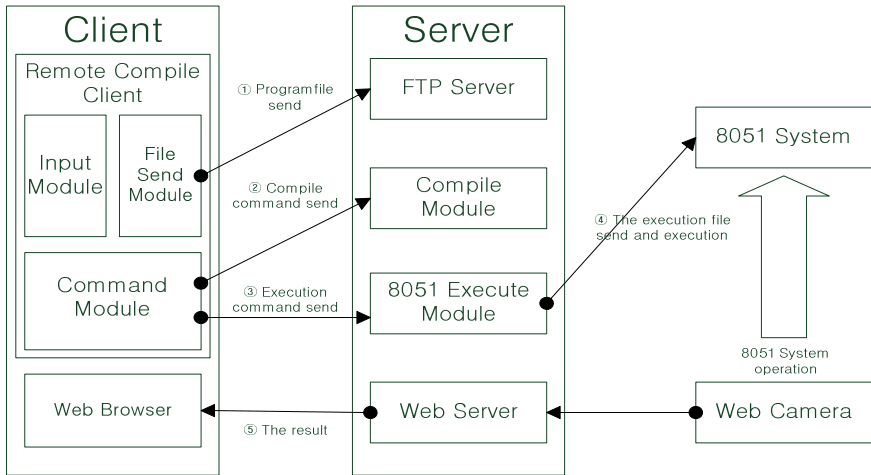


Fig. 8. Block diagram of remote laboratory



Fig. 9. Image including execution result returned to clients

2.4 Client'View of 8051 Remote Laboratory

When a learner has access to the web page for remote laboratory, client modules under the environment of Java Web START open the window as shown in Fig.10. The Client system is composed of program input module, file send module and control input command module. To write a program, a learner should click the first button named source writing. Then, the learner gets the source input window.

The source input module is composed of the text input module and file save module. The text input module helps a learner to write a source program and the file save module saves the source file on the client computer. The file send module sends the local source file to the server to compile and execute the source file. Compile module in server generates the execution file by compiling and linking the code received from the

client. The compile module returns the compiling message to the client. After completion of compilation and link, the 8051 execution modules take control over the 8051 system connected to the server computer by RS-232, execute the execution code, and return execution results to the clients through web camera.



Fig. 10. First view of remote lab

3 Usability Measurements

The usability of a web-based laboratory is a function of system design and is determined by various factors, but we focused on ease of use, quality of the learning materials, effectiveness of remote laboratory, coverage of the contents and system responsiveness. A survey questionnaire that has been developed based on these issues is summarized in Table1. Students were asked to rate the usability of the web-based combined laboratory on a five-point scale, as follows: 1-very poor; 2-poor; 3-satisfactory; 4-good; and 5-very

Table 1. Questionnaire used to measure the usability of the web-based laboratory

	On a scale of 1 to 5 rate: (1=very poor, 2=poor, 3=satisfactory, 4=good, 5=very good.
Q1	Was the web-based combined laboratory easy to use?
Q2	Were the laboratory components good enough to help you better understand the concepts and principles of learning materials?
Q3	Was the remote laboratory helpful to conduct the real-laboratory experiment?
Q4	Was the web-based combined laboratory self-contained enough to study alone?
Q5	How was the response time of the laboratory components?

Table 2. Percentage of Student versus Ratings

	Percentage of students who rated various aspects of the web-based combined laboratory as either very good, good, or satisfactory				
Rating	Q1	Q2	Q3	Q4	Q5
Very Good	8%	12%	26%	4%	5%
Very Good or Good	42%	40%	32%	16%	29%
Very Good or Good or Satisfactory	44%	40%	34%	38%	47%

good. The web-based combined laboratory is provided to the students enrolled in a microprocessor course in addition to onsite lecture and experiment to compensate for the lack of the time allowed for the course. A total of 50 students enrolled in the course took part voluntarily in the survey. Table 2 gives the percentages of students who rated the 5 different aspects of the web-based combined laboratory as very good, good, or satisfactory. Over 80% of the students rated the Q1, Q2, Q3, and Q5 to be satisfactory, good or very good. But only 60% of the students rated the Q4 to be satisfactory, good or very good. The web-based combined laboratory needs to provide more diverse contents related to the topics. The student's experience in the web-based combined laboratory considerably reduced the time for the onsite experiment and the given experiment can be finished in the given time, otherwise extra time would be needed. Therefore, Our laboratory is very useful to enhance the quality of the onsite experiment courses or can be used as online education tool for a 8051 microprocessor experiment stand alone.

4 Conclusions and Further Work

We have realized a microcontroller lab course that is remotely accessible to real hardware in distance education. This is accomplished by two modes of operation: virtual lab and remote lab. In this paper, we have implemented a web-based combined laboratory for 8051 microcontroller-related experiment. It is composed of a virtual laboratory and a real time remote laboratory. The former is implemented by HTML, Java applets and Flash animations, and the latter network technologies such as web-compilation and socket communication, which enables remote experimental devices to be controlled by local learners, compensating for the lack of reality in the virtual experiment. The authorized users who are allowed to have access to both labs using a web browser no longer need to have their own 8051 microcontroller-related experiment devices and software locally. Although clients can not physically touch any equipment, they can confirm the operation process of the 8051 microcontroller by observing the result of experiment transferred through the web camera.

The implemented system is a very effective education tool because the virtual lab cooperates with the remote lab to help learners easily understand the principal concepts and the process of complex experimental operations about the 8051 microcontroller. Virtually, it provides learners with almost all the same advantages as a real lab environment.

In the future, we will develop a hybrid education system which is enriched by creative multimedia contents and various devices and equipments controlled remotely.

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A Web-Based Virtual Laboratory System for Electronic and Digital Circuits Experiments

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Abstract. To achieve an integrated environment for measurement and instrumentation, we designed and implemented a client/server distributed environment and developed a web-based virtual laboratory system for electronic and digital circuit experiments. Since our virtual laboratory system is implemented to describe the on-campus laboratory, virtual experimental data similar to real experimental data can be obtained through the system. In addition, our web-based virtual laboratory is designed to enhance the efficiency of both the learners and the educators. The learners will be able to achieve high learning standard and the educators save time and labor. The proposed virtual laboratory system is composed of three important sessions: Principle Study Session to explain the concepts and to simulate digital circuit operations, Virtual Experiment Session to provide interactive multimedia contents about the syllabus of off-line laboratory class, Assessment Session and Management System. With the aid of the Management System every session is organically tied up together to achieve maximum learning efficiency. Through our virtual laboratory, the learners will be capable of learning the theories related to electronic circuit experiments and the operation method of the experimental equipments such as multimeters, function generators, digital oscilloscopes and DC power supplies. Also, every activity occurred in our virtual laboratory will be recorded on the database and will be printed out on the preliminary report form. Finally, we have obtained several affirmative effects such as reducing the total experimental hours and the damage rate for experimental equipments.

Keywords: Virtual Laboratory, Web-based Educational System, Multimedia Contents and Java Applets.

1 Introduction

In addition to enhancing traditional educational methods, information technology (IT) can also enable new ways of education delivery and innovative pedagogic strategies. Teaching is no longer confined to a time and a place. The time and physical boundaries of the traditional classroom are stretched to a learning space. A growing number

of universities worldwide are now offering virtual education problems. Several companies are also providing online training for their employees. A simple search on the worldwide web will result in hundreds of sites offering virtual courses or resources for developing and delivering such courses.

Electronic and digital experimental studies are very important component in engineering education. It not only acts as a bridge between theory and practice, but also solidifies the theoretical concepts presented in the classroom. In the classical approach, a complete manual, a detailed guideline for design and simulation steps, experiment procedures and a presentation of the technical report, accompanies most of electronics experiments performed at the actual on-campus laboratory. Before the laboratory session, the learners should re-enforce basic concepts, prepare some design and simulation steps, and acquire a clear idea on what they should expect from the experimental work they will be carrying out in the laboratory. At the laboratory session, the learners are required to assemble the circuits, connect the equipment, make the measurements, compare the data to the expected behavior, and deliver a partial or complete report to the professor at the end of the session. This classical way of experimenting clearly has the following shortcomings.

- The classroom lectures or the handouts are generally not sufficient for the learners to be fully prepared for a hands-on experiment or to appreciate the significance of the previously explained theory in the experiment to be performed.
- When the learners are passive observers or a semi-active part of an experiment, they will understand neither the correspondence nor the difference between theory and practice.

To cope with these difficulties we proposed virtual laboratory system in the area of electronic engineering which provides the learners with improved experimental methods. If the learners have access to the virtual laboratory system through signing up procedure, they can acquire the fundamental concepts on the related experiment and make a virtual experiment on basic electronic circuits according to the guided experiment procedures. Equipped with theoretical knowledge acquired by executing flash animations and Java applets, the learners can easily understand the important principles and the significance in the experiment to be performed. All of these activities will be carrying out in the virtual laboratory system by clicking the menu buttons in it and filling out some text fields to change the values of experimental components. Since this interactive virtual laboratory is implemented to describe the actual on-campus laboratory, virtual experimental data similar to real experimental data can be obtained through the system.

The proposed virtual laboratory system is composed of three important sessions and management system: Principle Study Sessions, Virtual Experiment Session, Assessment Session and Management System. With the implementation of the proposed virtual laboratory system, it has become to intensify the work during the laboratory session and to provide the learners with better understanding of the significances related to the electronic experiments.

Our virtual laboratory system is designed to support from elementary electrical and digital experiments to advanced electronic experiments included in the curriculum of electrical engineering. It has interactive multimedia contents to get the learners exact understanding of the concepts and theories of circuit operation, and they can build their own

circuits and measure all information about the status of the circuits on virtual space by clicking some menu buttons in it and filling out some text fields. Every activities done during the virtual laboratory session is recorded on database and will be provided to them as the printout report form included their experimental information and results. The educators check the printout form turned in to estimate how well they understand the experimental contents and methods during virtual laboratory session. Our virtual laboratory system provides 2 courses and each course needs one semester. The implemented virtual laboratory system can be used in stand-alone fashion, but using, as assistants of the actual on-campus laboratory class, will show more encouraging results.

2 Structure of Proposed Virtual Laboratory System

The web-based virtual laboratory needs, in general, various interactive multimedia components such as Java Applets, Flash animations with useful actions etc. In order to achieve this goal, we suggest that our virtual laboratory include three important sessions and management system for effective experiments on the worldwide web. The material in third and fourth courses of our virtual laboratory system is appropriate for advanced courses on electrical and electronic circuit experiments. Each course consists of 15 chapters and each chapter comprises the Principle Study Session to explain the concepts and theories of circuit operations, the Virtual Experiment Session to provide the learners with making virtual experiments on several electronic circuits. The Management System assigns the username and password to the eligible authorized persons and provides printout service for all information about the experiment done in the Virtual Experiment Session. In Fig. 1, the structure diagram of our virtual laboratory system is shown.

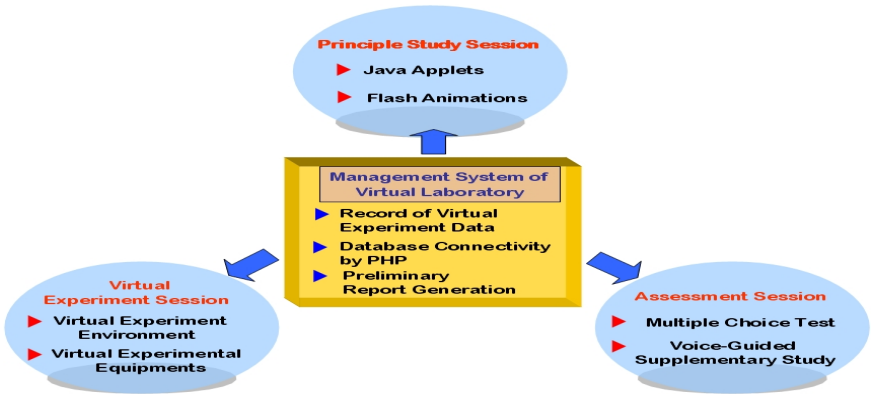


Fig. 1. Structure Diagram of our Virtual Laboratory System

2.1 Principle Study Session

The Principal Study Session is responsible for making the learners understand the concepts and theories of the circuit operations included in each chapter. Interactive flash animations with creative and intuitive ideas for each subject lead the learners to

themselves simulate several digital circuits on the web for specific input conditions and can be able to design/analyze digital circuits. Furthermore, two or more different digital circuits can be simulated simultaneously for different input conditions.

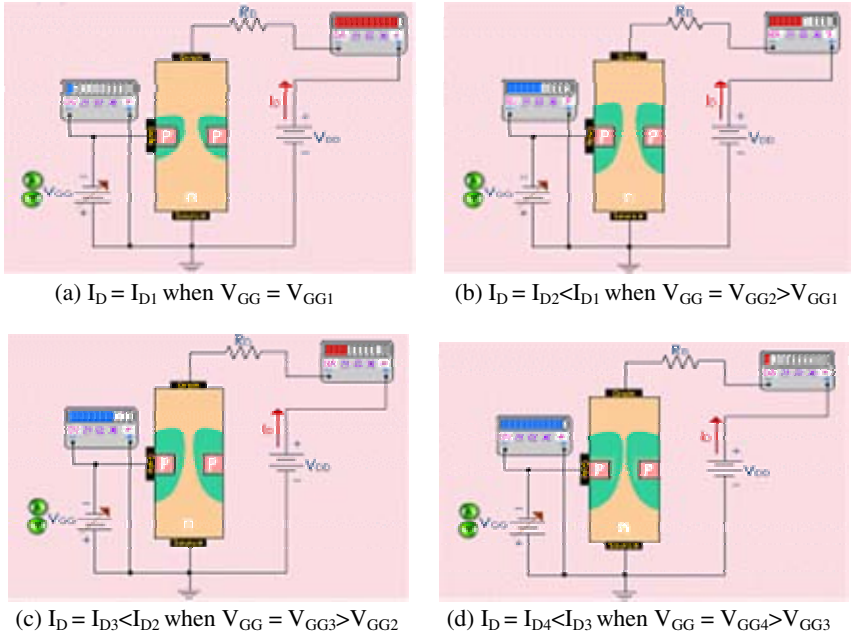


Fig. 3. Flash Animation for Explaining the JFET Characteristics

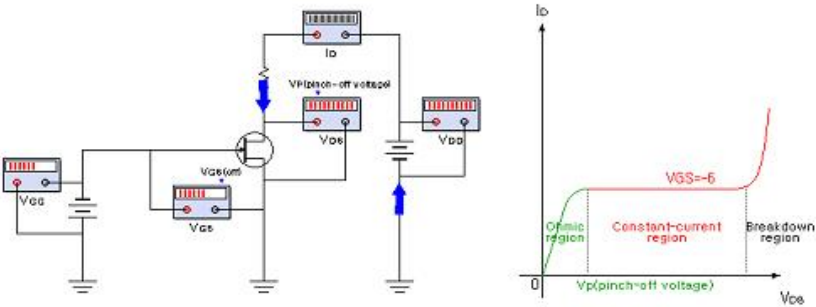


Fig. 4. Java Applet for JFET Characteristic Curves

The proposed digital simulator, combined with multimedia contents, can be used as an auxiliary educational tool to enhance the learning efficiency. Fig. 5 shows a web-based digital simulator which is performing simulation for logic gates. The simulation is performed according to the following procedure: (1) Circuit Composition on the Layout Grid (2) Applying Input Pulse (3) Output Measurements.

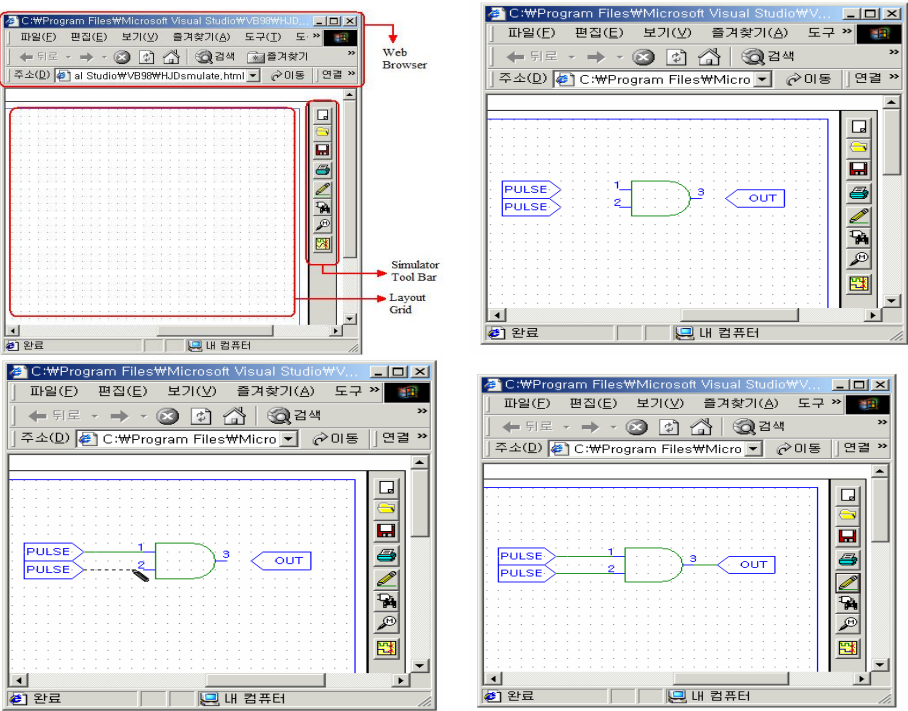


Fig. 5. A Digital Simulation for Logic Gates

2.2 Virtual Experiment Session

The Virtual Experiment Session provides virtual experimental environment to the learners. Java Applets implement widely used experimental equipments such as oscilloscopes, multimeters, function generators and power supply etc. During this session, the learners can build circuits for each subject, set the values for each circuit element, and measure voltages or currents using the experimental equipments. The virtual experiment results are based on the typical textbook for electronic circuit experiments. In order to generate the appropriate outputs internal calculation through well-known circuit theory is essential for the fixed circuit structure. Though the virtual experiment is not arbitrary, the learners can changes the values of several circuit components. When finishing the virtual experiment on the web, they can print out the all information regarding that virtual experiment and submit it as their preliminary report to the educators in their on-campus laboratory classes. For example, when clicking the button “ZOOM” in the virtual experiment on the CS JFET amplifier in Fig.6a, the learners can observe augmented output waveforms of the CS JFET amplifier as shown in Fig.6b. The virtual oscilloscope was designed for the learners to adjust VOLT/DIV and TIME/DIV of each channel; to save the output waveforms; to load previous waveforms and to print out the output waveforms.

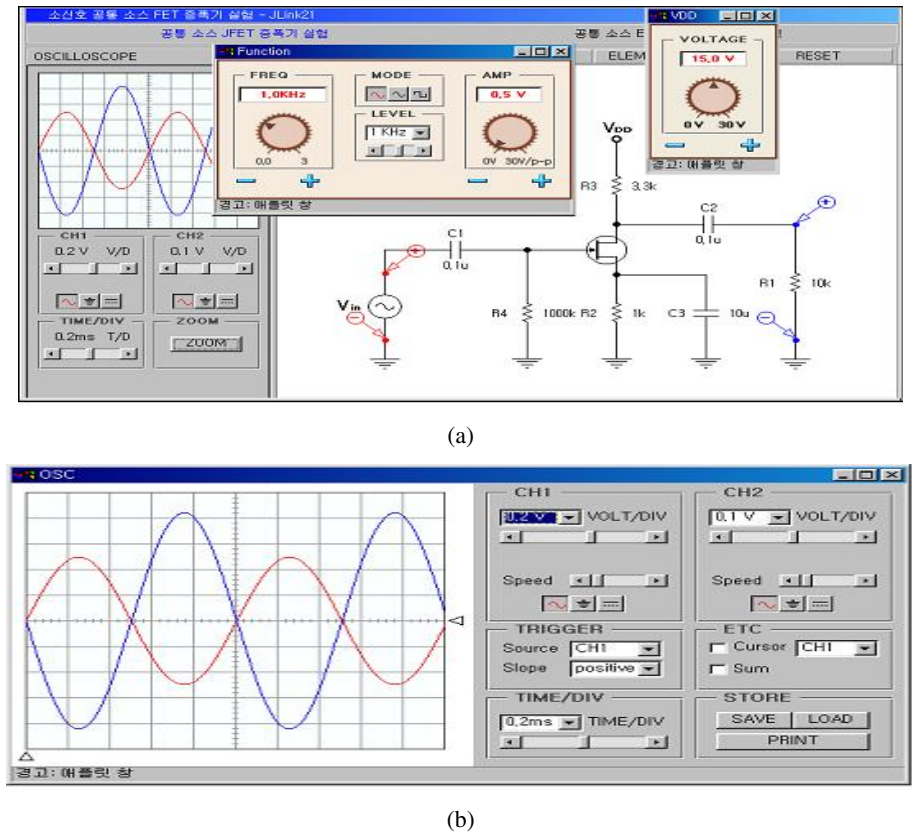


Fig. 6. (a) Java Applet for Virtual Experiment on CS JFET Amplifier. (b) Augmented Output Waveforms of CS JFET Amplifier.

The virtual experiment for electronic circuits is performed according to the following procedure: (1) Assembling and connecting the circuits (2) Applying input voltages (3) Making the output measurements (4) Transmitting experimental data to the database (5) Printing out the preliminary report as shown in Fig. 7(a)-(d). The learners build a given circuit by placing proper circuit elements from ELEMENT CHOICE tab. With this menu, the learner can select circuit elements and change their types or values. In Fig. 7, V_{DD} is set to have 7.6[V]. They can change the value of DC power supply by double-clicking the DC power supply symbol. In addition, they can insert a voltage and/or current markers into the circuit by using MEASURE tab. The learner can also measure several outputs for the various values of V_{cc} using the oscilloscope.

The virtual experiment for digital circuits is performed by virtual experiment kit with interactive and innovative multimedia contents, which can be used to enhance the quality of education in the area of digital circuits. A Java applet for virtual experiment on a full-adder is illustrated as an example in Fig. 8. Note that the circuit composition on the virtual bread board(VBB) and its corresponding online schematic diagram are displayed together on the virtual experiment kit.

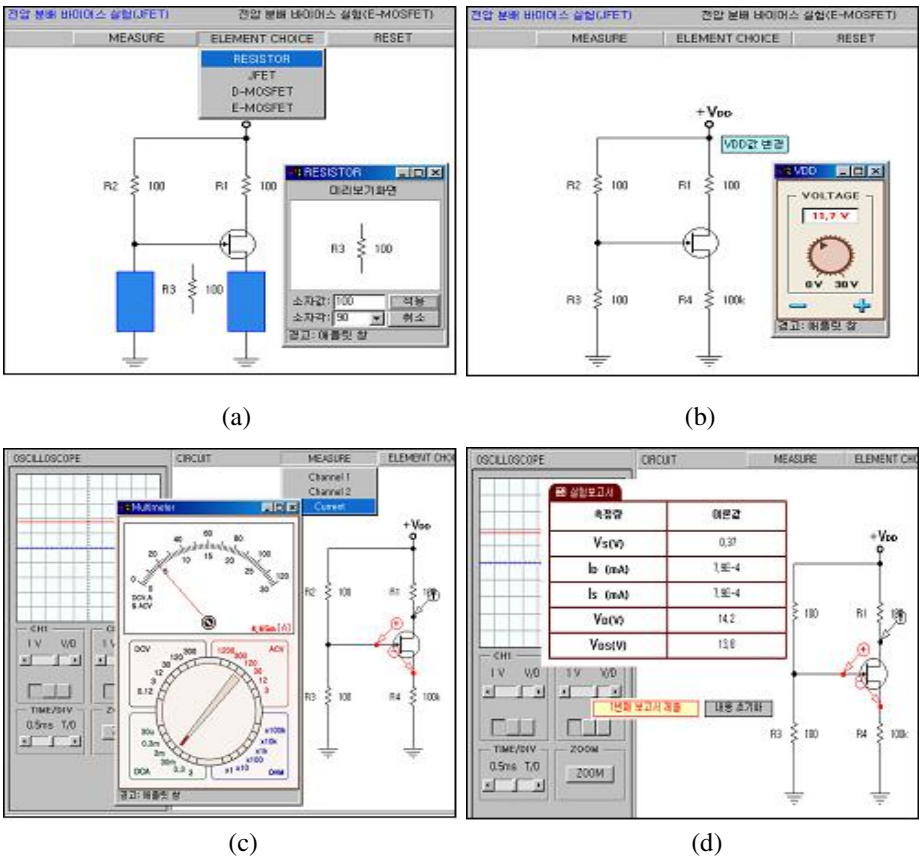


Fig. 7. (a) Connecting the Circuits. (b) Applying Input Voltages. (c) Making Output Measurements. (d) Transmitting Experimental Data.

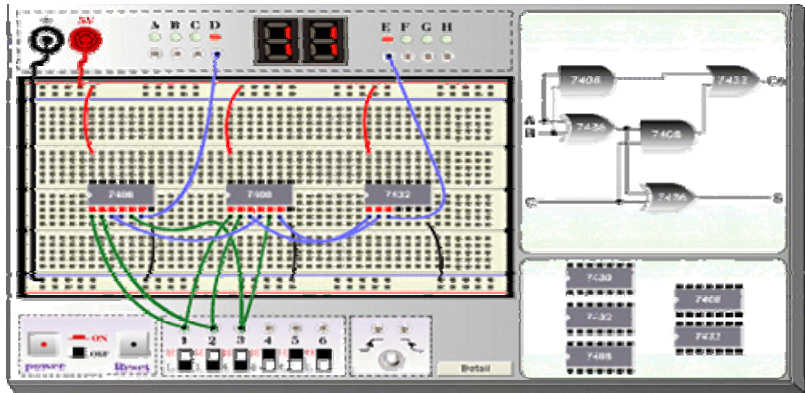


Fig. 8. A Web-based Virtual Experiment Kit for Full-Adder

2.3 Assessment Session

It is very important to provide the educators with useful information about experiments done in virtual laboratory by which the educators evaluate how well the learners are doing. Every activity done during the virtual laboratory session is recorded on the database and will be provided to them as the printout form included their experimental information and results. The educators check out the submitted printout form to estimate how well the learners understand the overall experimental process. The management system supports communications between the educators and the learners in the ways mentioned above, and different setups for each learner. Our system based on the client/server architecture uses noncommercial software.

Furthermore, simple multiple choices are given to the learners after virtual experiments and the test results are displayed on the message box. According to the test result for each question, if the learners click one of two buttons named as "supplementary" or "more challenging", they can listen to the voice regarding its related explanation. This assessment process is very essential to increase the learner's academic capability. In Fig. 9, our interactive questioning system is displayed as an example.

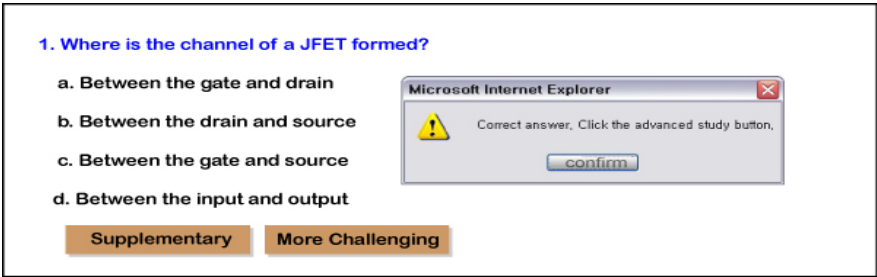


Fig. 9. Our Interactive Questioning System

2.4 Management System

Good instructional development is an iterative process by which the educators and learners perform formative assessments and summative evaluations to improve a course continually. Effective instructors use a variety of means, some formal and others informal, to determine how much and how well their students are learning. In the proposed virtual laboratory system, every activity occurred during the virtual laboratory session will be recorded on database and printed out as the preliminary report form. All of these can be achieved by the aid of the Management System. Professional HTML Preprocessor (PHP) makes the database connectivity and the virtual laboratory environment is set up slightly differently for each learner. Our virtual laboratory system, based on client/server architecture, uses none of the commercial software package. Fig. 10 shows database connectivity of the Management System using PHP. Fig. 11a shows a captured image for submitting preliminary report form preliminary report form and Fig. 11b shows the sample preliminary report done during the virtual laboratory session.

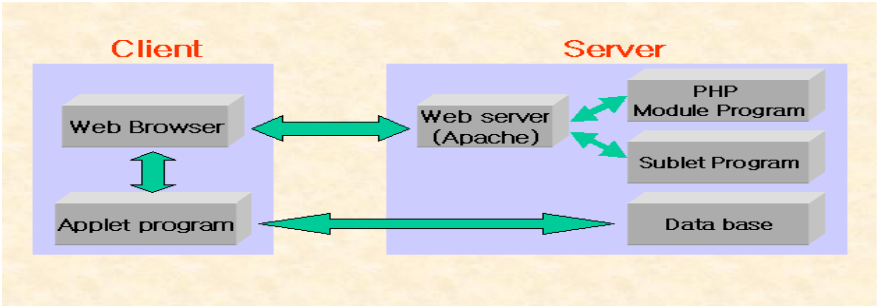


Fig. 10. Database Connectivity of the Management System using PHP

Experimental Report

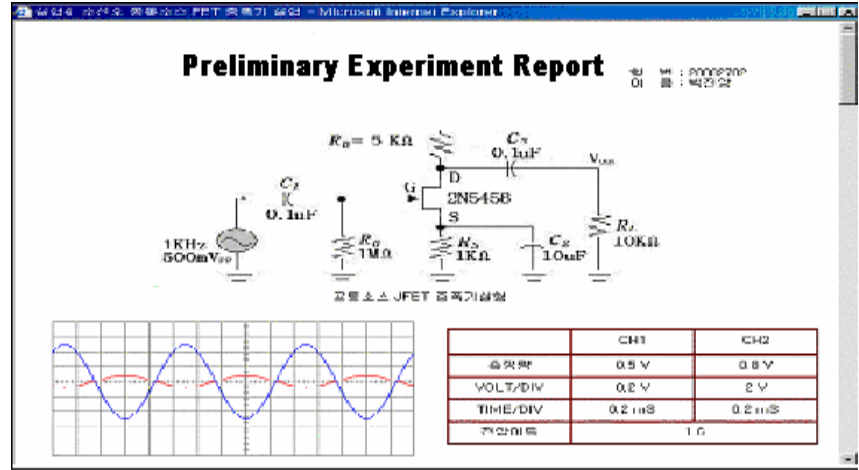
☐ The virtual experiments of this chapter have been completed and submitted as preliminary report for you.

☐ Upon request print it out before on-campus laboratory session.

PRINT

CANCEL

(a)



(b)

Fig. 11. (a) Submission of Preliminary Report Form. (b) Generation of a Preliminary Report Form.

In addition, in order to show the validity of our virtual laboratory system we investigated the damage rate of real experimental equipment during class and assessed student performance on the five quizzes for one semester. The students were divided

into two groups: Group 1(G1) not using the virtual laboratory system, Group 2(G2) using the virtual laboratory system. The students also were asked to evaluate the virtual laboratory environment in terms of process effectiveness, degree of interactivity, and enjoyment. More specifically, for our virtual laboratory environment the students in Group 2 had to rate on a 5-point Likert scale their level of agreement with the following statements.

- The virtual laboratory system was effective in supporting my learning method.
- The virtual laboratory system provided me with the appropriate level of interactivity with the real experiment.
- I enjoyed using the virtual laboratory system to learn.

As shown in Table 1 we have obtained several affirmative effects such as reducing the damage rate of real experimental equipment, and increasing learning efficiency. The results of our survey show strong evidence of the superiority of the virtual laboratory environment over the classical on-campus laboratory environment. In addition, we can conclude that the virtual laboratory environment enables the learners to interact not only with the learning material but also with the educators.

Table 1. Between-group comparisons on the virtual laboratory system

	Damage Rate of Real Equipment	Average Score of 5 Quizzes	Process Effectiveness	Degree of Interactivity	Enjoyment
G1	25.4%	64.5	N/A	N/A	N/A
G2	4.8%	81.4	4.31	4.01	4.13
Group1 : The students not using the virtual laboratory system Group2 : The students using the virtual laboratory system Scale: Strongly disagree 1 2 3 4 5 Strongly agree					

3 Conclusions

An efficient virtual laboratory system with creative and interactive multimedia contents is implemented, which can be used to enhance the quality of education in the area of electrical and electronic circuit experiments.

The difficult concepts, principles and theories related to the experiments can be conveyed to the learners effectively by creative multimedia contents and the virtual experimental equipments such as oscilloscopes, multimeters and function generators can be good examples of educational tools. The new and innovative structure has been used for eliminating the difficulties of classical engineering experimental system. With this new system structure, the learners can compare theoretical and experimental data; develop their capability in designing and analyzing the electronic circuits; and make use of auxiliary educational tool for understanding complicated concepts.

Also, we have obtained several affirmative effects such as reducing the waste time and labor of both the educators and students, and the damage rate of real equipments, and increasing learning efficiency as well as faculty productivity. The implemented virtual laboratory system can be used in stand-alone fashion, but using as assistants of the actual on-campus laboratory class is recommended. The proposed system is also expected to contribute to the activation of internet-based educational systems.

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An Ontological Approach to Infer Student's Emotions

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Abstract. This paper presents a method which is based on an Ontological Approach in combination with the Bayesian Network (BN) model in order to elicit student's emotion during the learning process. The produced Ontology serves as a basis for the formal representation of emotions and it is stored in the Learner Affective Model (LAM). The use of BNs contributes to the identification of student's affective state and deals with affective information (emotions, personality) which involves uncertainty. The proposed method is exploited by an Affective Module of a Web-Based Adaptive Educational System, which is called MENTOR, to support personalized distance learning.

Keywords: Affective computing in education, Ontology, BN, distance learning.

1 Introduction

The Web is the ideal environment for the promotion of the personalized learning according to the student needs. Various educational systems, especially the Adaptive Educational Systems have been developed to this direction. These systems allow the identification of students' learning needs, support the appropriate presentation of the instructive material and the selection of the suitable learning strategies.

However, these systems in their majority develop their educational dimension, based only on cognitive parameters such as learning styles, without taking into consideration the emotional factors that are related to the mood and the personality of the student. Many Web learning designers realize that this omission deprives the education from a very important pedagogical dimension. Thus, they conceive the necessity to turn their attention in affective subjects which influence the learning.

In this paper we present a method for the inference of student's emotions during the learning process and an Affective Module for personalized learning. In this frame we also examine some affective matters in order to present a proposal for the formal representation of student's emotions. This formal representation is implemented via an Ontology, which is called Affective Ontology, and correlates the individual learning preferences of a student with his personality and his emotional state.

The remainder of the paper is organized as follows: In section 2 we first introduce the basic concepts of our framework. Section 3 presents the MENTOR's Affective Module. Sections 4 and 5, respectively, provide the inference process of the student's emotions and some preliminary experimental results. We conclude in Section 6.

2 Background and Basic Concepts

2.1 Affective Computing, Emotions, Mood and Personality

The term Affective Computing involves the intention of Artificial Intelligence researchers to model and incorporate emotions in intelligent systems. It is a novel and important topic for the field of human computer interaction in order to improve quality of communication and transaction intelligence between human and computer. It is Picard [12], who coined the term affective computing. She defines affective as the “computing that relates to, arises from or deliberately influences emotions”. Based on this definition, an affective system must be capable of recognizing emotions, respond to them and react “emotionally”.

In the conceptual map of affective computing, emotions play a predominant role. Emotion is analogous to a state of mind that is only momentary. Although many efforts have been made, there is not an explicit definition for emotion. It is easy to feel, but it is hard to describe it. There are still basic questions in the emotion theory such as what are emotions, why do we have emotions, what exactly causes them, how could we control them effectively, but satisfactory answers are forthcoming. According to Ortony, Clore and Collins [10], emotions are valenced reactions to events, agents, or objects.

Another important concept in the terminology of affective computing is the term mood. Mood is a prolonged state of mind, resulting from a cumulative effect of emotions. Mood differs from the emotion because it has lower intensity and longer duration. It can be consequently considered that mood is an emotional situation more stable than emotions and more volatile than personality. Scherer [13] mentions that mood is an affective state of low intensity but long duration, which is incurred without evident reason and is formulated and varied in relation to person’s subjective sensitivity.

In affective computing the particular occurrence of emotions and the consequent expression of mood are assigned to some extent to the individual characteristics that distinguish one human being from another. These characteristics determine the personality of a person which is related to the person’s behavior and mental processes and has a permanent character [13]. It would be considered that personality refers to the determinant and predictable attributes and behaviors by which people are identified and categorized. Emotions and moods are connected with the term of personality by the name of traits or factors. For instance, optimist, imaginative, nervous, envious, rational, are some personality traits which personify a person.

2.2 The OCC and the Five-Factor Models

Despite the significant theories that have been proposed for affective computing, the two major theories, where the majority of affective systems are relied on, are the cognitive theory of emotions (OCC) which is related to the origination and the appraisal of emotions and the Five Factor Model which is connected to the explanation and the prediction of a person’s behaviour according to his personality.

In order to explain the origins of emotions and to describe the cognitive processes that elicit them, Ortony, Clore and Collins [10] formulated the cognitive theory of emotions known also as the OCC model. Regardless of the various attempts that have

been made in order to define and explain sufficiently the emotional processes, this theory keeps a distinctive position among them. According to this theory, in connection to a person's perception of the world, his emotions can be elicited. This process is named appraisal and the OCC model assumes that the emotions can be triggered by the assessment of three perception aspects of the world. These aspects are events, objects and agents. The OCC model provides a classification scheme for 22 in total emotions based on a valence reaction in relation to them. That is, all emotions engage a kind of positive or negative reaction to the way the world is conceived. The intensity of the affective reactions determines whether or not they will be experienced as emotions. According to this point of view, the OCC model has been integrated in many affective computational systems with the aim of recognizing the user's affective state and implementing emotions in machines.

The second significant theory that is used for the integration of affective systems is the Five Factor Model (FFM). This is the most known model of personality and results from the study of Costa and McCrae [3]. It is a descriptive model with five dimensions (Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism) and views the personality as the set of all those characteristics that distinguish one human being from another. Due to these dimensions the model is also called OCEAN model. The FFM provides us with a reliable way in order to connect a student's personality with his mood and emotions that he possibly experiences during the learning process. This is very useful because we are able to initiate student's emotional state and select the suitable pedagogical strategy.

2.3 Ontologies, OWL and BNs

Ontology is a formal way to represent the specific knowledge of a domain, providing an explicit and extendable framework to describe it. It is a technique for describing formally and explicitly the vocabulary of a domain in terms of concepts, classes, instances, relations, axioms, constraints and inference rules. Ontologies represent knowledge in taxonomies, where more specific concepts inherit the properties of those concepts which they specialize [14]. We exploit the advantages of ontological representation in our model to set the vocabulary, properties, and relationships for learning and pedagogical concepts under an affective perspective.

Taking advantage of the above, we use an Ontology of emotions and affective tactics in order to achieve a formal representation of the LAM and the system's learning strategies. The structure of the proposed Ontology is in compliance with the OCC emotions classification [10] as well as the OCEAN model of personality [3] and has been adjusted suitably in order to attain the requiring domain knowledge and pedagogical representation for our educational system. This Ontology, which is an application – domain Ontology and is called Affective Ontology, contains the necessary affective information to model and support specifically the MENTOR's educational operations.

In our framework we use an ontological approach based on the Web Ontology Language (OWL) [11], as the knowledge representation mechanism of MENTOR's affective information, in combination with a BN model in order to provide the student with the suitable affective guidance. OWL is a semantic markup language for publishing and sharing Ontologies on the World Wide Web. In our model OWL is extended appropriately to model uncertain information and to incorporate probabilities in the

Ontology representation. In this way probability values can be assigned to the concepts of our Ontology. Moreover, suitable rules are defined to transform the enhanced OWL Ontology into a BN. Thus, the proposed method provides us with a powerful structure for the formal representation of the uncertain affective information as well as an effective method to convert respectively an ontological structure into a BN.

Bayesian Networks are graphs the nodes of which depict random values and the arcs the correlations between independent assumptions [5]. More specifically a BN is a Directed Acyclic Graph, or DAG, that is a structure that has no directed cycles. A set of random variables makes up the nodes of the network. Directed arcs connect pairs of nodes. The meaning of an arc from node X to node Y is that X has a direct influence on Y . The uncertainty of the relationship of each node is represented by the Conditional Probability Table (CPT). The CPT presents the probability that a child node is assigned to a certain value for each combination of possible values of its parent nodes. The parents of a node are all those nodes that have arcs pointing to it. In this manner the CPT quantifies the effects that the parents have on the node. We denote as $P(X_i | \text{Parents}(X_i))$ the probability that is associated with each node X_i , where $\text{Parents}(X_i)$ is the parent set of X_i . Then we can calculate the joint probability distribution of X_i under the conditional independence assumption making use of the following formula:

$$P(X) = \prod_i P(X_i | \text{Parents}(X_i)), i=1, 2, \dots, n$$

Because of the nature of BNs we can define the concepts of our Ontology as the variable nodes of the BN and the arcs between them as the probabilities which influence their relation. Under this perspective we can reliably estimate how the initial probabilities affect uncertain cases such as the process of establishing the student's affective state.

3 The MENTOR's Affective Module

MENTOR [7] is a Web-based Adaptive Educational System (WBAES) which incorporates an Affective Module. The main aim of the Affective Module is to recognize the student's emotions during his interaction with an educational environment and thereafter to provide him with an appropriate learning strategy. The operation of MENTOR, is based on the FFM [3] and the OCC model [10]. The MENTOR's Affective Module architecture is presented in figure 1.

The Affective Module has three main components: The Emotional Component (EC), the Teacher Component (TC) and the Visualization Component (VC), which are respectively responsible for: a) the recognition of student's personality (PR), mood (MR) and emotions (ER) during the learning process, b) the selection of the suitable teaching and pedagogical strategy and c) the appropriate visualization of the educational environment. The combined function of these components "feeds" the educational system with the affective dimension optimizing the effectiveness of the learning process and enhancing the personalized teaching. The main purpose of MENTOR is to create the appropriate learning environment for the learner, taking into account particular affective factors in combination with cognitive abilities of the learner offering in this way personalized learning. Further analysis of the operation of the Teacher and the Visualization Component is beyond of the scope of this paper which is focused on the Emotional Component.

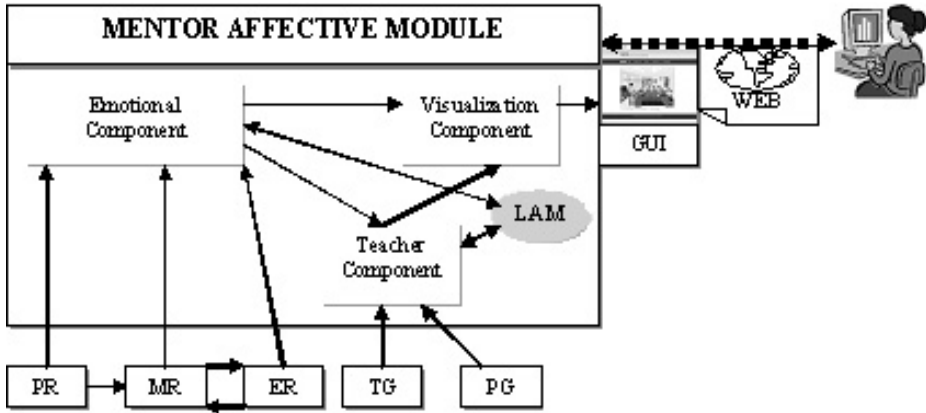


Fig. 1. The architecture of the MENTOR's Affective Module

The Emotional Component is in every moment aware of the student's emotions during the learning process. Several ways have been proposed about the recognition of emotions. Some are based on the detection of physical and biological signs [12] and others are based on AI techniques like Transition Networks [6], or Dynamic Decision Networks (DNNs) [2]. In the following sub-section we describe in more detail the Emotional Component of MENTOR's Affective Module.

3.1 The Emotional Component

Concerning the Affective Module, responsible for the recognition of the student's emotions is the Emotional Component. This component (figure 1) is composed by three subcomponents, the Personality Recognizer (PR), the Mood Recognizer (MR) and the Emotion Recognizer (ER), which are responsible for the recognition of the personality, mood and emotions of the student. As it has been already mentioned, there are five personality types. When the student uses the system for the first time, the PR subcomponent selects a suitable dialogue specified by the FFM to assess the type of a student's personality. The dialogue is articulated in accordance to Goldberg's questionnaire [4]. As a result, the student's traits are being recognized and are being used by the Teacher Component for the suitable selection of pedagogical and teaching strategy. For example, a student that has been recognized as Openness, according to FFM is imaginative, creative, explorative and aesthetic [3]. These characteristics are evaluated by the TC providing the system with an exploratory learning strategy, giving more autonomy of learning to the student and limiting the guidance of the teacher. The MR subcomponent provides the system with a dialogue that can elicit emotions depending upon the semantics and its context. This dialogue is used in every new session and defines the current student's mood. Based on this dialogue the student's mood is recognized either as positive or as negative. In our approach, good mood consists of emotions like joy, satisfaction, pride, hope, gratification and bad mood consists of emotions like distress, disappointment, shame, fear, reproach. As a result, we have an initial evaluation of the current emotions of the student. Thus, if the student is unhappy for some reason, the MR recognizes it and in collaboration with TC,

it defines the suitable pedagogical actions that decrease this negative mood and try to change it into a positive one. Finally, the ER subcomponent is in every moment aware of the student's emotions during the learning process, following the forthcoming method. So as to deal effectively with the emotions elicitation process, the Emotional Component has a Learner's Affective Model (LAM) where the affective information is stored. In the following two sections, we describe the method which is used by the Affective Module in order to (i) represent the emotions of the student in a formal way, and (ii) elicit his emotions during the learning process.

4 An Ontology-Based BN for the Elicitation of Student's Emotions

The model which is proposed in this paper is based on the combination of two different technological approaches (figure 2). The first adopts an ontological approach, so that the representation of the affective information can be achieved. The second uses the BN model in order to infer about the prevalent emotions of the student during the learning process. In this way an Ontology-based BN is formed which stores the affective information of MENTOR, the Acyclic Graph, the data set of implicit evidence and the transitions between the affective situations.

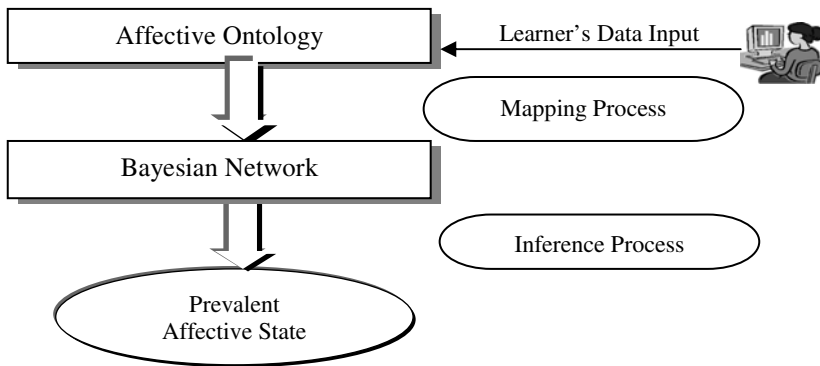


Fig. 2. The proposed model

4.1 An Affective Ontology for the Representation of Student's Emotions

Taking advantage of the above method, we use the Ontology-based BN in order to achieve a formal and proper representation of the LAM and to reason and infer efficiently with the affective factors which occur during the learning process. This Ontology is called Affective Ontology because it stores and deals with affective information such as the student's emotional state, the LAM and the affective tactics. Consequently, to represent the affective information in the Ontology the creation of the relative classes is necessary. Thus, the Emotional_State Class, the Affective_Model Class and the Affective_Tactic Class for instance, are constructed.

The first class represents the current affective state of the student which can be positive, or negative. The second represents his attributes and his preferences. The

third represents the twenty affective tactics that have been already implemented in MENTOR. We use the term affective tactic so as to denote that the learning method which is suggested by the Teacher Component is a two-dimensional combination of cognitive and emotional guidance and support [8]. The Emotional_State Class is divided into two sub-classes the Positive-Emotional-State sub-class and the Negative-Emotional-State subclass. Every of ten selected emotions is represented as a second layer sub-class, into these sub-classes.

According to the above analysis the main purpose of the proposed Ontology is the formal representation of the student's emotions which our system particularly deals with. The Ontology has been built to be aware of ten emotions which are: joy, satisfaction, pride, hope, gratification, distress, disappointment, shame, fear, reproach. The former five emotions comprise the classification of positive emotions and are related to the positive student's affective state. The latter five emotions comprise the classification of negative emotions and are related to the negative student's affective state. We use the DL-OWL (Description Logic – Ontology Web Language) as a reasoning and inference mechanism to obtain the essential production rules, as well as analyze the domain knowledge and interaction data. For example, the Emotional_State Class is encoded as shown in figure 3(a).

<pre> <owl:Class rdf:ID="Emotional_State"> <rdf:subClassOf> <owl:Class> <rdf:resource="Learner_Affective_Model"/> </rdf:subClassOf> </owl:Class> </pre>	<pre> <owl:DatatypeProperty rdf:ID="Valence"> <rdf:range><owl:Datatype> <owl:oneOf rdf:parseType="Resource"> <rdf:first rdf:datatype="xsd:string">positive</rdf:first> <rdf:rest rdf:parseType="Resource"> <rdf:rest rdf:parseType="Resource"> <rdf:first rdf:datatype="xsd:string">negative</rdf:first> </rdf:rest> </owl:oneOf> </owl:Datatype> </rdf:range> <rdf:domain rdf:resource="Emotional_State"/> </owl:DatatypeProperty> </pre>	<pre> <owl:Class rdf:about="Emotional_State"> <owl:Restriction> <owl:cardinality rdf:datatype="xsd:integer">1 <owl:property> <owl:DatatypeProperty rdf:ID="Valence"> <owl:restriction> <owl:Class> </pre>

Fig. 3. The OWL encoding for (a) Emotional_State Class (b) Valence's data property and (c) Emotional_State Class restriction property

Properties for these classes are also defined. For instance, the code in figure 3(b) specifies a data type property Valence for the previous class. Because in our Ontology we use discrete random variables the values of this property is restricted to the set [positive, negative]. We can also specify the cardinality of one class posing constraint statements. For example, the use of the restriction property which is shown in figure 3(c) denotes that the class Emotional_State has only one Valence.

In this way, the formal and flexible representation of an emotion can be achieved in relation to the learning goal of a student. The proposed Ontology of emotions has been implemented with the Protégé tool [1].

4.2 BN's Construction and Mapping Process with the Affective Ontology

The above Affective Ontology must be transformed into a BN. According to the OWL semantics two concepts are represented by the classes A, B and we consider them as random variables. With the aim of corresponding the prior or conditional

probabilities to the classes and relations of the Ontology we define the $P(A = a)$ as the prior probability that an arbitrary individual belongs to class A and $P(a | b)$ as the conditional probability that an individual of class B also belongs to class A.

Establishing a set of rules we are able to specify dependency information in this OWL-Ontology. According to the proposed schema all classes of the Ontology are converted into nodes in BN using a set of rules. For instance, if two classes of the Ontology are related by the Dependent property then we draw an arc which connects two nodes of the BN to the direction from the super-class to the sub-class. Every class of the Ontology is mapped as a two-valued (true or false) variable node. If a class C is related to other classes $C_1, \dots, C_n$ with the identifier <owl:intersectionOf> then an additional node S is used to denote the intersection property, so that C is mapped into a subnet in the derived BN with directed arcs from each C_i to C, each C_i to S and one arc from C to S, as shown in the example of figure 4.

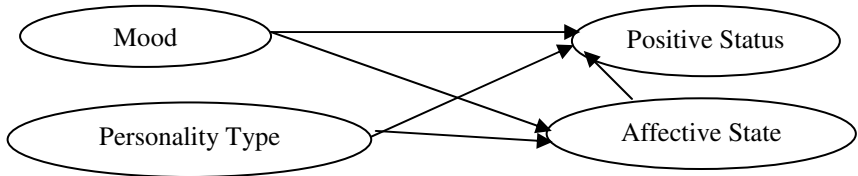


Fig. 4. The intersection relation

After the encoding of the uncertain information in the Ontology and the completion of the network's construction, the final step is the construction of the CPT for the BN. We set the values of the CPT according to the logical relation that is held between the parent nodes. For example, when the value of an S node is set True, then is held the intersection relation of the nodes C1 and C2 that is connected to it. More detailed information for readers who interested in this process can be found in the work of Leontidis and Halatsis [9].

4.3 The Inference of Student's Emotions

Inferring student's emotions in an on-line educational environment is a multi-parameter and highly demanding task. The inference of student's emotions presupposes the awareness of many factors like his personality, mood, current affective state and learning goals. All these factors must be considered during the learning process and progress of the student, taking into account the constraints of the particular educational context. In MENTOR these factors is stored in the LAM and they are handled by the components of the Affective Module.

Based on the proposed affective model and taking advantage of the significant probabilistic features of the BNs which enable us to reason and make inferences in an efficient way, we can provide the learner with the appropriate pedagogical guidance. The probabilistic inference considers a set S of propositional variables S_i , $i=1, \dots, n$ and the evidence that the variables in a subset U of the S have definite values, $U_i = u$ (true or false). Then the conditional probability, that a variable S_i has value s given the evidence, is calculated by the type: $P(S_i | U_i) \times P(U_i) = P(U_i | S_i) \times P(S_i)$.

In our model we use an Ontology-based BN approach to represent the affective information of MENTOR [9], in order to deal effectively with the uncertain factors which occur during the learning process such as student's mood and emotions. All this information is stored in the LAM in order to provide the student with a suitable affective tactic and to engage him effectively into the learning process. The main reason for using in our method the BN model is that allows us to deal with uncertainty and to infer reliably the uncertain values of the nodes in relation to the affective information of the learner's model, as shown in figure 5. This model supplies us with evidences for identifying the affective state and the prevalent emotions of the student, given the values of the Learner's, Affective Model and Educational Goals nodes as well as the Educational Events node. As a result, calculating the posterior probability which a certain affective state has a given value we can infer that the prevalent emotions of the student are these which have the greatest probability value.

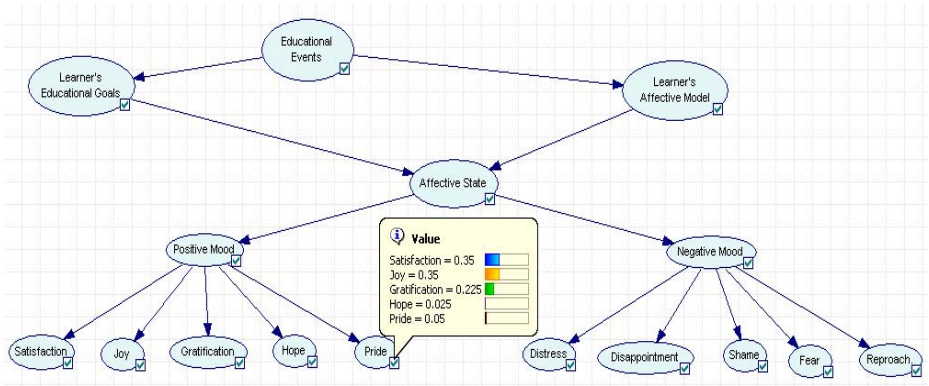


Fig. 5. A part of the Ontology-based BN for the inference of student's emotions

The initialization of the student's emotions is realized at the starting session of the interaction. An initial dialogue is established between the system and the student, where after a sequence of appropriate selected questions the former determines the current affective state of the latter. After that, the student is provided with a NEO-PI-R questionnaire [4], which its completion aims to the identification of the student's personality type. The second step is performed once, at the first time that the student uses the system.

According to this perspective we consider as $P_{in}(E_i)$, $i=1,2,\dots,10$ the probability of each emotional situation at a given period of time t_k which is related with the intrinsic characteristics of the student's personality as it is identified by the entry test. We consider as $P_{tr}(E_i)$, $i=1,2,\dots,10$ the probability of each emotional situation at a given period of time t_k which is related with the transition from one affective state s_a to another affective state s_b and as $P_{tr}(s_a|s_b, E_i)$, $a \neq b$ the probability of this transition.

$$\sum_i P_{in}(E_i) = 1, i=1,2,\dots,10 \quad (1)$$

$$\sum_i P_{tr}(s_a|s_b, E_i) = 1, i=1,2,\dots,10 \quad (2)$$

These probabilities are obtained by psychological experimental questionnaires [6] and experts' teaching experience in relation with the events which are occurred in the educational system. For this reason, our module is restricted to elicit ten emotions and assumes that every affective state is independent from each other. Comparing these probabilities by making of use the difference between them, we can select the affective states with the smaller result. The equation which is used to calculate the related difference between these probabilities is:

$$P_{\text{dif}} = \sum_i |P_{\text{in}}(E_i) - P_{\text{tr}}(s_a|s_b, E_i)|, i=1,2,\dots,10 \quad (3)$$

If the P_{dif} is less than a threshold L which is determined by the individual personality traits of every student, we can infer with great confidence about the exact affective state of the student. Usually this threshold cannot be greater than 0.1, that is: $P_{\text{dif}} \leq 0.1$. In this way we have an initial estimation about the emotion of the student in a particular period of time in relation with a specific educational event.

Let us consider the following example. An Openness student is tested in the entry session and it is found to be in a positive affective state. According to his personality the P_i for every emotion is likely to be 0.5 for joy, 0.2 for satisfaction and 0.3 for pride. This affective state is pertained until the next time period when an educational event is occurred. This event is the assignment of a test which is comprised from ten questions. There are three possibilities for the student, to answer, not to answer or to avoid answering. In the first case he hopes that he will answer correctly. In the second case he fears that he doesn't know the answer but he hopes that he might answer later. In the third case he experiences distress. After the completion of the test he is provided with the result mark. If the mark is passing according to the first and second case the student experiences satisfaction, joy, pride and gratification. Otherwise he experience negative emotions. Thus, the current student's affective state is dependent on the educational event that occurs in the specific period of time and it is comprised of the contemporary student's emotions.

5 Preliminary Experimental Results

In order to evaluate our proposal and to validate the exactitude of MENTOR's Affective Module prediction, an experiment was conducted with forty-three participants. The participants were all students in the field of computer science and their age was between eighteen and twenty-five years old. The students were given with the NEO-PI-R personality test in order for their personality to be identified. According to this test they were five students who belonged to the Openness category, nine to the Conscientiousness category, sixteen to the Extraversion category, ten to the Agreeableness category and three to the Neuroticism category. Every student had the opportunity to interact with a pre-selected course of MENTOR (basic concepts of AI) for thirty minutes. Then taking the learners' responses into consideration and examining the log files of the system we were provided with the results which are shown in figure 6. In this figure the categories of the students' personalities and their corresponding prediction values are demonstrated in a graphical way.

From the figure's diagram we can infer that the percentage of MENTOR's correct predictions is about 78%. We can also easily draw the conclusion that for the categories of Openness and Neuroticism MENTOR had better and worse accuracy respectively in the prediction of their emotional states. Although these preliminary results are hopeful, there is still need for further research in order to improve our model and to establish a higher level of its prediction accuracy.

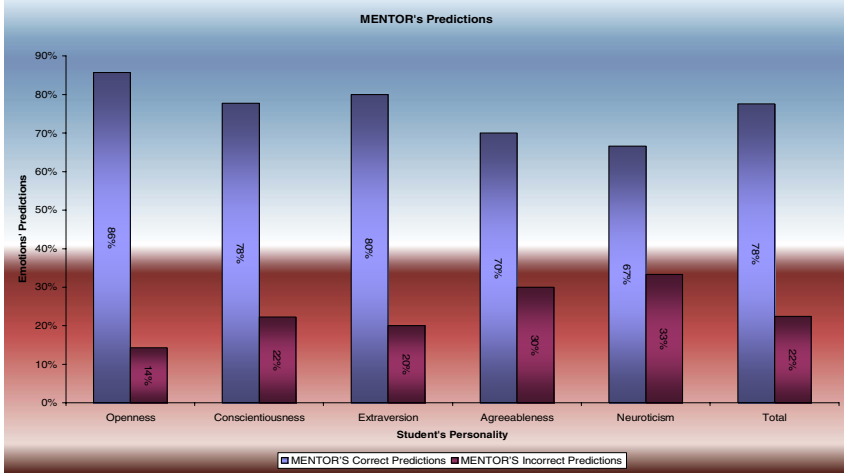


Fig. 6. MENTOR's prediction accuracy of students' emotions according to their personality

6 Conclusions and Further Research

In this paper we presented an Affective Module which is responsible for inferring student's emotions and providing them with the appropriate affective tactic for the support of learning process. The Affective Module is integrated in MENTOR which is a WBAES in order to provide personalized distance learning. The elicitation of emotions is based on a formal representation of emotions using an appropriate designed Ontology, the Affective Ontology and it is achieved by a BN-based method. An experiment has been also conducted with the aim of evaluating MENTOR's performance and has been presented in detail in the previous section. The preliminary experimental results are encouraging for the further development of the proposed model. MENTOR's implementation has been done using the PHP5 language supported by the Apache HTTP server 2.2.

Furthermore, we are developing this component bearing in mind to be independent from the specific domain model of educational systems, so that has the capability to be used by a wide range of them. In advance research we are intending to improve the accuracy of our system in order to be capable of recognizing more emotions and more complicated emotional situations. When the integration of the MENTOR will have been completed, we plan to keep running the experimental study conducting a web evaluation in order to testify its reliability more precisely.

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Design an e-Broadcasting System for Students' Online Learning

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Abstract. This study proposes an e-Broadcasting System (EBS) for students' online learning. With the increase in network bandwidth and the progress of upgrading computer performance, the transmission and communication of multimedia information on the Internet is becoming increasingly popular. The e-Broadcasting System, based on live broadcast and video-on-demand services, can provide students with high-quality films as their needs at any time by integrating various video and audio devices to output video and audio frames. Students can clearly view the live teaching situation and learning materials of the remote class. In advance, this system combines Windows Media Services with learning management system such as Moodle. It is helpful for students to learn the recorded learning materials of the contents.

Keywords: Hybrid learning, Cognitive load theory, Multimedia learning, Learning materials.

1 Introduction

Recently, many teachers use Information and Communication Technology (ICT) to create teaching materials with multimedia formats. It is helpful to effectively scaffold learners. However, it is not easy for teachers to use technological skills to create multimedia teaching materials. Especially, many instructors suffer from a major difficulty while producing online course. The difficulties are that they need more time to learn new technological skills such as programming, designing of asynchronous course activities, etc [1]. Currently, a solution to overcome the difficulties is that teachers can use screen-capturing software recording and delivering lectures with multimedia version.

IPTV means Internet Protocol Television. IPTV refers to Internet Protocol (IP), which is a transport protocol, a delivery mechanism, and not necessarily the Internet [2]. There are various definitions about IPTV [3][4]. The common definition is that IPTV is a system which delivers the digital video stream using Internet Protocol. Recently, global IPTV subscribers reached 15 million in 2007. Quickly exceed 5.3 million in 2006. Moreover, iSuppli predicts that global IPTV subscribers will reach 63.1 million by the year 2010. It can be seen that the development of IPTV is very rapid.

Instructors usually suffer from the insufficient technological skills or the time to develop e-learning instructional materials and learning objects. It is important to

provide instructors an effective tool to produce and manage materials. This study proposes an e-Broadcasting System to integrate various audio and video devices into a signal and to add text messages as scrolling text marquees. This system can broadcast immediately the facial expression of participants and the contents of slides and scripts. The e-Broadcasting System also has been integrated with Moodle to apply for the distance learning. Therefore, students can use the website of Moodle to learn the live video and content of teacher’s lecture. It is easy for teachers to provide learning materials with the e-Broadcasting System.

2 Literature Review

2.1 Distance Learning

Distance Learning means both teachers and learners are in a different time or different room for teaching and learning. The contents or materials of teaching are delivered to learners by all kinds of media [5]. Teachers can interact with students through electronic media [6][7]. Table 1 shows the differences between traditional learning and distance learning [8].

Table 1. The differences between traditional learning and distance learning

	Traditional classroom learning	Distance learning
Advantages	● Immediate feedback. ● Being familiar to both instructors and students. ● Motivating students. ● Cultivation of a social community.	● Learner-centered and self-paced. ● Time and location flexibility. ● Cost-effective for learners. ● Potentially available to global audience. ● Unlimited access to knowledge. ● Archival capability for knowledge reuse and sharing.
Disadvantages	● Instructor-centered. ● Time and location constraints. ● More expensive to deliver.	● Lack of immediate feedback in asynchronous distance learning. ● Increased preparation time for the instructor. ● Not comfortable to some people. ● Potentially more frustration, anxiety, and confusion.

2.2 ICT Usage in Teaching and Learning

The integration of ICT can bring many benefits to teachers and students [9]. ICT has brought challenges and opportunities to education because some instructional technologies augment and enhance the classroom effectiveness, not merely because these technologies are available and feasible [10]. Teachers can work with ICT to

enhance the classroom experience in ways it couldn't be done before for students [11]. Teachers have many more ways to present information for students to learn better. For example, teachers are using more audio and video files in the classroom. Teachers have the ability to better interact and manage students by Internet. Although teachers are willing to explore new opportunities for changing their classroom practices by using ICT [12], research studies also show that most teachers do not make use of the potential of ICT to contribute to the quality of learning environments, although they value this potential quite significantly [13][14].

Technology allows students to cover material, review, and test with immediate feedback [10]. It also helps students learn outside the classroom. For example, students can reach a faculty member by e-mail outside of class. Course materials are available to students and self-tests are also available on the Web. Students can spend an appropriate amount of time working on class materials by playing and re-playing the video recording of class lecture that students were missed or cover particularly complex materials. It has the advantage of being available at any time from any location with an Internet connection. ICT enables that community for discussion groups on topics of interest to happen. Students can become parts of groups in meaningful ways that they couldn't before. Consequently, ICT not only makes the business of education easier, but also enriches the learning environment for both in-classroom learners and those taking courses virtually.

2.3 Streaming Media Contents

The content of streaming media is divided into two types, live and on-demand [15]. Fig. 1 describes the live and on-demand streaming.

Live Streaming. In the type of live streaming, server does not store any file. Streaming is generated by an encoder and the encoder sends the signal which belongs to audio or video to the server in real time. When the server receives the signal from an encoder, it forwards the signal to client after client's requesting [16][17].

Video-on-Demand Streaming. The term Video-on-Demand (VoD) is widely used for systems that allow one to watch a certain video content at any point in time via communication systems such as cable TV, satellite or the Internet [16][17]. Furthermore, the user can control the streaming, like jumping to any position and operating similar to those offered by a VCR. The user can operate functions such as fast-forward, fast-rewind or pause.

2.4 System Based on Windows Media Technologies

A multicast streaming is a one-to-many connection between the media server and the client. With a multicast stream, the server streams to a multicast IP address on the network, and clients receive the stream by subscribing to the IP address. No matter how many users receive the stream, there is only one stream from the server. Therefore, all users receive the same stream. It can preserve the bandwidth if using a multicast stream [18]. Fig. 2 shows the delivering content as a multicast stream [1].

First, retrieve the live image from the digital video. Second, encode the live image and forward it to the Windows Media server through HTTP. And then on the Windows Media Server named Server1 uses the Add Publishing Point Wizard to

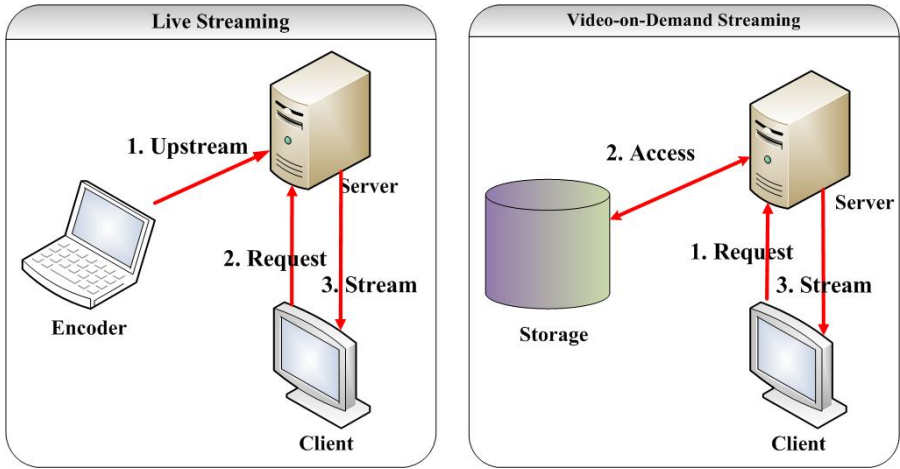


Fig. 1. The live and video-on-demand streaming

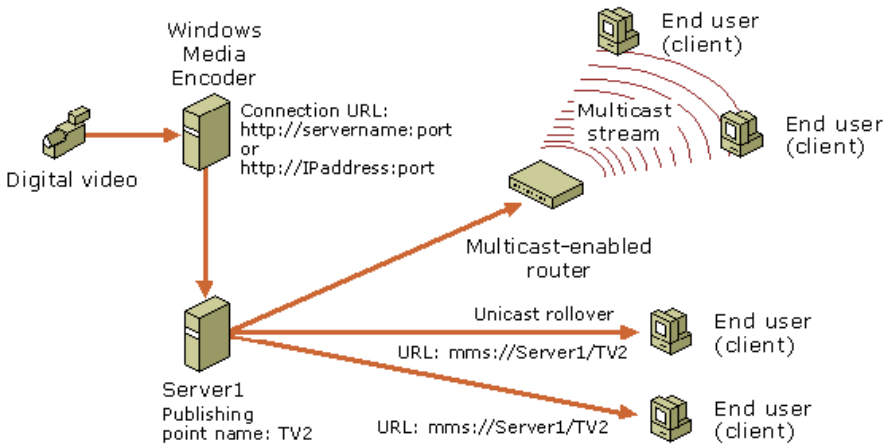


Fig. 2. Delivering content as a multicast stream

create a publishing point that source from the encoder. Subsequently, we can choose to deliver as a cast stream or a multicast stream.

3 The Construction of Learning Environment

3.1 The System Structure

EBS is applied to some occasions actually. In the following sections, we introduce three conferences. Moreover, EBS can integrate with Moodle to apply to the distance learning [19][20].

Fig. 3 describes the meeting-place of CCU Law International Conference. We marked some numbers on Fig. 3. Number 1 is the e-Broadcasting station. It is put by the desk to connect the notebook of speaker for retrieving screen's image. Number 2

means the Encoder station which is put on the desk and is not far from the e-Broadcasting station. The Live station is marked Number 3. It is placed on the table out of the chamber. And connect to the e-Broadcasting station at the meeting-place by a CAT5 wire. Number 4 stands for the DV1. It is responsible for shooting the audiences. We can achieve the “Interaction Mode” due to the DV1. Number 5 is the representative of DV2. The responsibility of DV2 is to capture the face of speakers. Because of it, we present the “Presentation Mode” under general condition.

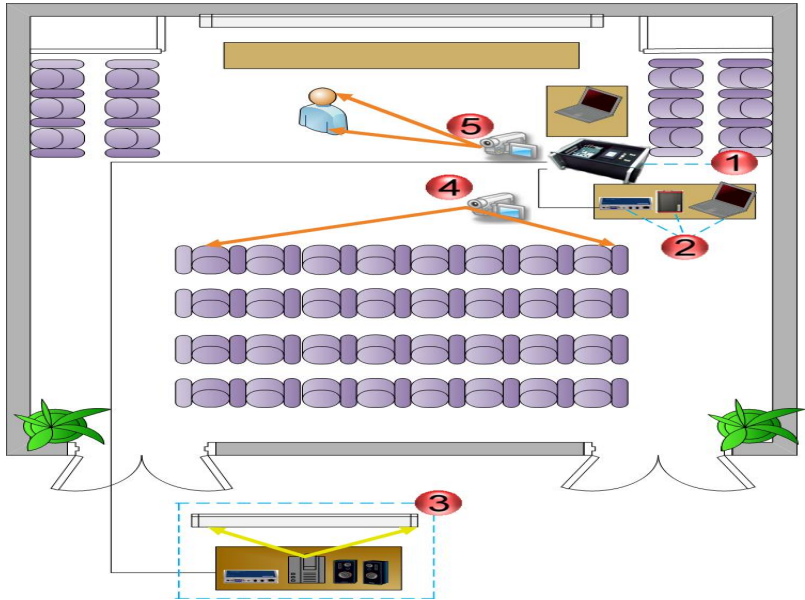


Fig. 3. Plan of the “CCU Law International Conference” Chamber

In order to reach the effective system management, we describe in Tables 2-3 to check if the equipment of EBS is prepared.

Table 2. The equipment of e-broadcasting station for Law Conference-device

Name	Number	Check	Remarks
1. e-Broadcasting Station	1	√	
2 Video Splitter(1 to 2)	1	√	
Video Splitter-Power Wire	1	√	
1. Digital Video	2	√	
Digital Video-Power Wire	2	√	
Digital Video-AV Wire	2	√	
2. Tripod	2	√	
3. *Microphone	1	√	offered by individual
*Microphone-Power Wire	1	√	offered by individual
“*”*” means we do not need the equipment if it is prepared in the chamber			

Table 3. The equipment of e-broadcasting station for Law Conference-Wire

Name	Number	Check	Remarks
1. CAT5 Wire	2	√	(10m, 50m)
2. VGA Wire	3	√	
3. Sound Source Wire	1	√	(20m)

3.2 Interaction Mode and Presentation Mode

We develop two teaching modes in this component, Interaction mode and Presentation mode. Fig. 4 displays interaction mode and presentation mode.

Interaction Mode. Operator sets up two input frames as two images of digital videos using the e-Broadcasting Control Panel. Moreover, one DV takes teacher’s image and the other takes student’s image in this situation. Thus, it can reach the interaction between a teacher and a student.

Presentation Mode. Operator sets up two input frames as the image of VGA input and the image of digital video using e-Broadcasting Control Panel. Furthermore, the DV takes teacher’s image and the VGA input shows images of PowerPoint. As a result, it can reach the presentation effect.



Fig. 4. Interaction mode and presentation mode

4 A Scenario of Application

4.1 Participants

Seventeen participants have answered the questionnaire. Most of them teach in universities of Taiwan and are the deans in these schools. We show pictures shots in the conference (Figs. 5-7) to present the practical situation of application.

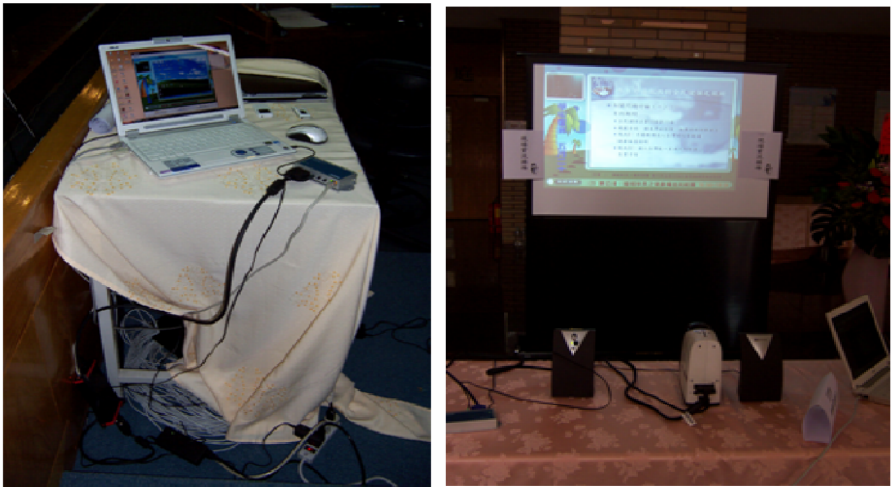


Fig. 5. Encoder station and live station

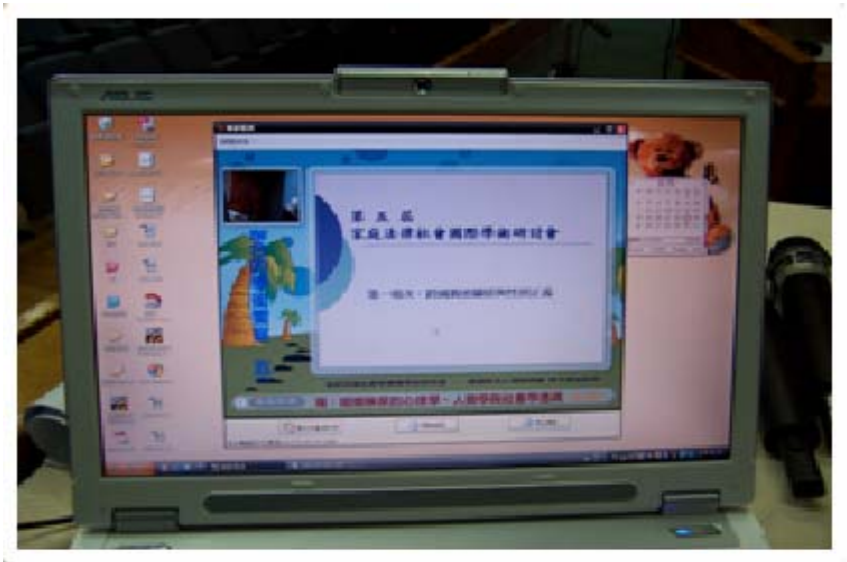


Fig. 6. The program of encoder station

4.2 Experiment and Result

A questionnaire survey is conducted to investigate the effects of applying the EBS. It is divided into two categories, satisfaction and usability. There were 10 items about the satisfaction of the EBS: The EBS content presented information(title, content, time point) is clearly ; I like the EBS interface at the conference presentation; I like the EBS interface on the web page; The EBS presents the information and function that I need at the conference; I am satisfied with the EBS's *the content of speaker*



Fig. 7. Watching through network

speech function; I am satisfied with the EBS's *broadcast video-information at the conference* function; I am satisfied with the EBS's *Marquee* function; I am satisfied with the EBS's *the live show on the network* function; I am satisfied with the EBS's *video-on-demand* function; and Generally speaking, I am satisfied with the EBS interface.

The 8 items about the usability of the system were listed as follows: I feel the EBS is easy to use; I found that the EBS is helpful to me for learning; I found the design of EBS so the content of speakers presented a clear speech, and understandable; Become skilled users of the EBS, for me is easy; I would like to link to the EBS website to watch the live broadcast of the network is easy; I would like to link to the EBS website to watch the video files is convenience; I accept the EBS applications at the

Table 4. The result of the questionnaire about NUF Dean Conference

Items	Satisfaction (Mean)	Usability (Mean)
1	4.12	3.56
2	4.06	3.88
3	4.18	4.13
4	4.06	3.63
5	4.24	4.85
6	4.06	3.88
7	4.25	4.12
8	4.19	3.94
9	3.76	
10	3.94	

conference; and I would like to attend the conference will be able to use the EBS. The scale of the questionnaire is 5-point Likert scale, which requires the participants to rate the EBS. Table 4 shows the mean score of the questionnaire's result. The mean score is the average score answered by seventeen participants.

Fig. 8 is the bar chart of the mean score of satisfaction. Fig. 9 is the bar chart of the mean score of usability. In these bar charts, the maximal value of y-axis is 5 and the minimal value of y-axis is 2.5. The interval of y-axis is 0.5.

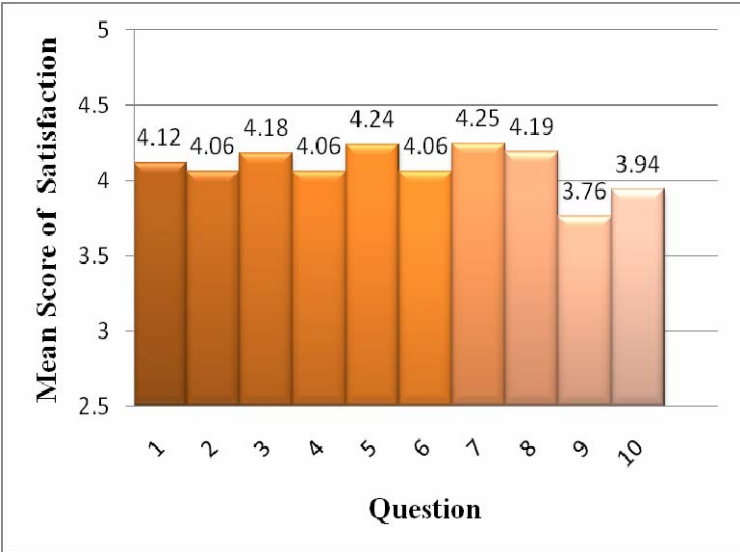


Fig. 8. The mean score of satisfaction for NFU Dean Conference

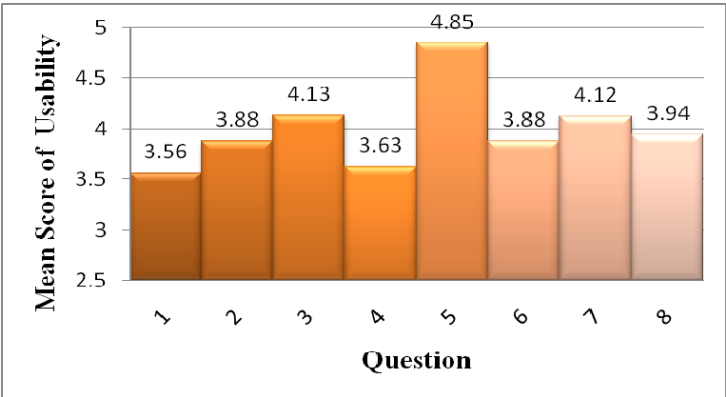


Fig. 9. The mean score of usability for NFU Dean Conference

In Figs. 8-9, y-axis means the degree of satisfaction or usability respectively. A score falls into 2.5 to 3.5 means “common”, 3.5 to 4.5 means “agreeable”, and greater than 4.5 means “very agreeable”. We realize in Fig. 8 that scores of every question

distribute between 3.5 and 4.5. And from Fig. 9, we can understand that scores of question 1, 2, 3, 4, 6, 7, and 8 distribute between 3.5 and 4.5. The score of question 5 is much better and it reaches 4.85. It means that participants think the EBS satisfactory and useful.

5 Conclusion

We have described the e-Broadcasting system. The contribution of this system has some aspects. First, we integrate various audio and video devices into a signal and add text as your wishes to become scrolling text marquees. In presentation part, viewers can see an appearance that has two images of DVs or one image of DV as well as one image of slide and some scrolling text marquees on it. Second, we provide a convenient interface to control what images are shown in the output signal.

The advances in computers and communication technologies such as digital video streaming and high speed networks during the last decade have made Internet Protocol Television (IPTV) service feasible [21]. The e-Broadcasting System also provides IPTV service. It allows the remote viewers to watch conferences both live and on-demand. If viewers cannot participate in lectures in person, they are able to view through worldwide Internet or long-distance live station immediately. Moreover, when viewers want to review any lecture, they use the function of video-on-demand which the e-Broadcasting system provides to satisfy their needs. The e-Broadcasting system also integrates with Moodle to apply to the distance learning. Students log in the website of Moodle and enter course to watch the live of teacher's lecture.

There are still many interesting issues that remain to be explored. For instance, we retrieve the output signal from e-Broadcasting station to Encoder station via a DVI2USB capture card directly now. And we cannot change the properties of the capture card, such as contrast and brightness. In the future, we should let operators adjust these properties as their wishes. In the Encoder station part, we have to provide a physical IP. The type of IP currently is usually a virtual IP so it is convenient for operator to provide a virtual IP. We can research on broadcasting live via a virtual IP in future. Furthermore, we are able to consider of inserting the technology of Digital Rights Management (DRM) in these films at the aspect of copyright considerations in order to protect these films that we recorded. Finally, it should be improved that adds the function of search for film in the aspect of presentational webpage. This is convenient for viewers to find the films they want if there are lots of film files.

Acknowledgements

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Characteristics Affecting Learner Participation in Large Hybrid Classrooms

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Abstract. This descriptive study explores characteristics that can affect learner participation in hybrid classrooms and also learning outcomes. Data were collected from an online survey of 200 students (with 107 responses) from the online degree programs of two American universities. These learners are diverse in age and ethnic backgrounds. Major findings include: 1) Learner perception of being equal or subordinate to the instructor affects their confidence to engage in online discussions. 2) There is a gender difference in dealing with conflicts in hybrid and online meetings. And 3) Students who dislike collaborative work tend to view online learning as inferior to face to face learning. These findings underscore the significance of student attitudes and differing cultural backgrounds in establishing confident participation in the online environment. We also suggest ways that these results can guide course design and conduct in online settings.

Keywords: Case study, learner characteristics, cultural differences, gender differences, learner participation in hybrid classrooms.

1 Introduction

As distance learning becomes more prevalent, online and hybrid learning programs need to examine the attitudes and effects of differing cultures of learners and how they impact student academic success. The purpose of this study was to uncover some of the critical attitudes and cultural norms that help shape the online and hybrid environment. The study focused on learner engagement in hybrid courses as demonstrated by student participation in the cognitive, emotive, and social environment of their online experience. The results of this study and others like it can offer designers and instructors some guidelines for successfully designing and teaching hybrid and online classes.

1.1 Theoretical Background

A handful of studies (e.g., [1] [2] [3] [4] [5]) reveal the connection between student participation and learning outcomes. Wang's study [4] suggests that tasks requiring collaboration demand more student participation from the learner. For many students the online experience can be culturally challenging because of its emphasis on self-directed learning and constructivist pedagogy. The constructivist approach to learning

highlights socially constructed knowledge [5], which requires participants' active engagement in social and intellectual interactions. As Wang and Kang [5] discovered, personal confidence must precede any affirmation of social presence in the online environment. They also noted that this presence is a result of the student's attitude toward self, the learning community, and the learning process.

Three aspects of presence (cognitive, social, and emotive) could affect student success in online or hybrid learning [7] [8] [5]. Combining the realms of cognitive, social, and emotive presence could lead to a more effective approach for engaging learners [5]. Wang and Kang [5] proposed a Cybergogy of Engaged Learning model (see Figure 1), which advocates for the integration of all three online modes of online presence. Engaging the learner on all three levels of presence simultaneously would promote the best learning outcomes. This Cybergogy model illustrates the areas of presence and where these areas overlap, so as to indicate the most fruitful area in which to develop learning strategies for online courses. The concept of "Cybergogy" relates to areas of student presence and what elements play key roles in developing different types of presence online.

Along with the importance of social presence in the online classroom, collaborative learning within an online course is important for student success. Students from different backgrounds may well formulate differing collaborative strategies based on cultural norms [9]. Collaborative communities establish "safety nets" for students and helps support students having difficulty with the course content. As online students are able to refer to fellow students for assistance and tutoring on course content, the social and emotional connections are strengthened along with cognitive understanding of the content.

Along the lines of instructor importance in online learning, the concept of student perception of instructors can strongly affect a student's online performance [4]. In cultural traditions in which the role of the learner is to be passive and a quiet and respectful recipient of knowledge, being in an active learning environment can be a struggle. Especially, if the instructor encourages students to debate issues and ask challenging questions [10]. Studies have shown that student perception of the instructor and culturally correct student behavior toward instructors can hinder learning online [4]. Wang [4] examined the cultural attribute of Power Distance Index (student perception of equality with the instructor) and how this perception influenced student's participation and overall online performance. Students whose culture placed instructors at a high power distance from themselves, may be intimidated by instructors and unaccustomed to interacting regularly with instructors. If, due to cultural norms, the instructor is seen as unapproachable, the student may have less confidence in engaging in discussion or asking questions to the instructor, thus affecting their level of participation. By contrast, students with a low power distance have less difficulty communicating and relating to instructors, and therefore may perform better online.

Conflict, and the avoidance of conflict on a cultural and/or gender basis impacts online learner success as well [11]. If the individual, due to gender role or cultural norms, is not likely to voice opinions contrary to those stated by others in online discussion, this could cause the online interaction to be a painful experience. A review of available literature indicated that conflict for online courses could be categorized as passive-aggressive, aggressive, and structural. While research has been done in this area, not a great deal of concrete research has identified methodologies that could reduce the conflict online in light of cultural or gender differences.

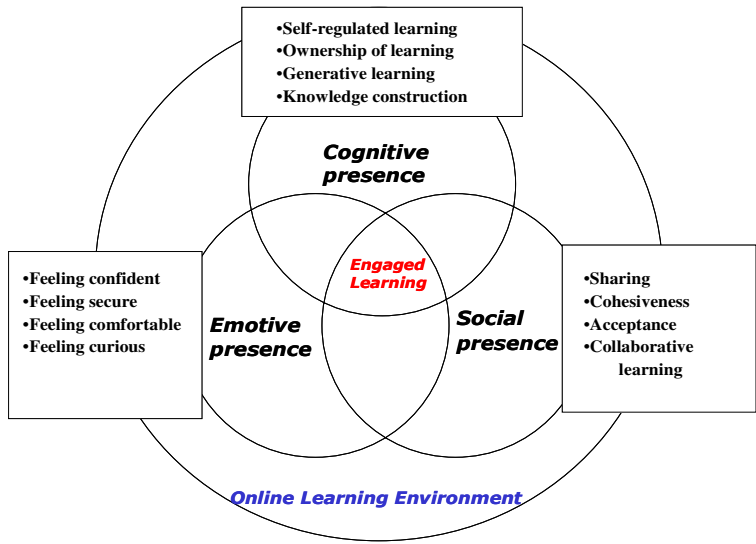


Fig. 1. Cybergogy for Engaged Learning (Wang & Kang, 2006)

Thus, there is a great need to design courses that accommodate cultural differences by emphasizing flexibility in several areas. Through examining personal characteristics that affect students' participation in hybrid classes, our study intends to fill in this gap. The goal of this study is to develop and disseminate guidelines for designing instructional materials and teaching facilitation that accommodates online student's diverse cultural backgrounds.

2 Research Method

This survey research examines the characteristics of students taking online or hybrid courses, and explores the influence of these characteristics on student's attitudes towards conflict, preference for the modality of work (solo versus group), and their preferences for communication tools. Gender is also factored in to further analyze these students' reactions towards conflict.

2.1 Participants, Instruments, and Data Collection

The respondents to the survey comprised of 107 graduate and undergraduate students, enrolled in hybrid courses offered at two public universities in California. These courses were considered hybrid because they included both campus and online students. (Please see section 2.2 for a detailed description of the hybrid learning environment). Participation in this study was entirely voluntary and the participants were reasonably knowledgeable about online learning environments.

The research team developed two online surveys for data collection using SurveyMonkey, an easy-to-use tool for the creation of online surveys. The first survey entitled *Survey on Online Learners' Perceptions* included fourteen questions, in the format of Single Choice, Multiple Choice, Likert Scale type questions and Rating

Scales. Questions one through six ask the respondents for demographic information and academic background; questions seven and eight elicit prior knowledge of the respondents' experience with online learning, use of the internet, and use of computers. Questions nine through fourteen ask for respondent's online learning experiences, attitudes of their teachers, emotional characteristics and perceptions of the media used online and in class. The second survey solicits data from eight constructs of the three domains illustrated in the Cybergogy Model (see Figure 1).

The eight constructs include: 1) prior knowledge, 2) motivation, 3) confidence for conflict management, 4) socializing, 5) perceptions of the instructor, 6) self-efficacy, 7) perceptions of online learning, and 8) tendency to interact online. Confidence for conflict management refers to how students create and dissipate conflicts in an online learning environment, as well as the instructor's ability to develop teaching strategies that could reduce the opportunities for destructive conflicts in online and classroom environments. Self-efficacy is an impression that one is capable of performing in a certain manner or attaining certain goals. Some studies find that learners' self-efficacy beliefs can be significant predictors of their performance of a task. These researchers argue that a learner can only actively engage in the learning process if they feel that a task is achievable and manageable.

The next two variables are perceptions of online learning and tendency to interact online. Although several studies suggest that online and hybrid learning can be as effective as traditional classroom models, more research is still needed to understand how students perceive and react to elements of online learning. Also, researchers should examine how to apply these approaches to enhance learning. The tendency to interact online has to do with the feeling of having a learning atmosphere that is safe versus fearful and having open negotiation versus domination. Quality interaction among students and instructor are conducive to a positive learning atmosphere, one that is marked by socializing, rapport, connections, debates, and open negotiation [12].

2.2 Learning Environment and Demographics of the Respondents

The hybrid classes offered at both universities often have about 50 students, with 60% being in the classroom and 40% being online. These students select their "modality" of study (online or campus) at the time of the admission, and their modality remain consistent during the course and their entire program of study. Online students are geographically dispersed, across the U.S. and around the world. They therefore bring diverse cultural and academic background to these classes.

Each class has one instructor and an assistant who operates the web camera and also answers questions from online students in the AdobeConnect chat room. AdobeConnect is the live meeting system used in these hybrid classes. Instructors show most of their instructional materials (e.g., PowerPoint, word document, URLs) in this system, which students see either through the classroom LCD projector or on their personal computer. Figure 2 is a screen capture of one hybrid classroom. In this research method class, the instructor was presenting to the campus class, with a few students tuning into the session online. The online students typed in their questions, comments, and feedback in the chat room, which was visible to campus students. They could also push the "talk" button in the AdobeConnect system to speak to the instructor and all students. The discussions among campus students were broadcast to online students through the many desk microphones. Thus, this robust hybrid learning

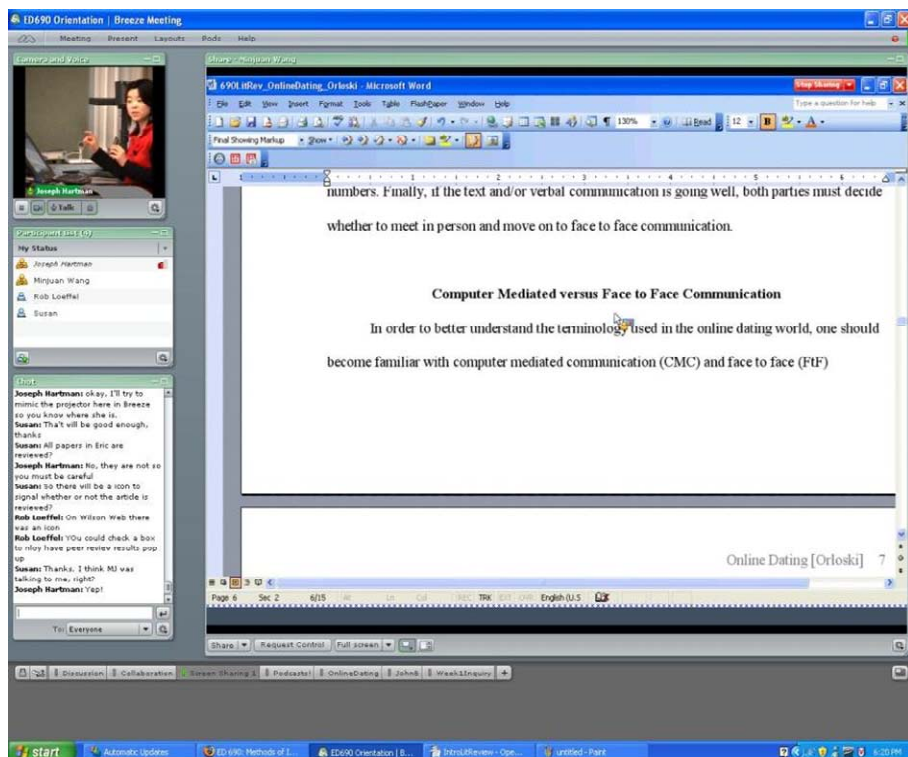


Fig. 2. A Hybrid research-method class in session

system enabled two groups of students to interact through both texts and audio. In addition to asking questions, students were also prompted to collaboratively solve problems that were anchored on real-life settings. For instance, they conducted a group data analysis using Google documents, to see if diet coke loses its taste after three months. These activities normally lasted 10 to 15 minutes. The course's learning system also had a forum (discussion board), where students posted questions or threaded discussions.

Among the 107 respondents to this study, the percent of female respondents (74.3%) was much higher than the male respondents. Even though the age range of the respondents varied from 20 to 63, 29% (the highest) of the respondents fell into the 25-26 age group. As to their educational background, 57.2% of the respondents were graduate students, who were pursuing masters and doctorates. Also, 52.3% of the respondents majored in education. The rest of the students were in the disciplines of business management, art history, and women studies. The discipline differences, however, are not compared in this study.

3 Major Findings

The following section selectively reports the findings that have implications for designing and facilitating hybrid classes.

3.1 Gender Differences in Confidence for Conflict Management

First, researchers looked for gender differences in the aforementioned eight variables studied. As both descriptive and inferential statistics (t test with $p < 0.01$, $n = 107$) indicate, the expressions of an opinion in the face of conflicts, exhibit the most noticeable gender difference. The mean score of confidence in conflict management for males is 16.14 (high) while for females it is 14.82 (low). This is a 1.320 mean difference, and it is the highest difference of all the results from other questions. Of the total 28 male respondents, only four express reservations about voicing their opinions. Of the 79 female respondents, 20 have reservations about expressing conflicting opinions. This means that 25% of the females lack the confidence in self-expression, as compared to only 14% of the males. This result points to a gender difference in the degree of confidence in expressing opinions that may challenge others. Table 1 displays the descriptive statistics of the variables studied.

Table 1. Gender Differences in self-expression, conflict, and perceptions of the instructor

Variable	G	N	Mean	SD	Variable	G	N	Mean	SD
prior knowledge	M	28	14.32	.983	Perceptions of Instructor	M	28	15.18	2.212
	F	79	13.94	1.530		F	79	14.47	1.832
motivation for accomplishment	M	28	8.14	1.557	Self-efficacy with study	M	28	8.18	1.442
	F	79	8.51	1.218		F	79	7.80	1.137
motivation for study	M	28	8.61	1.397	Self-efficacy with computers	M	28	4.21	.787
	F	79	7.96	1.445		F	79	3.78	.970
Confidence for conflict management	M	28	16.14	2.563	Effectiveness of online learning	M	28	11.68	2.539
	F	79	14.82	2.863		F	79	11.73	2.881
Preference for solo work	M	28	4.07	1.245	Attitudes toward interaction	M	28	14.86	2.534
	F	79	3.81	1.099		F	79	14.43	2.903
Preference for teamwork	M	28	7.75	2.030	Total Score	M	28	113.14	10.244
	F	79	7.29	1.902		F	79	108.54	10.297

3.2 Perceptions of the Instructor and Tendency to Interact Online

Analyzing the data in terms of ethnicity, 8 of the 12 Asians (foreign students) have low scores on the tendency to interact online. This can be partially attributed to their language abilities (English as a second language). Of the 67 Anglo-Europeans in the sample only 10 have such low scores. The Asian sample is small compared to the Anglo-European, but the results suggest that a higher percentage of the individuals sampled have low confidence in online discussions. This aligns with the findings from other cultural studies of online learning. In a previous study of cultural differences

among three groups (American Anglo-European, Chinese, Korean), Wang [4] reported significant cultural differences in students' sense of Power Distance with their instructors. Korean students had the highest score on the Power Distance Index and participated the least in online classes. American Anglo-Europeans demonstrated a much lower level of perceived Power Distance, and an increased level of participation. Wang points to this result as an explanation for the lack of student confidence in online courses.

In this study a similar and significant relationship ($r=0.48$, $p<0.0001$, $n=72$) exists between students who view instructors as equals and their willingness to voice opinions even when those opinions are in conflict with others. In this study one third of the males and one third of the females disagree that students are equal with the instructors. The ethnic breakdown results in a greater percentage of the Asians that do not view themselves equal in stature with the instructor, while a higher percentage of American Anglo-Europeans express the opposite view. This re-confirms Wang's [4] study and underscores the student attitude toward the instructor in contributing to their active participation in classes.

3.3 Preferences for Collaboration and Perceptions of Learning Effectiveness

In their "Cybergogy" model, Wang and Kang [5] assert that self-confidence and positive self-perception must be complemented with a positive attitude about the larger community and a sense of belonging. For constructivists the social dimension is crucial for cognitive development. Social discourse is fundamental in constructing knowledge. Therefore, collaborative activities must be an essential part of online courses. This study suggests that working with others may be problematic for students. There is a significant correlation ($r=0.44$, $p<0.0001$, $n=69$) between students' preference for teamwork and their attitude toward the proposition that hybrid learning is as effective as face to face. Both questions resulted in similar mean scores 3.43 and 3.44. Of the 38 students who disagree that online learning is as effective as face to face, 22 also express a dislike for group work; while 16 who like group work are not convinced that online learning is as effective.

In essence, there is a positive correlation between learners' preferences for collaboration and their perceptions of learning effectiveness in hybrid classrooms. Further research is needed to confirm that group work may have a negative impact on student participation for those that dislike group work. Considering that many online courses are built around collaborative work, this tentative finding has significant ramifications for online course design.

3.4 Active Participation and Feelings of Isolation

The survey also reveals a negative correlation between active participation and expressions of isolation from the online students. The Pearson r data ($r=-0.57$, $p<0.01$, $n=105$) also shows a significant, inverse relationship between those who voice their opinions and feelings of isolation in online courses. Students who participate more in online courses will be less likely to express feelings of isolation. The mean scores for questions of self-expression are 3.92 and 4. The inverse low mean scores of 2.17 and 2.93 result from questions of feeling isolated and anxious. There is also a significant

relationship ($r=0.47$, $p<0.0001$, $n=105$) between this feeling of isolation and the lack of online communication. Students who agree with feeling anxious when there is a lack of communication also feel isolated. Those who express loneliness and anxiety prefer live chats. Of the 25 respondents that express those feelings, 19 give higher scores for live chats over asynchronous communication. This suggests that more participation and live communication reduce anxiety and isolation in the online environment.

It's noteworthy that all classes studied here have access to similar asynchronous online forums. Though there are differences between how online learners and in-class learners use forums, the parity of access indicates that all students could participate outside of the regular classroom time and according to their preferences.

4 Conclusions, Design Implications, and Limitations of This Study

The study examined characteristics that affect online learners' participation in hybrid sessions, and ultimately the success of learning outcomes. The constructivist philosophy of instruction places great emphasis on social dialogue and co-construction of knowledge. Success in the online environment requires students to collaborate and communicate with others. In this setting, students must exhibit confidence in expressing their opinions and confidence in using technology. A review of the literature suggests that some student perceptions are conditioned by cultural differences. Studies by Wang [4] have demonstrated that Asian students view the instructor as intimidating, reducing their level of self-expression. Anglo-European Americans are more likely to consider the instructor equal in status and consequently exhibit more confidence in online courses.

These different attitudes result in different levels of engagement and must be considered by designers and instructors. This consideration will aid these students in developing the social skills required for success in online courses. Other attitudes are based on the new context of the online environment which requires student adaptation.

This study confirms Wang's conclusion [4] that a student perception of inequality with the instructor determines their confidence to engage in online discussions. A greater percentage of Asian students exhibited a lack of confidence in self-expression and also believed that the instructor was not equal in status with students.

Learners' confidence in expressing opinions in the face of conflicting viewpoints (i.e., conflict management) reveals a difference between the sexes. A higher percentage of females displayed a lack of confidence in presenting their opinions in controversial situations than males. A follow up study on content analysis of online discussions should be conducted to further investigate this conclusion.

The results of this study reveal a tentative link between dislike for group work and skeptical view that online learning is as good as face to face learning. The data reveal a strong correlation between the question on collaboration and the affirmation of the effectiveness of online learning. The evidence indicates that students who dislike collaborative work tend to view online learning as inferior to face-to-face learning. This conclusion has significant ramifications for online instructors who follow the constructivist approach and rely on collaborative assignments. Designers and instructors need to adjust their degree of facilitation in collaborative work based on the composition of their learner populations.

Online environments depend extensively on technologies and human interactions that bridge both the physical and psychological distance between instructors and students. When the distance is large, students experience feelings of isolation and anxiety. These feelings also arise when the level of participation is low. This study indicates that those students who are less confident and participate less frequently in online discussion experience isolation and anxiety. The data also confirmed that students experiencing isolation and anxiety prefer live communication over asynchronous communication. For these students, the live chat environment enhances the direct connections with instructor and other students.

These findings underscore the significance of student attitudes and differing cultural backgrounds in establishing confident participation in the online environment and must be considered by all online designers and instructors.

Student attitudes and backgrounds affect their level of participation and engagement in online courses more than in traditional settings. These factors are important considerations for successful student outcomes. This study confirms the important role that these student perceptions exert on student engagement. Course participation demands a level of student confidence in dialogues with the instructor and with other students. Identifying and examining these attitudes will help online courses deal more effectively with the root causes of student attrition and student failure.

Finally, this study only used surveys and the participants are from two public universities in California. In addition, the small sample sizes of culturally diverse students makes an analysis of cultural differences limited in its scope. Future studies should seek out larger and more diverse samples. The researchers did not examine the effect of media on the user's experience, as that fell outside of the bounds of study. Future research should also examine the effect of online and face-to-face learning on user preferences and confidence.

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An Empirical Study on Blended Learning in the Introduction to Educational Technology Course

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Abstract. “An Introduction to Educational Technology” is one of the core courses for undergraduate majors of educational technology at Beijing Normal University. It is a fundamental course which is intended to lay a solid foundation for the students of this field of study and to help them understand their field of study better. Based on empirical studies, the authors have developed a optimal method of curriculum design for blended Learning. The method has been proven to be fairly effective by a four-year implementation of a comprehensive hands-on practice through enabling the students to carry out relevant career designs. This paper attempts to shed light on the concepts of such curriculum design and to elaborate on the way it has been done and is also intended to provide a framework of reference for faculty of this field and other practitioners.

Keywords: Blended Learning, Introduction to Educational Technology.

1 Introduction

1.1 Background and Significance

Talent cultivation is the key to improving the quality of higher education. The mission of the educational technology major at Beijing Normal University is to cultivate inter-disciplinary talents needed for the information age. It is aimed to equip students with latest information technologies and to provide them access to the theories and methods of taking advantage of various technologies and resources so as to facilitate their learning. For years, Beijing Normal University has maintained the leading position in educational technology related subjects in China. In Chinese rankings for undergraduate major given by professional authorities in 2005, 2006 and 2007, the educational technology major of this institution came up top on the list of secondary disciplines of “A++” level for three years in a row.

As we know, undergraduate education plays a vital role in talent cultivation. However, quite a few problems exist in current undergraduate education for educational technology majors. For example, these students cannot land suitable jobs upon graduation; the curriculum system is not adjusted to the social development; importance is attached more to theoretical foundations rather than to practice; the positioning of the subjects is unclear and there is a shortage of faculty. In an attempt to solve these problems, we undertake a reform of the undergraduate curriculum and bring forth new

modes for talent cultivation so as to help the students develop an innovative spirit and practical competence. “An Introduction to Educational Technology” is a compulsory course for undergraduates, which attempts to transform the teaching of this course through blended learning. Based on a four-year learning experience of blended learning, not only can students understand the field of educational technology, but their learning initiative and learning enthusiasm are also markedly enhanced. They are able to take responsibilities for their own learning and gradually get a clear picture of their future development. Also, there is an obvious improvement in their learning strategies and learning abilities. All these can provide a sound foundation for the follow-up course development and exert a crucial effect on the pedagogical approaches to this particular course.

1.2 Research Questions

As an important basic course, “An Introduction to Educational Technology” has been offered to educational technology major freshmen since 1985. It is a compulsory course for educational technology majors as well as an introductory course for guiding students to know about the field of educational technology and to lay a foundation for them to under the field better. The course is designed to make students have a general knowledge of educational technology and get an understanding of their major, including its development history, its nature, and its research field as well as research methods. Through offering this course, students are expected to learn and understand the characteristics of educational technology and develop learning enthusiasm and initiative so that they will have a sound foundation for their study of more advanced courses. Through over 20 year’s efforts, this course has been developed into a core course in the field of the educational technology and has been widely popularized all over the entire country.

The following questions are addressed to guide this study:

- 1) Are students really learning anything?
- 2) What on earth have they learnt?
- 3) What are the teaching effects of the blended learning?

2 The Framework of the Curriculum Design

According to the framework of blended learning, we divide the curriculum design into three phases: pre-analysis, activity and resource design and instructional assessment [1].

(1) Pre-Analysis. In order to ascertain whether blended learning could be used, several observations and analyses need to be conducted. These analyses chiefly are composed of three factors: analysis of learner characteristics, analysis of learning objects (knowledge taxonomy) and analysis of blended learning environments.

In our case, the pre-analysis shows that although there are considerable differences in freshmen’s learning styles, they demonstrate some common features, such as their curiosity at their special field, their willingness to practice, their ignorance on the specialized knowledge and their self-monitoring ability required in self-regulated learning. Moreover, the knowledge in the curriculum, like that in other courses, is abstract and general, which covers almost every aspect of the field but lacks profundity due to the restrictions

of the curricular aim. Students find it hard to acquire the intended knowledge. Furthermore, there are dozens of networked classrooms available in our institution and, especially, there is a learning platform, which is called WebCL, a Blackboard-like learning system, which is free accessible for faculty and students. Based on the result of our pre-analysis, a blended learning curriculum might be a better choice teaching this course effectively. For the sake of this endeavor, part of the teaching hours are designed to give an overall introduction to the course and also allow students to engage themselves in learning activities while online communication and guidance are provided.

On the basis of the goal of this course, which is to assist students to have a general idea of the field of educational technology, we identify a practical issue that every university student has to deal with, that is “career design”. Based on this issue, we have developed the general concept of designing the curriculum. That is, by designing their future career, students are expected to acquire some basic knowledge of educational technology and at the same time make a four-year preliminary goal for their undergraduate studies.

(2) Activity and Resource Design. This phase involves three steps: the overall blended learning design, the unit (activity) design, and resources design. In the process of overall design, priorities are given to the arrangement of corresponding learning activities and the strategies of information communication in the process of learning. In addition, full consideration is given to questions like what kinds of support can be provided for learning, what activities and resources are suitable for students’ self-regulated learning, and what are suitable for learning in traditional classroom settings.

We divide the “career design” into four parts: “choosing directions”, “collecting data” as well as “learning methods” and “writing reports.” At the same time, corresponding resources design and teaching assessment design are completed. Hence, a complete blended learning teaching plan is devised. Through performing these task, students can get a comprehensive and profound understanding of the status quo and development trend of this field. We assert that only if learners assume some responsibilities and understand how to perform them can efficient learning take place. And the goal of blended learning is to improve learning by finding the possible “best” way. In blended learning, students should be encouraged to get involved in teamwork as well as to accomplish practical learning activities as apprentices. Furthermore, they need observe how their team members learn. As a result, they can develop their knowledge, habits, beliefs, personality and skills.

(3) Instructional Assessment. Instructional assessment is the third phase of curriculum design. It is an assessment of instructional effects by methods like assessing the process of learning (for example, through e-portfolios), test on curricular knowledge (such as online exams) and assessing the organization of learning activities.

The course under discussion adopts diversified assessment methods in terms of both assessment subjects and methods and the aspects of assessment content. It combines self-assessment, peer assessment with teacher assessment and score records available from the e-portfolios. Besides, the course adopts many rewarding mechanisms such as selecting excellent team assignments and rewarding all team members as well as students with creative ideas.

As for the students' reports on their career design, they will be assessed by the method of "proposal first and concluding report next." That is, the proposals should be finished in the mid-term period while the concluding reports should be done by the end of the term. Then the reports should be evaluated by the teacher and students from other teams. Meanwhile, constructive guidance will be given by the teacher. In this process, knowledge gained in learning, learning experiences and learning methods will be shared among the learners. Besides, the collaboration of the whole team, individual contribution and accomplishment of learning will all be examined additional credits.

3 Strategies for Curriculum Implementation

3.1 Implementation of the Career Design Activity

During the implementation period of the curriculum, the "Career Design" involves the comprehensive and practical activities of the whole learning process, with the objective of helping the students to acquire the rudiments of educational technology and to set the preliminary goals for their four-year undergraduate studies. The students were divided into groups based on their interests, academic performance and gender as well as the branches of educational technology (Instruction Design and Curriculum Development, Information Technology Education, Distance Education, Educational Software Development, Educational Media Development, and Enterprise Electronic Training and Performance Technology). Each group chose a branch that they were interested in and designed the career plan accordingly. Specific steps that have been taken are as follows:

- Research the status quo and trend of the selected branch and acquire a full understanding of the status quo of the selected branch, both at home and abroad.
- Work on the labor demand conditions of the selected branch and analyze the labor market and the employment conditions of the students in the selected career orientation and clarify its employment type.
- Research the competence required by the career corresponding to the selected branch. Here, we suggest that the students adopt the post analysis approach, which is often used in human resource management, to apply a traversal analysis to the activities of the vacancies belonging to the branch to define the required competence by the career. The students shall obtain the required competence of the position according to the position descriptions and regulation of the enterprise. In addition, relevant information could also be obtained through field work, work log, observation, interviews, typical incidences and questionnaires and then the competences required by each module of career branch could be generalized.
- Build a curricular system and a course selection plan. A curriculum of the selected branch should be constructed, including general requirement module, major common module and career module, which are combined into a new curriculum. Then the detailed course selection plan of the four-year undergraduate studies is drafted based on the curriculum.
- Design learning goals and make detailed plans for the four-year undergraduate studies. Each student shall design and plan his or her four-year undergraduate studies in details according to the five career life design steps, which are self-evaluation, external environment analysis, goals-setting, strategies-implementation, and feedback and adjustment.

3.2 Preparation of Instruction Resources

Three-dimensional instructional resources have been accumulated over the years of teaching the course mentioned above, which could be depicted as “Paper Instructional Materials + An Online Instructional Platform + Online Delivery + An Instructional Resources Repository + Instructional Tool Box”. Specifically, these resources go as follows:

(1) Paper Instructional Materials: A textbook titled “*An Introduction to Educational Technology*” which was edited by Professor Ronghuai Huang, was published by the China Higher Education Press in 2006. As one of the major instructional materials of the course, the book has been written in such a carefully designed way that it is made easy for the freshmen to understand the fundamental concepts of the related field, complemented with case studies and graphical visualizations..

(2) An Online Instructional Platform: Functions like “Course Materials” and “Course Discussion Clubs” provided by the platform of WebCL ([http://www .webcl.net.cn](http://www.webcl.net.cn)) are integrated with the traditional classroom instruction to offset the disadvantages of the traditional classroom instruction, such as the limitations of instruction materials and the disappearance of interactivity. The teacher can have an idea about their learning progress through knowing about their learning history such as the materials worked on and participation in discussions through the E-portfolios and Course Logs on the platform.

(3) Online Delivery: A supplementary online classroom has been constructed for the course (<http://ksei.bnu.edu.cn/ET/>) to provide the students with rich resources like course descriptions, instruction materials, professional dictionaries and literature and video clips of lectures made by experts.

(4) An Instructional Resources Repository: A series of instruction software have been developed over the years of instructional practices and the EasyThinking-Cognitive Assitant v 3.0 is one of them. These kinds of software have greatly facilitated student learning.

3.3 Provision of an Opportunity for the Students to Solve Real Life Problems

Practice is one of the most important means for the students to improve their capabilities of solving specific problems. The program encourages the students to know about the demands of educational technology graduates by educational institutions as well as business and government organizations and to make clear what their employment opportunities might be by interviewing, or doing internships at schools, enterprises or government agencies that are related to the field of educational technology. For example, the instructor took the students to visit Beijing Huaxia Dadi Education Co., Ltd. and Open E-Learning Center, to participate in China Content Broadcasting Expo and the Fifth Software Reporting Conference of China, to interview the IT teachers of the High School Affiliated to Beijing Normal University and to sit in on the classes at the same school. The students designed their career plan according to their respective interests and then with a further understanding of the demands of the positions of the different branches, they designed their own instructional plan of their selected branch.

The students were required to produce their corresponding design works to explain their understanding of the selected branch. For example, the students who have taken the sub-field of Information Technology Education designed a highly practical instruction plan; the students who selected the sub-field of Enterprise Electronic Training designed a series of customer training plans. In addition, the instructional practice has also cultivated the students' interpersonal communication skills and their competence for further research and for solving practical problems.

4 Methodology

The study employed a mixed research method. The data were gathered by using questionnaires and interviews through , investigating the students' learning strategies, interviewing the students in terms of their adaptation to the blended learning method, studying their opinions about the course, analyzing the e-learning documents and the course logs of the students and observing the full-session videos of the course.

5 Results and Analysis

5.1 Improvement of Students' Learning Strategies

Good learning strategies can effectively improve the academic performance of the students. During the instruction of the course, we constantly observed whether the students learned how to learn and whether they improved their learning strategies. Therefore, we measured the initial levels of the students' learning strategies. We used the Learning Strategies Form, which was formulated by Weinstein in the University of Texas at Austin at the end of 1980s[2]. The form has been used in more than 1000 universities in America for measuring the application level of learning strategies by the students[3]. The form is to measure the strategies and methods that are used by the students in their studies, concentrating on their thoughts and acts, either dominant or recessive, which are related to the successful learning and could be improved through instruction[4]. Many studies have shown that LASSI plays a positive role in helping the students learning the knacks of study and in helping the teachers with their researches and with their designing of instruction activities [5]. LASSI is composed of 10 scales, which are: Attitude (ATT), Motivation (MOT), Time Management (TMT), Anxiety (ANX), Concentration (CON), Information Processing (INP), Selecting Main Ideas (SMI), Study Aids (STA), Self-Testing (SFT) and Test Strategies (TST) [6].

The tests were officially administered under coherent written and oral instructions and a total of 43 questionnaires were distributed to the students in a class. All of the 43 questionnaires were retrieved, with a 100% effective retrieval rate.

The results revealed that the level of the students' learning strategies is not satisfying. None of the average score of the 10 scales exceeded 75%, and the scales of Motivation, Attitude, Self-Test, Test Strategies and Concentration remained especially low, which indicates that the students had a low level of learning strategies in general and relevant measures should be taken to improve their learning strategies. Detailed data are available in Table 1.

Table 1. Initial Average Score of the 10 Scales of the LASSI

	ATT	MOT	TMT	ANX	CON	INP	SMI	STA	SFT	TST
M	29.657	26.864	24.710	29.500	25.921	28.815	18.323	27.081	23.135	28.421
%	27.9%	19%	57.3%	67%	50.6%	61.1%	52.5%	68.9%	34.5%	37.2%
SD	4.3326	4.1577	5.6084	3.9388	4.6288	5.6322	2.4583	4.9181	4.2632	4.2530

We have taken the following measures to improve the students’ learning strategies in practical instruction:

- The traditional classroom instruction was combined with lectures given by experts. Lectures relating to the development of the discipline could not only broaden the students’ horizon but also help them to learn about the academic front of the field and dynamics of the field so as to motivate them explore this exciting field.
- Collaborative learning and motivational learning were interpolated into the classroom instruction, allowing the students to be actively involved in the feedback analysis of the instruction instead of totally relying on the instruction of the teacher so as to improve the students’ learning strategies.
- The blended learning method are adopted for implementing the instruction with the objective of optimizing achievement of learning objectives by applying the [‘]right[’] learning technologies to match the [‘]right[’]personal learning style to transfer the [‘]right[’] skills to the [‘]right[’] person at the [‘]right[’] time[1].

The learning strategies of the students in the class were re-measured at the end of the semester and the detailed data are available in table 2.

Table3 shows the ratio of improvement of learning strategies before and after experiment. It is obvious that the learning strategies of the students are generally improved. Except for the Study Aids, the other 9 scales have been greatly improved, especially Test Strategies, Attitude, Time Management, Concentration, Anxiety, Selecting Main Ideas and Motivation, which have improved conspicuously for more than 10%.

Table 2. Re-Measurement Average Score of the 10 Scales of LASSI

	ATT	MOT	TMT	ANX	CON	INP	SMI	STA	SFT	TST
M	36.837	29.767	30.093	34.604	30.930	29.325	20.907	26.930	24.38	36.767
%	85%	35%	85%	90%	80%	70%	75%	65%	42.3%	90%
SD	6.6795	4.8542	5.7438	6.4036	4.0379	5.9591	2.6887	7.9144	4.06	4.7149

Table 3. Ratio of Improvement of Learning Strategies Before and After Experiment

	ATT	MOT	TMT	ANX	CON	INP	SMI	STA	SFT	TST
Ratio of Improvement	24.2%	10.8%	21.8%	17.3%	19.3%	1.8%	14.1%	-0.6%	5.4%	29.4%

5.2 Fruitful Experience in Blended Learning Revealed from the Interviews

After all the learning activities of course were finished, the teacher interviewed the team leaders and several team members to learn about the adaptation of the students to the blended learning mode.

Their feedback showed that all students recognize and are well adapted to the blended learning strategies, which are characterized with the combination of the online resources and classroom instruction. The classroom instruction has reinforced the face-to-face exchange among the teacher and the students as well as among the students themselves; the WebCL platform and the online course have provided a rich pool of learning resources to enrich the students' knowledge; the students learn how to communicate and cooperate with others to accomplish their learning tasks by participating in the comprehensive and practical career design activity. The interests of the students in learning have been greatly enhanced and many students expressed their feelings about it when presenting the plans of their career design:

"Everybody has labored with heavy perspiration and has also reaped golden fruits, which, we think, include not only the precious documents that we have made, but also the communication skills, literature searching capabilities and independent thinking habits and the problem-solving capabilities that were cultivated in cooperation with the team members. We are in a happy mood since we have made our efforts! And we thank Professor Ronghuai Huang for giving us such a meaningful task and for giving us so much inspiring guidance."—Educational Software Development Team

5.3 An Enhanced Interest in the Field of Educational Technology Revealed from the Questionnaire Survey

After the course was finished, there was a follow-up instruction assessment, mainly based on the information provided by the students in the questionnaires on the network platform. The questionnaires mainly investigated the aspects such as class hours, the breadth and depth of the course, the learning load of the course, resources of the course, instructional design of the course, and etc. to evaluate the course, and evaluated the instructional quality by investigating 'how responsible the teachers are in teaching, the use of teaching aids, the instructional methodology, the communication between teachers and students, teaching styles, the influence of teachers' characters on students, how teachers arouse students' enthusiasm in their study, students' interest in the study, and so on.

The investigation showed that 95.7% of the students have become more interested in the field of educational technology through learning this course. 97.8% of the students claimed that teachers could motivate them to learn effectively; 97.9% of the students thought that their abilities were improved through learning this course. 97.9% of the students admitted that this course was very important for them.

5.4 Enhancing Learning through Self-reflection

The e-portfolios available from the WebCL provided the students with a record of their learning process and an opportunity to reflect on their own study, by recording all the detailed activities and outcomes during their study process, including the times where students logged on to the system, the time they spent on online learning, resource using frequency, the times and content of written communication, the completed coursework they uploaded and the time, their thoughts on study, their performance on homework and quizzes. By analyzing these data, we could know clearly about students progress made during their learning process, which can in turn inform our teaching. For example, students analyzed and reflected on their learning strategies, and then summarized their own strategies and shortcomings, which means that students could monitor and self-regulate their learning.

Besides, we compared the coursework handed in by the students every year and found that students in different academic year were making bigger progress. For example, there was only one paper published among the students of 2004, but 7 papers got published among the students of 2005.

5.5 The Heuristic Types Revealed from the Instructional Video

We have videotaped the entire course instruction and have also observed it carefully. We found that almost every teacher adopted the heuristic teaching mode to lead to students' thinking, thus we focused on a preliminary analysis of the "heuristic types" of fragments of their teachers and students' conversation.

There are five heuristic types of fragments of conversation, namely, content heuristic, metacognition heuristic, interactive heuristic, evaluative heuristic, and other heuristic [7]. We observed that a majority of teachers raised questions related to content heuristic and metacognition heuristic, such as, what is educational technology according to your understanding? From what point of view do you see the development of educational technology? While few were concerned with interactive heuristic. As far as students were concerned, they would rather their teachers offer them enough instruction to enlighten them. Therefore, they tend to ask such questions as, "Dear teacher, could you please tell us how to improve professional qualities?", "How to handle so many businesses?", or "We know that learning technology is essential, but there are fewer technology-related courses in the system, so how to deal with this phenomenon?" It is apparent that both teachers and students attached enough importance to assisting students in real learning by developing their learning capabilities and sparking their analytical thinking.

6 Findings

6.1 Creating a Virtual Learning Environment Is a Must

It is crucially important to have a virtual learning environment that lends support to blended learning. In this study, WebCL supports the web-based learning and diverse teaching designs and learning forms, and automatically monitors students' learning and supports various kinds of evaluation by offering functions like learning style assessment, grouping, communication and cooperation, evaluation of learning effectiveness and performance assessment. It has a rich resources depository and a database for case studies. Moreover, it informs the students of their learning progress in a timely manner and supports diverse evaluations by offering multiple interactive supports between students and teachers in addition to its powerful assignments management, online assignment delivery and automatic grading.

6.2 Activities for Blended Learning Are Fundamental

It is known that activity design is one of the most distinctive features that could reflect the design of a blended learning curriculum [1]. Thus, activity design should fully unleash students' initiative, and meanwhile should be closely related to students' personal development, as well as combine teaching with the goal of a particular curriculum. The activities are supposed to be the extension of classroom teaching, and their

purpose lies in developing students' analytical and creative thinking, as well as cultivating their capability of solving real world problems. It is what this course did that is intended to fulfill the goal.

6.3 The Role of the Teacher Is Critically Important

During the process of blended learning, teachers should possess corresponding techniques to achieve the anticipated effects. That is, teachers should create a suitable, favorable environment for virtual learning, have the ability to design and undertake teaching in a web environment. Teachers should serve as a guide, a helper, a facilitator, and an experienced peer for students. More importantly, teachers should effectively help them online and give timely feedback. On the web platform, teachers raise questions to spark students' thinking and help them to develop self-regulated learning strategies and make appropriate comments on students' replies to facilitate their learning. Also, teachers should provide prompt responses to students' questions. In the meantime, teachers can help students to have an in-depth look at what has been learned by offering a concept map and some utility software. Only by doing these can the anticipated learning effectiveness be assured.

7 Conclusion

The course discussed above consistently sticks to the five key principles: A. Clear teaching; B. Diverse teaching methods; C. helping student to be immersed in learning; D. task-based teaching; and E. Ensuring student success rates and positive responses. In addition, blended learning strategies combine teaching with real world problems, Through the applications of the right appropriate technologies in enhancing the right abilities, learning effects can be optimized.

This course has been trendsetting in the field of educational technology in China since it made its appearance. To begin with, aimed at students' personal growth and enhancing their creativity and problem solving abilities, this course is characterized with its sound positioning and design, and purposefully develops students' information literacy, thinking and problem-solving capabilities. Meanwhile, it brings advantages of the academic major of educational technology at Beijing Normal University into full play in various aspects of human resources, academic research, and talent training. It boasts of a large of capable and qualified faculty. Moreover, the blended learning course broadens students' horizon, stimulates their creative consciousness while offering them abundant opportunities for practice, exposing them to real life problems and allowing them to have a direction to personal development. In 2007, the Introduction to Educational Technology course was rewarded as an excellent course in the educational quality initiative launched by China's Ministry of Education.

At present, the content division of Introduction to Educational Technology course has evolved into the course-teaching division, which forms a "1 plus 5" course series with the course of "An Introduction to Educational Technology" as its core, and "Online education and Applications," "Instructional Resources Design and Development", "Media Theory and Practice", "Instructional Designer," Information Technology and Course Integration" as a course cluster. The last five courses correspond to the five sub-fields of educational technology, namely, modern long-distance education, educational software

design and development, digital media technology, fundamental theory of educational technology, and information technology education. This course series is targeted at developing students' problem solving skills and enhancing their creativity, and is devoted to optimizing their information qualities, thinking, and problem-solving capabilities. All courses are interconnected and the resources are shared with each other. It also assists students to learn about different sub-fields of education technology through designing their intended future careers. Through learning these courses, they can further consolidate their interests through solving real life problems. The teaching groups cover the overall the major and can be very helpful for the teaching of the education technology major.

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Experience on Outcome-Based Teaching and Learning

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Abstract. Outcome-based teaching and learning emphasizes the explicit declaration of learning outcomes which identify the tasks students are expected to be able to perform after completing the course, and to what standard. OBTL also requires the teaching, learning and assessment activities to align with the stated learning outcomes. We interviewed fifteen university instructors about their experience of teaching outcome-based computer science courses and how OBTL has affected students and themselves. Academic departments had not adjusted their teaching load to account for the added effort required for the migration to OBTL. Most instructors continue to use time-saving norm-referenced assessment. Students did not seem to perform better under OBTL. With the way OBTL is being implemented, it is doubtful that the full benefits of OBTL will ever be realized.

Keywords: Outcome-based teaching and learning (OBTL), outcome-based education (OBE), frequent summative assessment.

1 Introduction

OBTL has been a popular acronym in the higher education in Hong Kong over the past few years because of its endorsement by the funding agency University Grants Committee (UGC). In OBTL, learning outcomes are stated explicitly and must be supported by suitable teaching, learning and assessment activities. Not entirely new, OBTL corresponds closely to outcome-based education (OBE) that has been around from the early 80's [1]. OBE in turn has its roots in the competency-based movement introduced in the late 60's [2]. Advocates claimed that OBTL benefits student learning [3]. This paper examines this claim based on the experience of fifteen academic staffs who teach outcome-based computing courses at the university level in Hong Kong.

Successful experience of using OBTL has been reported but it was largely perceptual, anecdotal, and small scale [4] [5] [6]. There were also reports of withdrawal due to unsuccessful implementations [7]. A notable and recent failure took place in Western Australia where the government abandoned most of its OBE system for upper school (year 11 and 12) in response to massive objection from teachers and parents [8]. Literature that demonstrates the effects of OBTL at the university level is especially lacking [9]. There is a need for more empirical study of how OBTL affects learning at the university level.

Some readers may prefer to see large scale quantitative research where objective and precise relationships between variables are tested. Our chosen research approach however is qualitative for the following reason. University instructors do not like to be monitored and they have a fair amount of freedom in teaching and assessment. It is beyond our power to enforce learning and assessment activities be done in specific ways needed for a quantitative research. Instead we interviewed the academic staffs to find out the actual effects of their OBTL implementations at the course level. This qualitative research could pave the way for a quantitative research in the future.

In Section 2, we describe the interviews with the instructors. In Section 3, we describe their OBTL implementations. Sections 4 and 5 respectively report the effects of OBTL on students and instructors from the instructors' perspective. We summarize and reflect on our findings in Section 6.

2 The Interviews

We shall refer to academic staffs as instructors regardless of their title being instructor, lecturer, assistant professor, associate professor or professor. We interviewed fifteen instructors about their use of OBTL in eighteen computing courses. Among these courses, thirteen were introductory courses open to students from any disciplines. The other five courses were advanced courses taken mostly by computer science majors. The instructors were interviewed individually for about 30 minutes on basically three questions:

1. How did they implement OBTL in their courses?
2. How has OBTL affected their students?
3. How has OBTL affected them?

The interviews were not taped in order to encourage instructors to share freely. They were assured that their experience would only be used collectively without the risk of their identities being unveiled. We scripted each interview and forwarded it to the corresponding instructor for possible corrections. The instructors were pleased with the accuracy and completeness of the scripts. Thirteen of the fifteen scripts were accepted by the interviewed instructors without modifications. One instructor asked a statement be removed from the script because more observations were necessary before a generalized statement of the observed student performance could be made. Another instructor asked the record of a negative OBTL experience be removed. It is uncertain that the correction request was due to an error in the original script or the instructor not wanting to be associated with a true but negative experience. From what we can tell, the interviewed instructors, by and large, were candid to discuss their experience openly.

3 OBTL Implementations

Arbitrarily bad implementations leading to failures gave no proof that OBTL could not be successfully implemented. Hence we asked the instructors how they implemented OBTL in their courses.

3.1 Course Learning Outcomes

First, a clarification of terminology is in order. In the U.K., undergraduate students enrol in a number of modules in an academic term to complete a course in three years. In the U.S. and Canada, undergraduates enrol in a number of courses in a term to complete a program in four years. A *course* in North American is a *module* in the U.K. We use the American terminology in this paper. Most of our courses have five to six course learning outcomes. Two instructors painstakingly broke down the main outcomes into subtasks or multiple levels of performance standard.

3.2 In the Classroom

All instructors raised students' attention to the course learning outcomes in the first class. Some instructors even reminded students of the relevant learning outcomes every class. About half of the instructors reported that OBTL had no other impacts to their lectures.

Some instructors posted questions relating to the learning outcomes at the beginning of lectures to guide students' attention. The questions were found effective in motivating the students and keeping them focused throughout the class.

3.3 Assessment Approach

In its purest form, OBTL assessment is criterion-based. Students are given multiple opportunities to demonstrate their abilities to perform the tasks specified in the learning outcomes. If a student failed to perform the task in the first two attempts but succeeded in the third attempt, he or she still has achieved the learning outcome. In the spirit of OBTL, the final grade should just be the same whether the student only succeeded in the last attempt or in all three attempts.

A different assessment approach is norm-referenced. Each question in a quiz, assignment or examination is assigned a weight. Student performance is reflected by a final score, usually out of a hundred, accumulated from all the assessment activities. Instructors are free to decide whether a grade C requires a final score of 55 or 60 based on the performance of the whole class. OBTL advocates consider the use of norm-referenced assessment harmful.

Thirteen of our instructors used norm-referenced assessment in their courses that OBTL advocates advise against. Two remaining instructors used criterion-based assessment. However they had reverted back to norm-referenced assessment because criterion-based assessment took up too much of their time without significant benefits. One of them said, "Criterion-based assessment is problematic. First, judging the level of student performance on an outcome is subjective. Second, a student might do better in the mid-term than in the exam. Was it because the student was too nervous in the exam? Or had the student lost the ability over the few weeks between mid-term and exam? I really don't know how to interpret this."

3.4 Assignments

At the introductory level, computing courses lend themselves well to the use of frequent assignments. Since most courses in our study were introductory, students had

always been given numerous assignments. Under OBTL, our instructors had further increased the number of assignments, for example from biweekly to weekly. Of course, a weekly assignment will be shorter than a bi-weekly assignment. However students still saw a net increase in the total amount of time spent on the more frequent assignments under OBTL.

4 OBTL Influence on Students

4.1 Motivation

Thanks to the increased frequency, the smaller assignments took less time for instructors to grade and give feedback. The students received feedback of their work sooner and typically within a week. They were happy to know their current progress. For the few courses that used criterion-based assessments, students were also happy to have multiple opportunities to demonstrate their abilities on the learning outcomes. If a student had already achieved a learning outcome in a quiz, he or she had one less item to worry about in the final examination.

Some instructors reported an increase in class participation. We can think of two possible explanations, either the students were better motivated or they became more capable. The net increase in assignment workload did not cause students to complain except in one course where insufficient marks were allocated to the assignments. Three instructors reported that their students were happier in outcome-based courses. But one instructor put it bluntly, "Students do not seem to care if a course is OBTL or not. They only care about how OBTL will affect their grades."

4.2 Performance

Only one instructor reported a noticeable improvement in students' performance after switching to OBTL. But it is worth noting that this instructor received a very poor evaluation from students in the previous delivery of the same course in non-OBTL fashion. A swing from an extreme back to the norm may be natural and unrelated to the approach used.

One other instructor kept track of the rate of learning outcomes achieved in quizzes, mid-term and final examinations. A trend of progression was observed. In other words, more students could achieve a learning outcome in subsequent tests. But this is an improvement in performance from one assessment to the next. It did not indicate overall improvements due to the use of OBTL.

The other thirteen instructors reported no observed improvement in the overall student performance. This stagnant student performance in the final examination is especially disturbing amid the moderate increase in time spent on assignments and a likely improvement in motivation. The lack of observed improvement may not be a true picture. Papers and pencils used in a conventional setting of examinations could be unsuitable in the assessment of some learning outcomes. Even with known limitations in in-class quizzes and examinations, we cannot rely heavily on take-home assessment due to the concern of possible plagiarism. The unrealistically good performance on the assignments suggests that students are receiving too much help from fellow students.

Higher frequency of assignments is usually found to improve student performance [10]. The increased frequency in our sample has not found to improve student performance. It may suggest that the increase from bi-weekly to weekly is insignificant to university students.

5 OBTL Influence on Instructors

5.1 Assessment Design

The creation of practical artifacts is fundamental in computing. Students are almost always required to create something useful, for example working programs, diagrams, calculations, proofs and test data. It is rare in computing courses that students do not need to produce concrete artifacts. With or without OBTL, computing students are always asked to produce some artifacts. Under OBTL, learning outcomes are essentially the abilities to produce these artifacts. Therefore we were not surprised when the majority of our instructors did not find learning outcomes useful in their question preparation. However learning outcomes may help assessment design in other disciplines.

5.2 Instructor Workload

Instructors had taken the time to learn OBTL from seminars, workshops, printed and online materials. They spent a significant amount of time to prepare questions in the weekly assignments, grading them and giving comments. They could manage the additional effort in teaching and learning preparation.

The biggest problem for them is criterion-based assessment. A simple spreadsheet can represent a student with a row and a learning outcome with a column. But a learning outcome can be tested multiple times: in a quiz, a mid-term examination and again in a final examination. The spreadsheet has just gotten a little more complicated. In fact, a question can test multiple outcomes and vice versa an outcome can be demonstrated in multiple questions. Finally, the student's achievements in various outcomes need to be combined into a final grade. Our instructors found the effort excessive without proportionate benefits in student learning. They concluded that, given their current teaching load, criterion-based assessment endorsed by OBTL advocates is infeasible for courses with over fifty students. The two instructors, who had faithfully attempted the criterion-based assessment, decided to revert back to norm-referenced assessment.

The academic department tried to alleviate the problem of added instructor workload by approving instructors' requests to hire student helpers to mark the assignments. But this solution has its problems. One instructor reported the difficulty in hiring qualified helpers. Another instructor had to restrain the assignment questions so that they were easier to mark by the helpers.

6 Summary

Universities in Hong Kong have invested in OBTL: hiring external consultants, sending instructors to workshops, and creating printed and online OBTL resources. OBTL advocates recognize the extra time required to go OBTL [3]. However our

interviewed instructors had to teach the same number of courses under OBTL. With the typically large university classes in Hong Kong, instructors have taken the shortcut of norm-referenced assessment instead of the criterion-based assessment endorsed by OBTL advocates [11]. Fourteen of the fifteen instructors reported that student performance is unaffected by OBTL. We have made the assumption here that the instructors know how to accurately assess the students' abilities. Increasing assignment frequency from biweekly to weekly has not helped student performance either. Our findings are biased towards introductory courses and may not apply to non-computing courses.

The current grading system used in the universities, that represent a student's performance by a percentage or a letter grade, does not make OBTL any easier. Combining a student's abilities in various outcomes into a single final grade is tedious and somewhat arbitrary [12]. An overhaul of this grading system may be in order before criterion-based assessment can be practically applied.

A key reason for the current push towards OBTL in Hong Kong is accountability. However no mechanisms are in place to check that the teaching, learning and assessment activities are indeed constructively aligned with the learning outcomes. Instructors are our main reference of student performance. When instructor performance is affixed to student performance, instructors would be tempted to paint a rosy picture that is not necessary accurate and complete. The use of OBTL in this context gives a false sense of accountability.

To prevent OBTL from being reduced to a paper exercise, instructors' teaching load must be lowered to account for the additional effort in assessment. The effects of OBTL are not fully understood. Researchers should continue to look for empirical evidence. Missing in our paper is the perspective from students. Hopefully in the future, we will be better at tweaking OBTL for various disciplines and course levels. For your food for thought, we shall conclude the paper with the following quotation from an instructor.

My courses teach computer programming. I do not see the benefits of applying OBTL. I have always been a good teacher. I earned top evaluation from students. Even the weak students can learn in my courses. I received requests from around the world to use my online teaching materials. I don't want to change the non-OBTL approach that I have been using successfully for years.

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Design and Implementation of the Framework for Adaptive e-Learning System*

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Abstract. e-Learning system, being a great product of modern information technology, is an important means for implementing education informationization. Many e-Learning systems have been developed in recent years. However, most of them are unable to organize and present education materials according to individual learner's knowledge and learning ability. Aiming to this deficiency, this paper proposes a framework of adaptive e-Learning system, which employs an adaptive algorithm that uses Bayesian Network to configure the course knowledge and generates the adaptive learning path by the judging algorithm according to user's ability. And then the paper presents the implementation of the adaptive e-learning system, including system functional model, business flow, and data flow.

Keywords: Adaptability, e-Learning, Bayesian Network, XML.

1 Introduction

E-learning is defined as the whole activities of teaching and learning based on computer management environments constructed from network information techniques with interactive communications [1]. With the development of information technology, network technology, and multimedia technology, e-learning is becoming a trend of teaching methodology, which breaks the limitation of traditional teaching model in space-time.

Adaptable teaching may adaptively provide the teaching contents to learners according to the basis and ability of learners. As a developing teaching methodology, adaptive e-learning has become a challenging and interdisciplinary research field. For providing adaptability, the relative students' information should be collected, and the adaptive contents and adaptive navigation link are presented based on the personal characteristics. Gerhard Weber addressed the overlay model [2] for the modeling of students, in which the students' knowledge is regarded as a subset of specialist knowledge database. The understanding of knowledge is evaluated by comparing the students' performance with the required basic teaching outcomes, and hence, the corresponding teaching contents may be

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recommended to the corresponding students. Stereotype model [3] proposed by Elaine Rich is one that describes the knowledge status of users. In this model, the users are grouped before they are initialized according to the prototype. For evaluating the students' performance, Bayesian network has been used in teaching systems by Villano [4]. As a model for representing uncertainty and reasoning, Bayesian network is a directed acyclic graph. On the graph, each node has a conditional probability distribution, while each "directed connection" describes the causality among different nodes [5].

At present, the research of adaptive e-learning teaching system is not yet popular in china. Only a few valuable adaptive e-learning teaching systems are proposed. In literature [6], a set of teaching organization projects and method of user modeling are proposed, as well as learning supporting systems based on intelligence adaptive characteristics and A-Tutor prototype system are designed. However, due to the lack of module of evaluation, the adaptive teaching system is seldom used in practical courses. In literature [7], the learning methods and strategies of students are obtained through the observation of learning performance using Bayesian classifier, and a personal teaching strategy is generated. But this system is not being used as only the prototype of adaptive intelligence teaching-learning system is designed.

2 Design of Adaptive Algorithm

In this paper, an adaptive algorithm is proposed. First, the framework of course knowledge is configured using Bayesian network, and the generic learning path is generated. Then the prior probability table of influence extent among nodes is obtained according to the user profile and Bayesian network. Finally, the adaptive learning path is generated by the judging algorithm according to users' ability. Based on the steps, the adaptive teaching-learning is performed.

2.1 Prototype of Adaptive e-Learning Teaching System

The prototype of adaptive e-learning teaching-learning system consists of three layers: concept layer, relation layer, and user view layer, as shown in figure 1.

Concept layer is the physical layer for storing concepts. The learning behaviour is the cognization to concept. The concept may be either simple one or concept units formed from organization and application of multiple concepts. The relation layer describes the relation between concepts. The simple concept or composite concept extracted from concept layer combined with definitions form the knowledge unit, which generates a generic learning path. All the knowledge units are collected to form a curriculum. The relation of Bayesian network is defined in the relation layer. Father node is defined by prerequisites of concept, while conditional probability table is the joint probability distribution of each variable in Bayesian network. In user view layer, the adaptive learning path is generated for different learners by comparing generic learning path with users' profile.

2.2 Adaptive Diagnose Design

Adaptive diagnosis is the judgment of learners' ability. Students are tested by a group of selected questions. The test results are used to evaluate the abilities of students and the

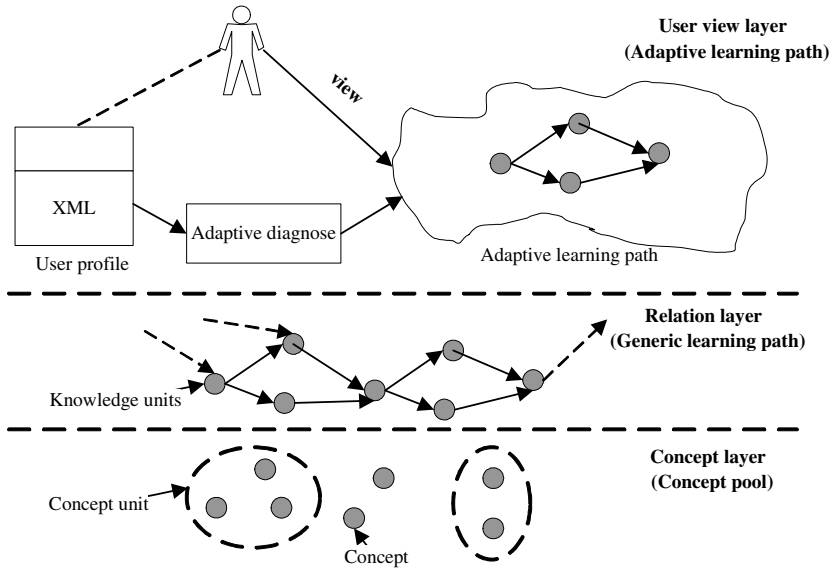


Fig. 1. Diagram of adaptive e-Learning system prototype

extent of understanding of knowledge. Adaptive diagnosis is important for organizing the learning contents actively, which is performed in the beginning or progress or end of the learning. If the judgment is not performed, there is no way to know the learning requirement of individual learners. Hence, the adaptive teacher-learning can not be realized.

The mostly used method in adaptive diagnosis is based on item response theory [8][9]. The three-parameter logistic model is used in the paper as shown in the following [10]:

$$P_i(\theta) = c_i + \frac{1 - c_i}{1 + e^{-1.702a_i(\theta - b_i)}} \quad (1)$$

Where $P_i(\theta)$ is the probability of response to question i correctly of students with ability of θ , a is discrimination of question i , b is the difficulty of question i , and c is pseudo-chance parameter of question i .

Figure 2 is the item characteristic curve of three different questions in 3-parameter logistic model.

From figure 2, we can see that a_i is the slope of inflexion of characteristic curve. A higher a value indicates the higher of discrimination. b_i is the value of θ corresponding to the $P_i(\theta)=0.5$ of the probability of right answer. The higher value of b_i means the higher difficulty. c_i is the intercept of curve. A higher c value indicates that the question is easy to answer no matter what the tester is high ability or low ability. In the diagnose process, the question should be with high discrimination, low pseudo-chance and appropriate difficulty, as illustrated by the question 2 in figure 2. After the

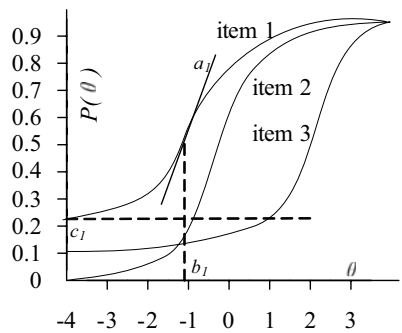


Fig. 2. Item characteristic curves

system worked for a period of time, the questions in database are adjusted according to the statistics of each question response, so that the ability judgment algorithm of learner is simplified.

2.3 Design of Adaptive Navigation

Due to different characteristics, each learner has his own user profile in the adaptive e-learning system. User profile is a formatted structure of XML file in the paper as shown in figure 3, which includes the learner’s information such as name, learning objective, learning ability, and learning experience. According to user profile, the adaptive learning path adaptive to each learner is generated through ability judgment algorithm of learner. As the result, adaptive navigation is implemented.

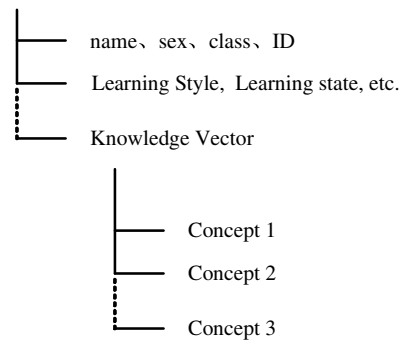


Fig. 3. User profile structure

Adaptive navigation is constructed using techniques of link hiding and Bayesian network. The state of each node is decided by the algorithm of Bayesian network, and the node may be removed according to learning objectives. The wrong path then are corrected and the adaptive path is generated. The pseudo code algorithm of adaptive navigation is described as follows.

```

1 : Initiate a empty set  $U$ .
2 : Initiate a graph  $G(V, E)$  where  $V = \{ \text{all nodes of a concept set} \}$ ,  $E = \{ \}$ .
3 : for all node  $v_i \in V$  do
4 :   Initiate a ordered set  $P = \{ \text{All require nodes of } v_i \}$ .
5 :   if  $P$  isn't empty then
6 :     Put all pair of nodes  $(p_i, v_i)$  into  $E$  where  $p_i \in P$ .
7 :   end if
8 : end for
9 : Set states of nodes.
10 : for all  $v_i \in V$  do
11 :   Initiate a empty ordered set  $R$ .
12 :   if the level of  $v_i > \text{learning objective}$  then
13 :     Put  $v_i$  into  $U$ .
14 :     for all  $(v_i, v_j)$  where  $v_j \in V$ ,  $(v_i, v_j) \in E$  do
15 :       Put them into  $R$  and remove them from  $E$ .
16 :     end for
17 :     Initiate a empty set  $E'$ .
18 :     for all pair  $(v_m, v_n) \in R$  do
19 :       for all pair  $(v_x, v_y) \in E$  do
20 :         if  $v_y = v_m$  then
21 :           Put  $(v_x, v_n)$  into  $E'$ .
22 :         else
23 :           Put  $(v_x, v_y)$  into  $E'$ .
24 :         end if
25 :       end for
26 :     end for
27 :      $E = E'$ 
28 :   end if
29 : end for
30 : Generate a new graph  $G'(V - U, E)$ .

```

Line 1: U is initialized for storing the removed nodes.

Line 2–8: A graph $G(V, E)$ is defined, in which V is a node set while E is a edge set. A generic learning path is initialized to a graph.

Line 9: The level of each concept layer is deduced.

Line 10–29: Browse each concept node.

Line 11–13: Find out concept nodes with level higher than learning objective, which can be removed and stored into U .

Line 14–16: Find out all the child-nodes in the removed node.

Line 17–26: Find out all the father nodes of removed node, and link each father node to all the child-nodes with direction line.

Line 27: Remove the directive line from E .

Line 30: The graph $G'(V - U, E)$ is the adaptive learning path.

3 Realization of Adaptive e-Learning System

3.1 Design of Framework

In this paper, we use a B/A/S (Browser/Agent/Server as shown in figure 4) mode for designing a system of adaptive e-learning. In this system, users can surf the internet using browser and no need to install software in the user computer.

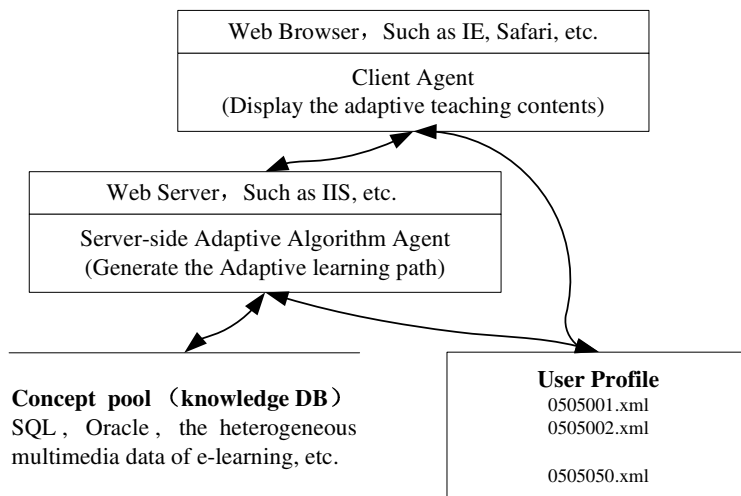


Fig. 4. System structure chart

The mode of B/A/S provides a unified environment for network teaching, and simplifies the development, maintenance, and training cost. On the other hand, user terminal and services can be enhanced by using intelligent agent. The agent is developed by Flash ActionScript 2.0, which is used to solve the problems of integration, exchange and presentation the heterogeneous multimedia data of e-learning. Because almost all internet browsers integrate plug-in of Flash Player ActiveX, the problem of presentation of multimedia of e-learning can be solved. The learning process may be recorded by intelligent agent, and the user profile of XML may be emended. Therefore the adaptive navigation can be generated and the adaptive teaching contents can be displayed to the user.

3.2 Design of System Function

Based on high cohesion and low coupling with modular programming design method, the adaptive e-learning system has the structure and function module as shown in figure 5.

3.3 Design of Business Flow and Data Flow

As the core user, the student can enter the all the activities provided by the adaptive e-learning system, which includes the activities like studying, testing, referring the course blog, joining the course discussion, submitting the assignment and experiment reporting.

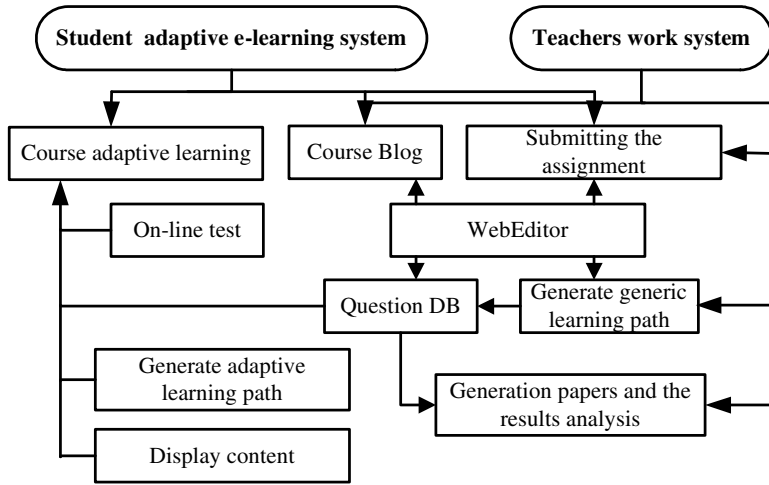


Fig. 5. System module division plans

3.3.1 Adaptive Testing Process

On the start of adaptive e-learning, the student will be tested for evaluating the knowledge level and ability. According to the testing results, the student will be provided the teaching contents that are mostly adaptive to their ability. The adaptive testing process of adaptive e-learning system is shown in figure 6.

Step0: Choosing the history records independently. It is one way of starting an adaptive testing. According to the historical records in adaptive learning diagnose table, the testing is stepped to step 3.

Step1: Choosing the corresponding knowledge independently. It is one way of starting an adaptive testing. According to statistics of questions belonged to a given knowledge in question database in 1-level knowledge table, the student may choose the 1-level knowledge that can be implemented based on adaptive learning.

Step2: Preparation of learning diagnose questions. According to statistics of questions belonged to a given knowledge in question database in 1-level knowledge table, choice question table, judge question table, and the distribution of questions related to the given knowledge, one question from one knowledge that matches the ability difficulty θ of learners is extracted from question database.

Step3: Learning diagnose testing. The students answer the question and submit the answer in prescribed time.

Step4: Analysis of knowledge structure defects. Learning diagnosis data may be analyzed automatically to evaluate the knowledge structure defects and ability of students. On the basis of analysis, the adaptive algorithm is constructed through adaptive navigation, and the adaptive learning path is organized and generated.

Step5: Adaptive teaching. Knowledge structure defects are remedied through adaptive learning.

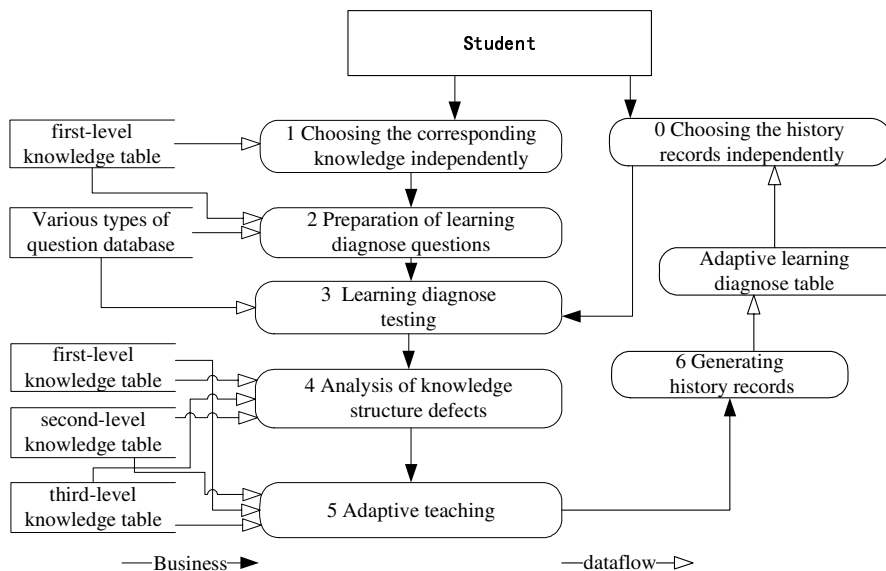


Fig. 6. Business flow diagram and dataflow diagram of adaptive testing system

Step6: Generating history records. Learning records are filled into adaptive learning diagnose table.

3.3.2 Phase Testing Process

The phase testing is implemented in the process of learning or after the end of learning. Testing during the process of learning can find out the weak aspect of learning and provide basis for consolidating learning. What is more, training and testing are the methodology of learning. Testing after the end of learning is the final test of students' learning outcomes, which tests that students meet the expected instructive objectives or not. The adaptive phase testing of e-learning system is shown in figure 7.

Step0: Preparation. This step is required if the course question database should be modified or the property of knowledge in database should be varied. Question database is ordered by setting the knowledge order, order of questions of high difficulty, order of questions of low difficulty. The statistics results are stored in "first-level knowledge table", "second-level knowledge table", and "third-level knowledge table", which will improve the efficiency of algorithm of generating testing paper.

Step1: Add phase testing and its query /modify of parameter. The different phase testing papers can be generated through adaptive e-learning system, in which the types of testing, question type, distribution of knowledge, difficulty coefficient, testing object, allowed testing times, paper open time, and testing time are set by requirements, as well as queried and modified at any time.

Step2: Setting the strategy of generating testing paper. There are three testing types provided by our e-learning system, they are course testing, unit testing, and knowledge testing. The table of generating paper strategy can be set according to the types of testing.

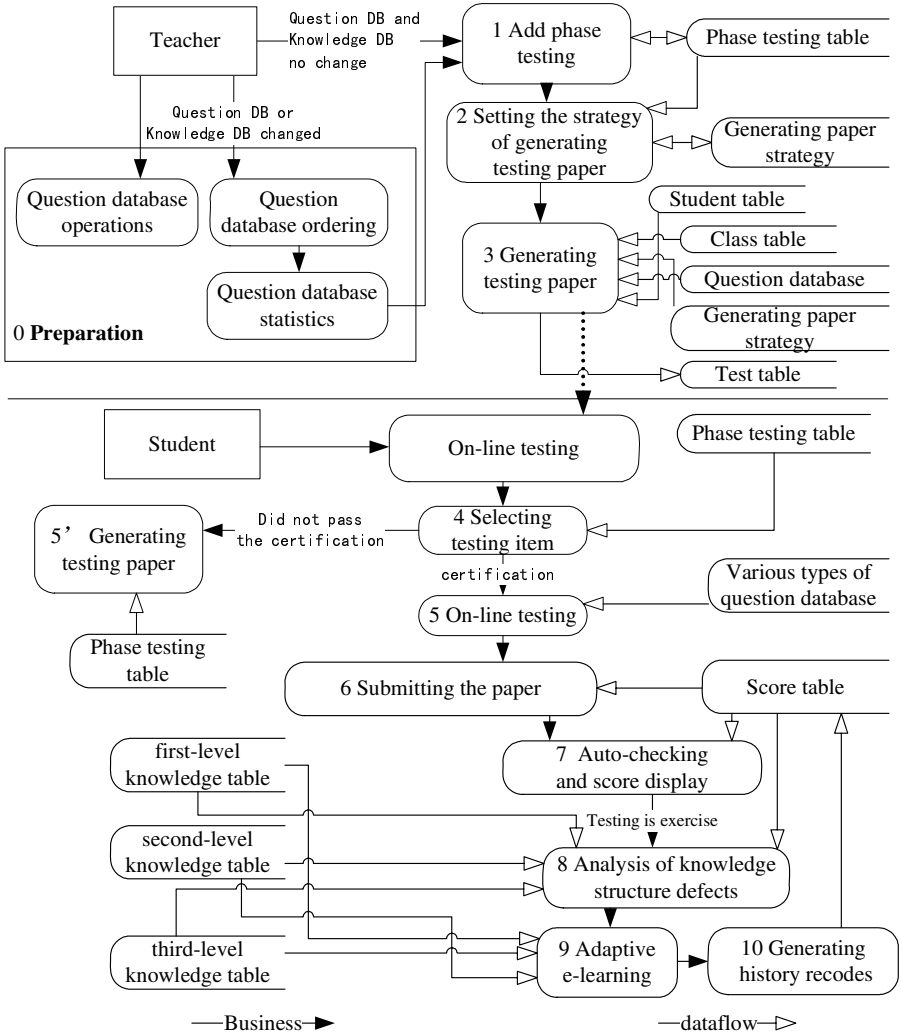


Fig. 7. Business flow diagram and dataflow diagram of phase testing system

Step3: Generating testing paper. After the user determine the strategy of generating paper, the questions are selected from database according to the table of strategy of generating paper. These selected questions form a desired testing paper.

Step4: Selecting testing item. The testing items can be recommended according to the learning progress and the current learning ability value. Students may choose all the phase testing items opened to the students' class.

Step5: On-line testing. Students should answer the paper and submit the paper in the prescribed time.

Step6: Submitting the paper. The on-line testing is set count down automatically. When the setting time is over, the system will submit the paper automatically. The students may submit the paper at any time.

Step7: Auto-checking and score display. The paper checking is performed by system automatically, and the scores are displayed in real time.

Step8: Analysis of knowledge structure defects. If the type of testing is of exercise, the system will take adaptive algorithm for learning diagnoses of knowledge structure defects.

Step9: Adaptive e-learning. The system may obtain situation of students' understanding of course based on the testing results. The adaptive tutorial contents is organized for the adaptive e-learning.

Step10: Generating historical records and adjustment of teaching strategy. The testing results of each test of each student are recorded in system automatically. The teacher can analyze the scores of phase testing, and know the teaching effects, the difficulty of test paper. Based on the analysis, the teacher can adjust his instructional contents.

4 Conclusion

The development of computer network is promoting the modernization of education. The development of E-learning is going with Internet technique. Our designed adaptive e-learning system has been used in several degree courses over ten classes for two years. In the use process, the system is stable, and produces a good teaching effect. Its performance meets the expected requirements.

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Engaging Students with Online Discussion in a Blended Learning Context: Issues and Implications

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Abstract. Computer-mediated communication tools have been increasingly used to support face-to-face teaching. In this paper, we explore the motivating and inhibiting factors that affect students' participation in voluntary online discussions in a blended learning context. Students' online participation is conceptualized as a three-phase process: jumpstart online activity, promote interaction and sustain discussion. The results indicate that students' disengagements in online discussions were due to a number of reasons: their perceptions, peer influence, media preferences and the voluntary nature of the activity, to name but a few. Finally, we highlight several issues concerning students' participation in online discussion and their implications for designing meaningful and engaging online discussion in parallel to in-class teaching.

Keywords: Online discussion, blended learning, participation.

1 Introduction

Increasingly, blended learning that utilizes computer-mediated communication (CMC) tools to support face-to-face (F2F) instruction has become a popular mode of e-learning [4], [13]. The essential rationale underlying this blended paradigm is the supplementary relationship between the online and offline modes of communication [20]. Online interaction made students better prepared, more comfortable and confident in in-class debate; and the F2F discussions warmed them up for the online work as well [24]. Compared to the sole F2F delivery mode, the blended learning environment led to enhanced learning performance, satisfaction and enriched learning experience on the part of students [1]. A successful blended course, however, entails more than just an addition of web-based media, but a thoughtful and meaningful integration of online and offline experiences [10]. As [5] observed, the synergy did not come naturally and automatically since the online and in-class discussions might compete with each other. This thereby poses daunting challenges for teachers to minimize the tension between the face-to-face and online activities.

Our study focused on a group of undergraduate students enrolled in BA (Bachelor of Arts) & BEd (Bachelor of Education) double degree program at a local university in Hong Kong. To expand in-class interaction and enhance group cohesiveness, online asynchronous discussion was employed as a supplement to F2F teaching. The instructor was an experienced and dedicated online facilitator, yet found this group of

students were not enthusiastic about online discussion in spite of her constant encouragement both online and offline. This set our investigation into the factors behind students' disengagement. The specific question posed to guide our study was: what are the factors affecting students' perceptions and participation in the voluntary online discussion in a blended learning context?

In the following review of literature, first the seemingly simple yet fuzzy and complex concept of online participation is unpacked into a three-phase process. Next, we synthesize current studies regarding students' motivation and online participation in the context of higher education. Finally, this paper identifies the knowledge gap in the research.

2 Literature Review

2.1 Online Participation: A Three-Phase Process

A substantial body of research has revealed a wide range of educational benefits of online asynchronous discussions, for example, temporal and spatial flexibility [7], [23]; equal participation [22], enhanced reflection and critical thinking [27]. However, an online forum itself is nothing but an empty shell. What bring this forum to life are those visitors, contributors and consumers. [9] maintained that a sizable number of posts was a necessary, if not sufficient condition for successful online discussions. On this account, students' participation in the online forum becomes a critical ingredient for its success and one of the main challenges in web-based learning as well [3].

Let's first take a step back and consider what constitutes online participation. As simple as it may seem, online participation is more than just the quantity of posts or time spent online [15]. There is a lack of strong theoretical frames of reference to better understand and study online participation. Through reviewing literature in this area, [15] noted a diverse way of conceptualizing learners' online participation, for example, time spent within an online system, quantity and quality of online posts, reading and writing posts, participation in a dialogue. [3] took another approach by classifying online learners based on Moore's model of interaction [18]. He/she differentiated four types of online learners according to the levels of student-content and student-student interaction: "missing in action" (low student-content and low student-student interaction), "witness learners" (high student-content interaction and low student-student interaction), "social participants" (low student-content interaction and high student-student interaction) and "active learners" (high student-content and student-student interaction).

In this study, we took a different approach by conceptualizing students' online participation as a series of processes: 1) jumpstart online presence; 2) promote interaction; and 3) sustain focused discussion.

Jumpstart Online Activities. The first challenge faced by online teachers is to attract students to discussion boards as both audiences and contributors. Arguably, it is more challenging to jumpstart an online discussion in a blended learning context, since the purpose of having an online discussion parallel to F2F classes needs to be justified and its added value needs to be understood and appreciated by students. Irrespective of the prevalent use of Course Management Systems (CMS) in higher education, they are mainly used as storage places for digital resources, not platforms for exchanging

ideas [19]. The potential of the web-based technology as an interactive medium is not fully exploited. With the limited exposure to asynchronous online discussions, students are unaware of their pedagogical benefits. In this circumstance, it becomes crucial to ascertain that students are oriented in online systems, informed of the benefits and convinced of the needs for web-based discussions.

Promote Interaction. Once students jump onto the bandwagon of online discussion, another issue at hand is to ensure they talk to each other and on-topic. Having students contribute in an online forum does not necessarily mean that they are engaged in a dialogue [9]. One potential problem with compulsory online postings is that the messages might be standalone rather than be related. In this way, online forums are more like bulletin boards, not interactive discussion spaces [6]. Thus the second challenge confronting teachers is to get students to read and respond to each other's posts.

Sustained the Focused Discussion. The ideal state of online discussion should be in-depth, interactive and sustained. However, even if students respond to each other, comments or feedback exchanged among peers might be repetitive, irrelevant and meaningless since many students are active for the sake of grade marks only [14]. Other times, online discussions might deteriorate into purely social interactions. Social presences or social interactions alone, as [11] noted, were not enough to ignite purposeful reflections and critical discourse. The real value of online asynchronous discussions lies in the sharing of alternative perspectives and constructive and affective feedbacks given to each other [7]. That suggests that endeavors should be made to move interactions beyond the social level and strive for engaging, focused and sustained online discussions.

2.2 Factors for Online Participation

With a better understanding of what online participation means, another question arises here is what makes students participate? The rather limited research on this theme revealed heterogeneous motivations. [2] summarized the crucial conditions for successful e-learning experience from the literature as follows: support from teacher and peers, time issues, experience with technology and adequate technical support. In particular, she stressed the importance of assessment by claiming that students' motivation suffered when online activities were not counted toward assessment. [6] explored students' participation in online courses and synthesized the determining factors into three categories: attributes of technology, course design and online facilitation, characteristics of students and context. First, the text-based and time-independence nature of online discussion created problem of information overload and time management. Second, in terms of course design and facilitation, students identified the need for social activities, pacing and instructor's participation. Besides, students' learning style or personality, their perceptions of online learning influenced their online engagements. Being used to the didactic mode of learning, students found it challenging to direct their own course of learning in the online context. In a more focused fashion, [9] examined the relationship between the design of online discussions and students' engagements in web-based courses. Among others, they found that the relevance of the online discussion to other course activities and

students' lives in general contributed to students' motivation or a motivation. [25], on the other hand, identified several learner-related factors affecting their participation in online discussions: previous online experience, learning style/ preference, content area expertise and experience, online role and instructional tasks and information overload/ time issue.

Studies on students' online participation in the blended learning context are even more scant. [28] examined students' intrinsic motivation related to their online discussions as a supplement to F2F teaching and delineated several issues: instructor's online presence, interaction between peers, discussion topics, course requirements and usability of the online system. [8] explored campus-based students' perceptions of the added value of online learning and summarized four types of factors that influenced students' experience with technology: 1) individual factors such as prior experience, attitude and self-efficacy; 2) support factors including peer encouragement and tutor support; 3) lecture/module factor such as grading, reward structures; 4) university factors including technical support, resource availability and accessibility. Among others, the peer encouragement and perceived tutor support were recognized as of great significance. However, both these studies failed to identify the determining factors specific or crucial for blended learning.

2.3 Research Gap

In spite of its prevalence in educational context, blended learning has not been sufficiently attended to in academic studies [16]. Little research has focused on blended learning environments and the mechanism of integrating F2F and CMC [11]. Through a comparatively extensive review of literature concerning online teaching and learning in higher education, [26] identified the blended mode of learning as an important yet neglected research area. At the same time, our understanding in relation to why learners participate in online discussions and the factors that influenced their engagements and satisfaction was limited [6]. To reinforce this point, [28] maintained that there was limited research on students' motivation for participating in online discussions. [12] reviewed the papers published in the late 90's in the refereed distance educational journals and found only a handful of studies addressing explicitly the relationship between learner's characteristics and the unique aspects of online learning. This study seeks to fill these research gaps by exploring students' perceptions and experiences of voluntary online discussions and unraveling factors that motivate or inhibit their online participation. An important mission of our work is to develop a set of recommendations for teachers to make informed decisions on how to better design meaningful and integrated blended learning experiences.

2.4 Study Context and Data Collection

This study focused on a group of year 2 BA & BEd double degree students at a large university in Hong Kong. BA&BEd degree program is offered jointly by the Faculty of Arts and the Faculty of Education. This cohort of students was chosen for our study due to a number of considerations. First, BA&BEd students are exposed to multiple CMSs during their study since there is no central and unified CMS in this decentralized institution. The Faculty of Arts adopts WebCT while the Faculty of Education uses a home-grown CMS – Interactive Learning Network (ILN). Second,

the instructor of this cohort used to have successful online discussions on ILN with her BEd students but found this group of double-degree students not so engaged. It is this problematic situation and the unique circumstance that provoked our interest in this case. The course we focused on was a core course which lasted for 21 weeks starting from September 2007 with a three-week teaching practicum included. During the teaching practicum, students were dispersed in various schools across Hong Kong mostly in pairs. There were 24 students in the class. In the instructor's words, this group of students was "the most self-motivated, autonomous and keen group" she had ever taught. The instructor herself was a very experienced user of ILN and used the embedded discussion forum for almost all the courses she taught. In this course, students' participation in online discussions was voluntary except for the last two weeks. It was her intention to strengthen the cohesiveness of the group and promote collaborative learning through online discussion. However, students' voluntary participation in the online discussion turned out to be sporadic. They seemed to have little interest in the online venue for discussions even during the teaching practice when the class became physically dispersed.

As an exploratory case study, the present study used questionnaire and interview as the main vehicles for data collection. We also conducted observation of the class both online and in the classroom setting. The online posts were collected for further analysis. A paper-based questionnaire was administered at the middle of the course. It was when the online participation problem had emerged and before students left for teaching practicum. The purpose of the questionnaire was to tap into reasons for students' low interest in online discussion and evaluate their needs for its continuous use. The design of the questionnaire was informed by both the related literature and the instructor's perspectives. The instructor suspected that the low level of participation might be associated with the two parallel CMSs in use. Thus the questionnaire aimed to elicit students' experience and perceptions of two CMS systems – WebCT and ILN, and the factors that influenced their online engagements. To be more specific, we tried to collect data in the following aspects:

- Students experience: CMSs usage (frequency, features used)
- Students perceptions: perceived ease of use, perceived usefulness of CMSs
- Factors that might influence students' online participation: 1) individual, e.g. technical skills, habit, experience with other technology, comfortable level with asynchronous communication; 2) instructional, e.g. teaching strategy, teacher support, reward scheme; and 3) contextual, e.g. resource, support.

To have a more in-depth understanding of students' perceptions regarding online discussion, we conducted two focus group interviews at the end of the course. The student representative was involved in recruiting interviewees. The researchers suggested several students they were particularly interested in, for example, a student who was very active in the online discussions at the beginning. We finally selected three male students in the first group and three female students in the other group. Consisting mostly semi-structured questions, the interviews focused on students' engagement with online discussions, reasons behind this and suggestions for improvement. The interviews were audio-taped and transcribed for later data analysis. Additionally, informal interviews were conducted with the instructor on a number of occasions to collect her viewpoints and perceptions.

3 Results

3.1 Online Activities

During the course of 17 weeks, 11 folders (T1 to T11) were created in the online forum on ILN based on topics covered in weekly sessions. Figure 1 illustrates the number of posts in each discussion folder. We further differentiated online posts made by the instructor and students. The students generated posts were mostly lower than 10 in each folder except for T10 which yielded significantly higher number of posts (67) due to its required participation. T10 was created to supplement the student-led discussions for the last two sessions of the course. Students worked in groups and took an active role in selecting readings, presenting and leading the class discussion on a chosen topic based on their interest or teaching experience. After the class, students were also required to post their reflection online and choose at least one post to comment. Additionally, we browsed through the posts in each folder to get a broad-brush sense of the content. Posts in three folders (T6, T7, T11) were found to be of a “house-keeping” nature which consisted of course administrative notices. T4 and T8 were designated for group-based micro-teaching workshops thus were mostly used as bulletin boards to announce the formation of groups and circulate group work. The rest of the discussion topics related to course content, where the instructor took a lead role and initiated the discussion in T2, T3 and T9. Students themselves took the initiative in posting questions in T1 and T5 only. T9 was created for students to share experience and keep in touch during their teaching practice.

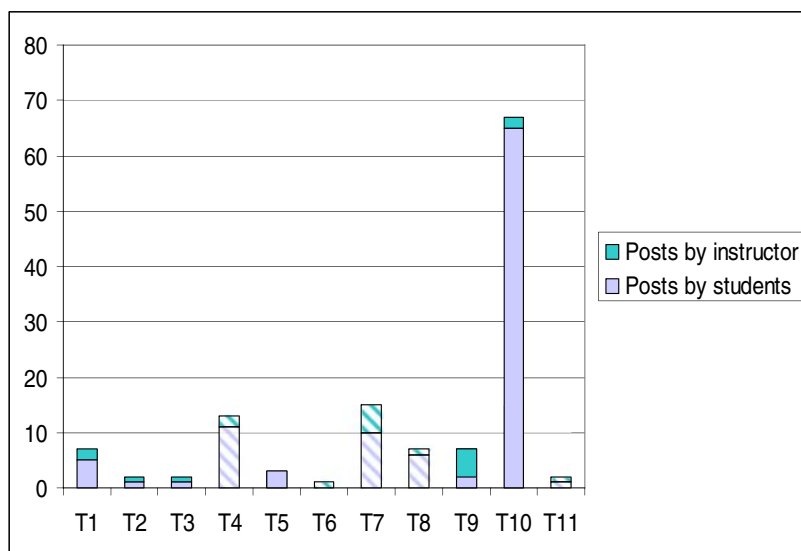


Fig. 1. Posts in each discussion folder

The instructor hoped the additional online channel could further strengthen collaborative learning and discussion among students. From a social point of view, the online presence outside limited classroom meetings helped to maintain cohesiveness and

social relations in the group. This was especially important during the teaching practicum when students became physically dispersed. The instructor also saw herself as a member of the learning community both on- and offline. She not only consistently encouraged students to share ideas, pursue further the topics covered in F2F teaching through online discussion, but also actively participated. Students' participation in the online discussion was optional except for the SLD sessions at the end of the course. The instructor's opposition to compulsory participation stemmed from negative feedback she heard towards it. *"I'd rather see the genuine output from students, not the forced writing."*

3.2 Questionnaire

According to the questionnaire (n=23), this group of BA&BEd students were quite sophisticated users of web-based technology. All of them had experience with both WebCT and ILN and 90% used blogs and over 80% used social networking websites. Over 70% had experience with wiki and IM. Nearly 70% of students rated their technical skill as average with 17 % thought their technical skills were weak. The majority of students thought both systems – WebCT and ILN - were easy to use with the percentage for ILN (96%) slightly higher than that of WebCT (87%). Generally, students considered CMS useful in their study and no one disagreed with this point. The salient advantage of CMS was perceived to be the convenient access to course materials. While 40% of students felt CMS helped the exchange of ideas with peers and lecturers, another 44% showed uncertainty.

When exploring deeper into the factors contributing to their online participation, the preference of using other media for peer interaction was rated as the most influencing factor with 56% agreement. The vast majority of students (91%) used the phone to communicate with each other after class. Emails, Instant Messenger and real time meetings also played an important role in peer interaction. Besides, students were reluctant to take a part in online discussions since there was not a critical mass online for meaningful discussions. Additionally, 65% of students acknowledged that their preference for in-class discussion. The biggest barrier we assumed originally – the use of multiple systems – was only perceived as troublesome by 30% of students. Surprisingly, only 13% of students felt it was time-consuming to post online. Students were also invited to rate the motivators for their online participation. 85% of students indicated that peers' participation influenced their interest in online activities. Besides, they also expected the instructor to take a leading role (83%) and acknowledged that assessment might serve as an incentive for online participation (78%).

3.3 Focus Group Interviews

The focus-group interviews provided us with more in-depth insights into students' perceptions and factors affecting their enthusiasm for and engagements with online discussions. Through a preliminary data analysis, several themes related to students' online engagements surfaced.

Perceptions of CMS and Online Discussion. Students saw ILN mainly as an online reservoir rather than a platform for discussion. This was directly related to their prior experience with CMS as mainly a storage place for course materials. One student commented about their initial experience with ILN: *"the first impression is that ILN is*

a place nobody goes for discussion. We just go there for readings and lecture notes.” They did not have a habit of participating in online discussions; nor perceived ILN as a useful platform for that purpose. Two focus groups expressed divided opinions concerning online discussions. One group looked on the forum as mainly a platform for student-to-teacher discussion, while the other group considered it mostly useful for student-to-student interaction.

Low Participation. The participation problem directly influenced students’ perceptions as one respondent remarked: *“I don’t think the online discussion was very useful since not many people posted things often and I don’t check it that often.”* Another student mentioned: *“after you checked it a few times and found there was no new posts, you just abandon it”*. Meanwhile, an early participant who was attracted to the forum on account of its convenient accessibility soon got discouraged by the low participation level. On the whole, our respondents felt that online discussion had the potential to be useful if *“everybody contributes to it and there is more interaction”*.

Media Preferences. In addition, the interviewees commented that they didn’t feel a strong need for having discussions online since they could communicate with the instructor and peer students through other media. As a part of the course requirement, each student wrote weekly journals and shared with another “critical friend”, a classmate they chose, and the instructor. They saw the journals as *“personal chatting or private communication”* and resented the idea of sharing them online. One student commented, *“... journals are like individual assignments. We won’t easily share our term papers with others.”* Another student thought of journals as a good platform to communicate with the lecturer, thus there was *“no need to raise our concerns or thoughts elsewhere”*. Email was regarded another important channel for class-wide communication. Compared to the online forum, email was perceived to be more efficient and personal.

Voluntary Nature of the Task. When a learning task becomes voluntary, it’s natural for students to feel “I don’t need to do it”. Most of the interviewees admitted that the participation requirement could be the most effective measure to at least jumpstart the online presence. Still one student remarked that the forced participation might not guarantee meaningful and authentic engagements. Students had experience with the compulsory online discussion in another course and they didn’t like the experience due to a number of reasons. They felt forced to write something that was redundant rather than supplementary to in-class discussions? (Not sure what we are trying to say here). The instructor in that course only posted notes or questions already discussed at class and he did not participate in the online discussions. The criteria for assessment that emphasized quantity only propelled students to compete with each other for the highest number of entries instead of the quality. *“We posted just for the sake of posting”*, one student commented, and he also admitted that he didn’t even read other students’ postings in that course.

Attributes of Technology. Through the interviews, we found the students had experience with three CMSs - WebCT, ILN and Moodle. One group preferred the interface of Moodle more; while the other group preferred ILN. Our respondents pointed out several constraints of online forums that thwarted their online

participation. Both focus groups thought it would be nice for ILN to send out email reminders when new posts were added in the forum. As one student put it: *"I don't go to the forum to check what's new everyday. But I check my email everyday."* One student hoped that ILN could show the recent updates on the front page of the course as Facebook does.

Community Characteristics. Due to the nature of the program, the social structure of this BA&BEEd group was more fragmented. Unlike BEEd students who have mostly the same class composition, BA&BEEd students tend to have different class schedules. The instructor felt this might be an important influencing factor for their online engagements. *"The BEd groups were more close and cohesive, so they were more comfortable sharing with others online. For BA&BEEd, they form different groups based on their schedule each year, so the group dynamics were different"*. Meanwhile, this group of students was also academically competitive. One student in the interview gave an example to show they were more motivated when tasks were associated with marks. Compared to BEEd students, *"we are motivated if the lecturer gave us some encouragement"*.

Role of Instructor. The perceived role of instructor was closely associated with students' perceived use of online discussion. In general, students expected the teacher to take a lead in initiating the topics for discussion. One group thought the input and feedback from the instructor would be of great importance since they could talk with other peer students on MSN, phone or even in-person. The other group looked upon the expert opinion from the instructor as a valuable add-on, but not a necessary condition for vibrant online discussion. What they really appreciated was the opportunity to "see different perspectives" and "learn from each other". Students in both focus groups acknowledged the instructor's diligence in the online environment and the importance of her involvement and support.

4 Discussion

In this study, an attempt to employ online discussion in support of F2F teaching resulted in a limited number of students generating posts online except for the last two weeks with required participation. The investigation into the inhibiting and motivating factors for students' online participation shed light on a number of critical issues. The upcoming discussion will center on these issues and their implications for designing engaging online discussions. An overarching framework by [6] is used for the sake of an organized and cohesive discussion.

4.1 Course Design and Online Facilitation

The main purpose of the online discussion, according to the instructor, was to maintain cohesiveness of the group and to enhance collaborative learning. Her opposition to compulsory participation stemmed from the negative feedback she received. *"I'd rather see the genuine output from students, not forced writing."* Admittedly, required participation might entail anxiety, resistance and resentment among students [1], [21]. Some students felt it was detrimental to their autonomy and intrinsic motivation for online discussions [28].

However, as [1] noted, students did not naturally understand or appreciate the values of sharing and discussing online. When leaving students to choose, only a small number of students turned out to be active participants. This did not mean that many students missed out the learning opportunities afforded by CMC, but for courses with a small number of enrollments as in our case, there would be no critical mass online for meaningful discussions. The number of posts in the forum has a direct impact on students' engagement as both contributors and audiences (is 'audience' the right word? Taylor (2000) talks of 'lurkers' - those that read but don't participate. He also made another distinction 'shirkers' these were students that neither participated nor read discussions, just avoided them. Then of course there were the 'workers' those that regularly participated). Students recognized that incentives of some kind were needed, especially at the initial stage, to help them overcome the "initial inertia" [21]. In resonance, students in our case candidly acknowledged the importance of assessment as a driver for their online participation. Hence, we suggest that the assessment might be a viable option to tackle students' motivation problem and to jumpstart their online presence - the first phase of online participation.

Having said this, assessment itself is insufficient to ensure quality discussion. This is where careful and purposeful instructional design could come into play. Online discussion in a blended learning setting, however, warrants special design considerations. The topics for discussions online should be relevant to and integrated with the in-class lectures or discussions. As our respondents indicated, simply posting the same topics already covered in the F2F sessions online was unlikely to generate lively discussions. Assessment criteria should not just appraise quantity, but also quality of the posts. Additionally, instructors' online presence, support and facilitation are also crucial. Our study confirmed the fact that students often depend on the instructor to initiate and guide discussion [29]. Students in our study appreciated and acknowledged the importance of the instructor's online presence and facilitation. Yet this factor alone, apparently, was not strong enough to drive them online in the first place. This is congruent with the statement that an instructor with a high level of presence may still have participation problems if the activity and guidelines are not properly designed. [9]. This also leads us to reflect on whether various factors weigh differently at each phase of online participation. It appears that the design of online tasks including assessment scheme, discussion topics bear more importance for jumpstarting the online presence and involvement (phase 1); while the instructor's support and facilitation might have more effects over sustained and focused online discussion (phase 2 and 3).

4.2 Technology

In our case, technology in general didn't pose as a major obstacle for students' online discussion. The majority of students felt CMSs were easy to use and they did not perceive the co-existence of multiple CMSs as particularly troublesome. Students seemed to have rather a high adaptability to various systems. The main complaint students had towards CMSs concerned their inherent constraints, i.e. their nature as a "pull" media [17]. On a discussion forum, unlike email, people must take action to seek and request information. Meanwhile, students showed a preference for having mechanisms such as email reminders to make online posts more "visible".

4.3 Students' Characteristics and Community Dynamics

Additionally, students' online participation was found to be significantly correlated to their individual and community characteristics. First, students' perceptions of CMS governed their engagement. Based on their prior experience with CMS, they only perceived CMS as a repertoire of course materials, not a useful platform for collaborative learning. As to the purpose of online discussion, students had different views. Some perceived this added channel of discussion as potentially helpful for sharing different perspectives and learning together. Others thought of it as mainly a dialogue between the instructor and students in a more public manner. Either way, their media preferences put on a tension on the adoption of the online forum. Many of them preferred F2F discussion in class and felt content with the opportunities to interact with the instructor through email and journal assignments outside class. Regarding peer interaction, students gave a number of options: phone, instant messenger, email or even in-person meetings. In addition, there were several community-related factors we cannot afford to overlook. Compared with her successful use of voluntary online discussions in the past, the instructor brought forth the issue of community dynamics and their possible effects on students' motivation. This group of students was also found to be competitive and rather assessment-driven. They were found to be more responsive to incentives related to their academic performance.

5 Conclusion

In this paper, we conceptualized students' participation in online discussions as a three-phase process: jumpstart online activities, promote interaction, and sustain discussion. We explored motivating and inhibiting factors that affect students' participation in the voluntary online discussions parallel to the F2F teaching. The results indicated that students' disengagement in online discussions were due to a number of factors that can be roughly categorized into course design, technology and students' characteristics as well as community dynamics. It was suggested that the design of online activities plays a critical role in arousing students' interests, engagement and motivation especially at the launching stage of online discussions. Rewarding system, appropriate online tasks compatible with F2F meetings are all important elements. In addition, the instructor's facilitation and support were essential to ensure the focused, meaningful and quality online discussion. Meanwhile, we consider that students' characteristics and community dynamics are vital factors teachers should take heed of when planning and designing the online activities. For instance, students' prior experience, comfortable level with technology, their perceptions of online discussion, current media practice as well as the community characteristics should be taken into account.

The findings of this study have practical implications for teachers or instructional designers to make informed decisions of and purposeful design efforts for online discussions in particular in a blended learning context. Our study confirms and extends the collective understanding concerning students' motivation and engagement with asynchronous online discussions. When comparing the results of our study with

other similar ones conducted elsewhere, we noted several interesting discrepancies. For example, students in our study had less resentment towards required participation compared to students in other studies (e.g. [21]). They also seemed to be more assessment-driven and susceptible to peer-influence. It warrants further investigation to understand whether those learner characteristics are related to the local cultural background.

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Using Web-Analytics to Optimize Education Website*

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Abstract. Since the first log analyzer was invented by Dr. Stephen Turner in 1995, web-analytics has been widely used on the Internet to achieve goals as making smart business decisions, improve business website performance, processes and their bottom lines, etc. Although web-analytics has been widely used in the economic field, yet it has not been utilized in the education domain. So this is the first introduction of the theory and the technique into the education domain. We choose the software which is a kind of log analyzer named SurfStats Website Traffic Analyzer (SurfStats for short) to be our web-analytics tool to analyze the education website — the programming of the college life website (<http://cnu401.w165.vhostgo.com/>). In order to make our education website more humanistic, practical and suitable for students to learn online, we collected the data throughout the three periods of scheduled time and then analyze the factors such as the exit ratio, the time spent per visitor, the average ratio of returning visitors per day, the pages viewed per visitor and the website overlay, etc.

Keywords: Data Collection, Reports, Web-analytics, Optimization, exit ratio, time spent per visitor, returning visitors, pages viewed per visitor, website overlay.

1 Introduction

The objectives of this study are to conceptualize and empirically build a theoretical model that how to use web-analytics to optimize the education website. Such an approach can also influence on the development of the new domain — Educational Technology. The findings of this research will not only enhance the understanding of the influence of web-analytics usage, but also affect the innovation in the domain-specific of education. The remainder of the paper proceeds as follows. The next section gives a brief introduction of the concepts and the importance of web-analytics for education website. The third section presents the conceptual model and methodology of this study. The fourth section describes web-analytics and the results of the education website. The final section discusses the implications and the limitations of this study.

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2 Web-Analytics for Education Website

The Web Analytics Association (<http://www.webanalyticsassociation.org>) has recently proposed a standard definition for web analytics:

Web analytics is the objective tracking, collection, measurement, reporting, and analysis of quantitative Internet data to optimize websites and web marketing initiatives.

Web analytics was first appeared in the 1990s. However, the preceding definition — the very first standardized definition — was not proposed until 2006, a reflection of how young the field is (Kaushik, 2007, 41). The definition above show that web-analytics helps you to find out what is the choke point of a website, but it can not offer you the ways to optimize your website. You can find out the choke point of the website through analyzing the data and think out how to optimize your website aiming for solving the choke point. Web-analytics can help overcome the age-old-analytics problem of tons of data with little action. We can collect many types of data by using a log analyzer to improve the education website. For instance, we can optimize the education website by analyzing website overlay from which you can get the overall view of how many times the links are clicked and which link is the hottest one on the home page. Then we can organize the data collected in the log files and pulled by the web-analytics tool. There are two reasons why we choose SurfStats Website Traffic Analyzer as the education Website web-analytics tool. Firstly, SurfStats Website Traffic Analyzer is primarily a site statistics program which can calculate more data than the log files record. It is intended to be a simpler sort of program — nothing wrong with that. Some other high-end web-analytics tools are intended to be a business strength program. They calculate as much as counts and gives you metrics that, as a business person, you will want. Secondly, SurfStats Website Traffic Analyzer is a log analyzer. Some other web-analytics tools may rely on cookies and JavaScript. To a log analyzer, all traffic coming from a single IP address is one “user”. But when using scripting, we have to set a cookie on an individual user’s machine, or even in a particular account profile. Then, if six computers share an outside IP on a local area network, and there are four user accounts on each computer, you “see” 24 users, not one. On the other hand, if users turn off the cookies, or forbid “third-party” cookies, we may not be able to track them at all with that kind of web-analytics tool. The best circumstance is that we may be able to track them for a particular session, but a few hours later (or the next day), they will look like brand-new visitors. To some extent, no matter how we gather the data, the most important part of web-Analytics is the stage of “Analyses” (see Figure 1) that is how we organize, plow, dig in the data and go through the details.

3 Conceptual Model and Methodology

Consistent with the aforesaid research objectives, the conceptual model has four main stages (see Figure 1). The red round circle is a period of web-analytics which is started from the red arrowhead in figure 1. The first stage named “Data Collection”, you can use the log files to collect a reasonable amount of data of the engaged education website. The second step is the stage of “Reports”(see Figure 1) which is not the

same as merely creating a report, during which stage you need to import the log files of the scheduled time into the log Analyzer together with the targeted education website. Then export the reports to a certain file. Following this step is the stage “Analysis”. During this stage you look at the massive number of reports and try your best to make sense of them. When you are starting analysis, it is all too easy to be overwhelmed by the amount of data. Instead, you should focus on what really matters and on specific behavior you are trying to understand (Burby, 2007, 96). So before moving forward, organize your data and focus on the exit ratio, the time spent per visitor, the average ratio of returning visitors per day, the pages viewed per visitor and the website overlay, etc. The process of web-analytics is rather complex and it is always seems to step back from the web-analytics tools and reports. There is no guarantee that the fourth stage can bring out a good result, but “analytics” is still the key element of the whole process. Now there comes the fourth stage — “Optimization” which can also be named as “Action” stage. It is time for you to conceive an executable scheme for optimizing the aimed education website. The executable scheme is targeting for solving the choke points which are found out by analyzing the reports generated by the web-analytics tool. The fourth stage is based on the third stage. The first, the second and the third stages are objective stages. However, the fourth stage is subjective. So the optimization should be proved during the next period of web-analytics. The result that the education website generated after optimizing means the first period of web-analytics is finished. Simultaneously, we can start again another circle (see Figure 1) which is another period of web-analytics which is also started from the red arrowhead — the first stage “Data Collection”. The education website analyzed via several periods definitely would be a more humanistic, practical and suitable for students’ learning website. The ZAAZ Methodology (see Figure 2) shows web analytics as a cyclical process focused on delivering results. There is key difference between the two Models. First of all the ZAAZ Methodology is for business purpose and it is designed for optimizing commercial website to improve economic benefits of the website. Secondly, it is based on the Business metrics. However, Education Website Web-analytics Methodology is based on the visitors’ physiological features and the psychological features especially for the online learners. Therefore we need to consider how we can make the education website fitter for learners to learn online and more humanistic, practical and suitable in psychological characteristics and physiological characteristics.

4 Education Website Web-Analytics and Result

The programming of the college life website can not achieve the previously creating education website goal and then the site owner comes for the help of web-analytics. To start with, we need to choose which one is the most suitable web-analytics tool for this education website and the Analysts to make reasonable analysis. In our project we choose SurfStats Website Traffic Analyzer as the web-analytics tool for the programming of the college life website. The first period of scheduled time (2009-3-4~2009-3-15) of the web-analytics process lasted 12 days (Table 1). Table 1 shows that the exit ratio of home page is so high that reaches 95.58%. There is enormous amount of visitors only stay on the website for 1 to 2 minutes and during these 12 days there is only 10 visitors stay on the website for more than 10 minutes. The



Fig. 1. Education Website Web-analytics Conceptual Model and Methodology



Fig. 2. The ZAAZ Methodology sees web analytics as a cyclical process focused on delivering results(Burby, 2007, 96)

Returning Visitors							
Rank	IP Address	Domain Name/IP Address	Page Views	% of Total Page Views	Visits	Bandwidth	Trend Type
1	61.232.0.138	61.232.0.138	61	33.89 %	20	0.90 MB	
2	202.108.11.100	202.108.11.100	9	5.00 %	6	0.10 MB	
3	222.73.74.110	222.73.74.110	3	1.67 %	3	0.07 MB	
4	221.239.189.159	221.239.189.159	2	1.11 %	2	0.05 MB	
5	61.232.0.132	61.232.0.132	3	1.67 %	2	0.05 MB	
6	61.232.0.136	61.232.0.136	3	1.67 %	2	0.05 MB	
Subtotal this Page			81	45.01 %	35	1.23 MB	
Total all Pages			18	100.00 %	115	3.25 MB	

Fig. 3. Returning Visitors Analyzed by the Software of SurfStats

Table 1. Data Collected During the First Period

		The First Period 2009-3-4~3-15
Days		12
Exit Ratio Of Home Page		95.58%
Average Ratio Of Pages viewed By Returning Visitors Per Day		0.93%
Time Spent Per Visitor	Percentage Of visitors 0 to 1 minute	80.87%
	Number Of visitors Over 10 minutes	10
Pages Viewed Per Visitor	Percentage Of visitors Who Views 1 to 2 pages	90.43%
	Number Of visitors Who Views over 10 pages	0

remainder of this paragraph shows how we deal with the data of returning visitors. As showed in Figure 3 during these 12 days there are 180 pages viewed among the 115 visits to the website, only 81 pages were viewed among the 35 visits. However, the IP Address 61.232.0.138 is the IP of our testing local computer, hence 33.89% is invalid datum. So we have to subtract the percentage of this item 33.89% from the item of “subtotal this page” 45.01% which makes the actual percent of total page views 11.12%. Then 11.12% divided by 12 is 0.93% per day.

The formula used above is:

Actual Return Ratio = (Total Ratio – Invalid Ratio) / Days

Based on all the factors analyzed above we had no time to hesitate to get a hump on analyzing the data, taking some measures to optimize it. In many cases, the home page is the first impression for the visitors. The purpose of the home page is to attract the site visitors to stay longer on this website for more information, to arouse the desire to learn on the website and to help them find what they need so that they can improve the performance of online learning. From table 1 we can see that the exit ratio of home page was 95.58%. So instead of blaming outside factors, the website owners need to look within themselves to find out why their website can not achieve the primary goal. The answer is the design of home page especially the layout. There are so many links on the navigation bar of the home page (see Figure 4) which may cause confusion to the site visitors and make them difficult to decide which link they



Fig. 4. The Original Home Page of the Programming of the College Life Website

Clicks		
http://www.cnu.edu.cn/gsk/index.html:		
link	Clicks	Clicks %
index/学校概况.htm 学校概况	7	17.50%
index/时间管理.htm 时间管理	6	15.00%
index/目标设立.htm 目标设立	6	12.50%
index/校外.htm 校 外	5	12.50%
index/教育天地.htm 教育天地	4	10.00%
index/人际交往.htm 人际交往	4	10.00%
index/教育科研.htm 教育科研	2	5.00%
index/教育时空.htm 教育时空	2	5.00%
index/理财投资.htm 理财投资	2	5.00%
index/压力管理.htm 压力管理	2	5.00%
index/学生专栏.htm 学生专栏	1	2.50%
Total	40	

Fig. 5. Website Overlay from the Software of SurfStats

were supposed to click. Unfortunately, behavioral and attitudinal data, as well as usability best practices, have proved that within reason, less is more when it comes to giving your visitors choices on the home page (Burby, 2007, 162-170). When people can not find what they are looking for on a web page. An enormous percentage of them will leave the site without hesitation. Only a small percentage of people will continue to dig through the site looking for what they need, but the site owner can not count on them visiting again. For the most of the patient digger will never return again. We need to make it easier for them to use the education website conveniently. Further more, seeing Figure 4 and Figure 5, the left part of the navigation bar had more clicks. The links on the left part of navigation bar like “Time Management”, “Blueprint” and “instruction sky” had 15 clicks, but the right links “Extracurricular”, “Student column” and “Finance and investment” had 8 clicks. We draw the conclusion that the links lay on the left area of the navigation bar almost doubled clicks compared to the links on the right. So we might put the important links on the left and set the navigation bar on the left area of the home age to attract more visitors and let the visitors find the most important information conveniently.

Seeing the relationship among the factors — the exit ratio of home page, the average ratio of returning visitors per day, the time spent per visitor and the pages viewed per visitor, the first step we need to improve is to make the confusable navigation bar clearer, sort the links into several categories and align the navigation bar on the right part of the home page (see Figure 6, A). Then, we changed the news photo (see Figure 6, B) in the middle of the home page to a more relevant vivid picture which will reveal the theme of this website. The three basic elements of a web page are the text, the graphics and the links. In order to attract more site visitors the web page must be designed with artistic design as media. We can add some graphics, animation, audio, media and some other kinds of multimedia to express the theme of the website (Zhiting Zhu, 2004, 88-95). Through the data we see that the home page is not so attractive and the home page has



Fig. 6. The Optimized Home Page View

contained the three basic elements of a web page. So, for the purpose of enriching the site content we added “Employment Guidance” and the “Video” categories to the navigation bar and linked to some external sites. We also added suitable background music named Net_Memory which was from the album of MistyLand created by Bandari to the site which visitors could decide whether to play or not (see Figure 6, C). We also link to some external sites to enrich the site content (see Figure 6, D). Seen from Figure 1, it is time for the result of optimization which was a new revision of the education website to come out, and along the way, moved on to the next period of web-analytics that started another red circle in Figure 1.

A: We add Employment Guidance and the video categories to the navigation bar.

B: We change the news photo to a more relevant vivid picture which can reveal the website theme.

C: We add the background music to the website and visitors can choose whether to play it or not.

D: We also link to some external sites to enrich the site content.

The first period of our study had been finished and the next period of web-analytics commenced collecting data. On one hand, the data was utilized for proving the result of the first period whether the education website had been successfully optimized. On the other hand, the data was utilized for the stage of “Analysis” in this period of web-analytics. We had been collecting the data for 10 days lasted from 2009-3-15~2009-3-24. As showed in Table 2 the exit ratio of home page had reduced from 95.58% to 89.59% which could prove that the optimization really worked. The average ratio of pages viewed by returning visitors per day was 1.50% increased by more than 50% of the percentage of the first period. While the proportion of time spent 0-1minute still accounted for over 80%. In addition, 89.56% of visitors only viewed 1-2 pages. Therefore we had to combine the data with the details of the website. As the home page had been optimized in the first period, we decided to make a detailed analysis of the sub-pages of the education website. We found that the sub-pages were not well designed for the link mode, when the sub-page opened, is designed as “TARGET=_self”, so if the visitors close one of the sub-pages, the whole website would be closed at one time. Maybe this was a significant reason for the result analyzed above. According to this analysis, the first step to optimize was to change the link mode from “TARGET=_self” to “TARGET=_blank”. Seeing from Figure 7, the second item shows that the sub-page “Time Management” was the second top exit page. So we needed to analyze this sub-page earnestly. Further more the problem aroused in part from the interface of the other sub-pages which was also not humanistic and suitable for visitors to read, especially the “Time Management” page is too long for readers to read, and the interface is not nice enough (see Figure 8). We re-designed the interface and reset the layout of the text as well as the illustrations (see Figure 9). The text is divided into 7 items. In order to make the readers switch from the different part of a long sub-page easily, we added “anchor” which were links among the contents in the same page and similar to the links between web-pages. Take the character “Top” in “Time Management” page for example; when you reach the bottom of the page, then you can click the anchor “Top” to jump to the top of the webpage which made you feel so easy to switch from different parts of the web-page. We made homologous change to the other sub-pages. After programming all the optimization scheme the fourth stage “Optimization” was accomplished and the third period of web-analytics could be started.

Table 2. Data Collected During the First Period and the Second Period

		The First Period 2009-3-4~3-15	The Second Period 2009-3-15~3-24	Remarks
Days		12	10	
Exit Ratio Of Home Page		95.58%	89.57%	↘
Average Ratio Of Pages viewed By Returning Visitors Per Day		0.93%	1.50%	↗
Time Spent Per Visitor	Percentage Of visitors0 to 1 minute	80.87%	82.61%	↘
	Number Of visitors Over 10 minutes	10	7	↘
Pages Viewed Per Visitor	Percentage Of visitors Who Views 1 to 2 pages	90.43%	89.56%	↘
	Number Of visitors Who Views over 10 pages	0	3	↗

Top Exit Pages			
Rank	Page/Filename	Visits	% of Total Visits
1	default.htm	103	89.57 %
2	index/时间管理.htm	4	3.48 %
3	index/国外.htm	2	1.74 %
4	index/学校概况.htm	2	1.74 %
5	index/教育新闻.htm	1	0.87 %

Fig. 7. Top Exit Pages Analyzed by SurfStats



Fig. 8. The Primary Interface of the sub-page “Time Management”



Fig. 9. The Optimized Interface of the sub-page “Time Management”

Table 3. Data Collected During the First, the Second and the third period

		The First Period 2009-3-4~3-15	The Second Period 2009-3-15~3-24	The Third Period 2009-3-24~3-29	Remarks	Conclusion
Days		12	10	5		
Exit Ratio Of Home Page		95.58%	89.57%	43.40%	↘	Successfully optimized
Average Ratio Of Pages viewed By Returning Visitors Per Day		0.93%	1.50%	2.03%	↗	Successfully optimized
Time Spent Per Visitor	Percentage Of visitors 0 to 1 minute	80.87%	82.61%	66.36%	↘	Successfully optimized
	Number Of visitors Over 10 minutes	10	7	19	↘	Successfully optimized
	The ratio of Number Of visitors Over 10 minutes	8.70%	6.09%	17.76%	↗	Successfully optimized
Pages Viewed Per Visitor	Percentage Of visitors Who Views 1 to 2 pages	90.43%	89.56%	51.40%	↘	Successfully optimized
	Number Of visitors Who Views over 10 pages	0	3	17	↗	Successfully optimized

Due to the limitation of study period, the third period of web-analytics lasted 5 days was accomplished three stages of the circle including the “Data Collection”, the “Reports” and the “Analysis” stages. The data collected shows as follow in Table 3 which has obvious advantageous trend that the exit ratio of home page is sharply decreased to 43.40% through longitudinal analysis. The average ratio of pages viewed by returning visitors per day was 2.03% doubled to the first period and increased by half of the percentage of second period. While the proportion of time spent 0-1 minute still accounted for 66.36% which was 16.5 % lower compared to the second period. In

addition, 51.40% of visitors viewed 1-2 pages that was 39.03% lower than the first period and 38.16% lower than the second period. As the home page and the sub-pages had been optimized during the first and the second period, the ratio of number of visitors visit over 10 minutes has raise from 8.70% (the first period) to 17.76% now. Seeing from the software SurfStats in the beginning there was no visitor stay on this education website for more than 60 minutes, but during this period it appears! The education website made great progress that not only the time spent per visitor but also the pages viewed by the visitors. Nevertheless to say, the optimization made by the “Optimization” stage is proved correct! The conclusion showed in Table 3 is consistently the same — “The targeted education website is successfully optimized!” which makes this study achieve the objectives. The three periods of web-analytics was put across. Even so there is still a lot of progress we could make to improve the programming of the college life website and do more in-depth study in the future on how to use web-analytics to optimize education website.

5 Conclusion

5.1 Summary of Research Findings

The objectives of this study are to conceptualize and empirically build a theoretical model that how to optimize education website using web-analytics. According to the study results (Figure 1, Tables 1, 2 and 3 and the optimized education website: the programming of the college life website), there are three key findings from this study. Firstly, education website web-analytics conceptual model differs from the ZAAZ methodology which means web analytics as a cyclical process focused on delivering results. Secondly, through the three periods of this study web-analytics suit education website optimization. The last but not the least, compared to the traditional statistical analysis the significant advantage of web-analytics is convenient and time saving, in addition, the optimization result is effective.

5.2 Implications of This Research

Such an approach can also influence on the development of the new domain — Educational Technology. The findings of this research will not only enhance the understanding of the influence of web-analytics usage and domain-specific innovativeness on education. It may be possible to promote the development of education website and make a meaningful positive difference to the exploration how to optimize education website effectively and time saving. Further more it will specially benefit the online learners to become more efficient in online learning. According to the findings of this study, the innovation in website optimization may make online learning popular in China.

5.3 Limitations of This Research

Although this study provides a Conceptual Model and Methodology for optimizing education website, yet, the results must be utilized with caution. Based on the analysis of all the reports analyzed in the software, the optimization scheme should be carried

out carefully according to the actual situation, such as the finance, the limit of the technology to optimize the education website, etc. Since the average ratio of pages viewed by returning visitors per day was 2.03% only, there is also a need for further research to find out the potential of using web-analytics. We plan to optimize the education website with the theory of Constructivism. However we are not familiar with web-analytics and this is web-analytics is introduced into the domain of education for the first time. So, when carrying out the experiment there is little difference between optimizing business website and education website. However it proved that web-analytics fit to optimize education website. We carry out our scheme and do further research to find out a more appropriate way to optimize education website with the workable conceptual model.

5.4 Future Research

Our further objectives are to broaden the utilization range among the education websites and web-analytics will also be used for tracking online instruction and online interactive system. On a broader front, some attention will also be given to combine web-analytics and traditional statistical analysis and track the process of online learning to find out what is the bottleneck of an education website and what is the best online learning mode. In addition, if the online learners are aware that their online behaviors were tracked and monitored online, will they reluctantly to visit the website or will they keep learning online? Further research can address web-analytics combined with other kinds of methodology so that education website can better serve the instructors, the learners and all other the site visitors.

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Research into the Status Quo of Learning Strategies of College Students and Blended Learning Strategy

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Abstract. Learning Strategies are the essential symbol of students “knowing how to learn”. In order to understand the status quo of learning strategies of college students and effectively implement blended learning, the research adopts the LASSI to carry out the investigation into the learning strategy level of college students from regular institutions of higher education. The results indicate that (1) the overall level of the implementation of learning strategies by college students is not so optimistic, as their consciousness of using learning strategies is weak and they are generally lack of learning strategies; (2) for those subject college students, their attitudes and motivations are mainly affected by learning strategies such as time management, information processing, selecting main ideas, self testing, study aids and test strategies via the intervening variables like anxiety and concentration. In the end, specific measures of implementing blended learning are put forward based on the research results.

Keywords: Learning strategies, Blended learning, LASSI.

1 Introduction

So far, blended learning has been widely adopted in the fields of education and enterprises training, which has been proved to be a very effective strategy. However, different people have different opinions on the concept of blended learning. This paper adopts the conception given by Singh & Reed. Singh & Reed(2001) says, blended learning is the optimizing achievement of learning objectives by applying the “right” learning technologies to match the “right” personal learning style to transfer the “right” skills to the “right” person at the “right” time [1]. Here, “right” learner actually emphasizes on the analysis of learners’ characteristics. And learning strategies of the learners are the main aspects of learners’ characteristics. Therefore, this paper mainly explores effective measures of implementing blended learning in the perspective of learning strategies.

Learning Strategies are the essential symbol of students “knowing how to learn”, which is also an important factor affecting learning efficiency and quality. Since the 1970s, with the generation of Cognitive Psychology, researches into learning strategies have occupied an important place in the research fields of learning psychology and educational psychology in China and throughout the world and has drawn great

attention of researchers. Learning strategies will help to the integration of knowledge and the activation of experience. What is more important, they will make students' behaviors of highly direction and insistency, which will effectively enhance the academic achievements of students.

In recent years, researchers (Xin, T., Li, Y., Wang, Y.Q., 1998) focus more on case study of qualitative research or statistical research methods of qualitative and quantitative combination, which has achieved new progress [2]. Researches into learning strategies in China started later and are still at a lower level than foreign countries, but are developing rapidly. Some researchers once investigate and find that the number of published papers of research into learning strategies written by college students has increased in recent 30 years, but the qualities are not high with few valuable academic achievements. Researches into learning strategies gradually change from speculative study to empirical survey but the theory is hardly integrated to empirical researches. Researchers (Yao, Q., Ge, M.G., 2006) either use research tools usually made by themselves or adopt acknowledged standard investigation questionnaire of learning strategies, which shows that researches into learning strategies of Chinese students still lack measuring tools of specialization [3].

Research contents of learning strategies mainly focus on the identification of concepts, the establishment of system and the analysis of functions, while research objects mainly focus on the cognitive strategy. Researchers introduce the foreign researches into learner strategies and the meanings, approaches, subjects and categories of learner strategies separately (Wu, Z.S., 1994; Zhuang, Z. X., Shu, D. F., 1994) [4][5], analyze the structure of learning strategies (Hu, B. W., 1995) [6] and introduce the development and status quo of researches into learning strategies (Zhang, R. M., 1998)[7], etc. Although field study has been carried out in this field in recent years, most researches focus on learning strategies of high school students or learning strategies of learning English as a foreign language, such as the analysis and research of the relationships of grades, learning performances and learning strategies (Xin, T., Li, Y., Wang, Y.Q., 1998) [2], investigate into the level of learning strategies of high school student in Beijing (Pan, Y. Q., Liu, S. X., Gong, Z. Y., 2000)[8], etc. Among these researches, very few papers are about the researches into learning strategies of college students.

Since 1997, the education for China's public security basically forms the educational system of different levels of cadre educational institutions, secondary vocational schools, college-level vocational schools and undergraduate level universities, etc. As the educational institutions of China's public security mostly start late, with weak base and poor conditions, there are gaps in every aspect compared with comprehensive universities and other vocational colleges in China. When Mr. Zhou Yongkang, former Minister of the Ministry of Public Security, visited Chinese People's Public Security University, he pointed out that the main problem in the educational institutions of public security is that of professional instruction, to which the solution lies in strengthening the establishment and reform of the professional teaching materials, the instructors, the instructional methods, etc of vocations (Zhang, L., 2005)[9]. In fact, instructional problem, especially the problem of instructional methods does not exist alone. Instructional methods of the instructors have to match with the learning methods of the students. Therefore, the exploration of the learning methods of students is one of the important aspects of solving the problem of professional instruction, which has been rarely covered in the instructional researches about the educational institutions of China's public security.

Researchers have taken active exploration in many aspects from the conception of learning strategies to the structure of learning strategies and from the categories of learning strategies to the researches into the application, and have generated a great amount of new theories and new knowledge about learning strategies, which set up the foundation for further researches into learning strategies. The academia has the following main concepts about learning strategies. Rigney (1978) thinks that learning strategies are the procedure and process of learning for learners. Duffy (1982) thinks that learning strategies are a kind of implicit learning regulation system. Nisbet (1986) considers learning strategies as the learning course of students, while Mayer (1988) believes that learning strategies are specific learning approaches and skills applied to the learning course of learners. Chinese scholars define learning strategies as learners' effective learning procedures, regulations, approaches and skills as well as their modulation of learning process in learning activities, based on the integration of the above main conceptions (Yang, Z. L., Da, H. M., 2006) [10].

This paper adopts the conception of learning strategies defined by Claire E. Weinstein (1985), which are learners' behaviors and thoughts in the learning process in order to influence the coding process of learners, including cognitive information processing strategy, active learning strategy, aiding strategy and mega-cognitive strategy.

The objective of the research is to know about and analyze the implementation level and characteristics of learning strategies of college students by LASSI to provide evidence of effective implementation of blended learning. The research aims to clarify the following two questions: (1) the status quo and characteristics of learning strategies level of college students in regular higher educational institutions; (2) relevant strategies of implementing blended learning.

2 Investigative Methods and Tools of the Status Quo of Learning Strategies

The subjects of the investigation are 1290 undergraduate students from regular higher educational institutions, which consist of 246 undergraduate students from Chinese People's Public Security University, 295 from Beijing Normal University, 452 of Zhejiang University and 297 from Zhejiang Normal University.

The research uses Learning and Study Strategies Inventory (LASSI) formulated by Weinstein et al. of the Department of Education of Texas University in Austin in 1987 and its norm as investigation tools [11]. Both LASSI and the norm are translated and adopted directly without revision. LASSI has 10 sub-scales altogether, which are Attitude, Motivation, Time Management, Anxiety, Concentration, Information Processing, Selecting Main Ideas, Study Aids, Self Testing and Test Strategies. Except that the sub-scale of Selecting Main Ideas has only 5 items, the other sub-scales all have 8 items, in total of 77 items. LASSI has almost half forward statement items and half backward statement items. The score calculation uses Likert ways of five levels of scoring from completely negative to completely positive.

The norm is adopted from the international norm without revision. The subjects can use norm to change the original scores into percentage. Each sub-scale is divided into three levels of percentage, which are above 75%, 50%~75%, below 50%. If the score is

at the level of above 75%, it means learning strategies are good; if the score is at the level of 50%~75%, it means learning strategies are common and the subjects need to improve learning strategies to facilitate learning; if the score is at the level of below 50%, it means learning strategies are poor and the subjects need to learn relevant learning strategies and learn to select the right learning strategy according to different learning scenarios.

3 The Characteristics of Learning Strategies of the College Students from Four Universities

3.1 Overall Statistics

There are 1290 people participating in this investigation, and 1199 effective questionnaires are received at the effective rate of 93%. The data are processed and analyzed by SPSS for windows11.5 and Amos 4.0.

Table1 shows the average scores, standard deviations, and percentages transformed from corresponding original average scores according to the international norm of the subject students in the sub-scales of learning strategies. It can be concluded from Table 1 that generally speaking, the level of learning strategies of college students is pretty low, with only the average scores of Time Management and Concentration at the level of above 50% and the other average scores all at the level of below 50%.

Table 1. Average Scores of the Sub-scales of Learning Strategies

	ATT	MOT	TMT	ANX	CON	INP	SMI	STA	SFT	TST
	27.73	26.22	24.72	26.34	25.95	25.85	16.906	24.49	22.92	26.94
Std.	5.90	4.59	4.76	5.78	4.65	4.88	3.1732	4.78	4.41	5.10
Percentage	15.8%	19%	57.3%	49.9%	50.6%	41.1%	29.5%	46.5%	28.3%	26.2%

Table 2 shows the distribution of the number of college students at different percentage levels of the norm based on their scores of learning strategies sub-scales. The results show that the number of college students at the level of above 75% is quite a few, among which that of Time Management is the highest, Concentration and Study Aids are secondary to it and Motivation and Self Testing are lowest, which are below 10%, which indicates that few students have good learning strategies; the number of those at the level of 50%~75% is higher, with the highest sub-scale of Time Management at 45.9 % and the lowest sub-scale of Motivation at 13.9 %; while the number of those at the level of below 50% takes a pretty large percentage of each sub-scale, among which some sub-scales even takes 70-80% of the total number, with Motivation as the highest sub-scale and the other sub-scales from high to low are Motivation, Test Strategies, Self Testing, Select Main Ideas, Information Processing, Anxiety, Study Aids, Concentration and Time Management, among which only the scores of Time Management and Concentration take the smallest percentage, but still at 29.2 % and 37.3 %. Above all, the use of learning strategies by college students is commonly

insufficient, and the overall situations are worrisome. Figure 1 shows the distribution chart of the number of college students at three percentage levels of each sub-scale of learning strategies.

Table 2. Distribution of the Number of College Students at Three Percentage Levels of the Norm Based on their Scores of Learning Strategies

	ATT	MOT	TMT	ANX	CON	INP	SMI	STA	SFT	TST
Above 75% (Good)	11.1%	2%	24.9%	22%	23.2%	15.8%	21.2%	22.7%	9.2%	12.4%
50%-75% (Common)	14.8%	13.9%	45.9%	26.9%	39.5%	28.5%	21.8%	29.1%	25.7%	16.4%
Below 50% (Poor)	74.1%	84.1%	29.2%	51.1%	37.3%	55.7%	57%	48.2%	65.1%	71.2%

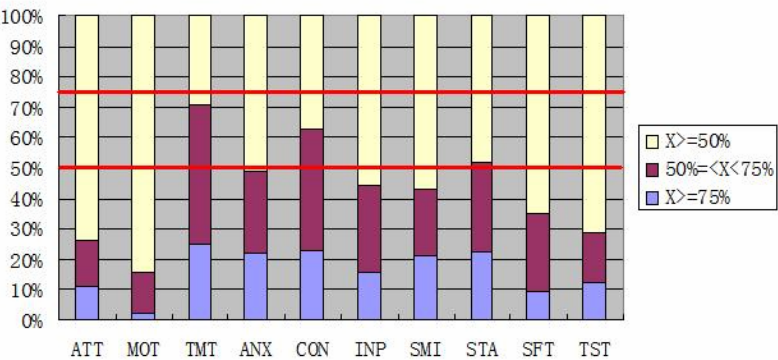


Fig. 1. Distribution of the Number of College Students at Three Percentage Levels of the Sub-scales of Learning Strategies

From the investigation results of learning strategies of college students, we find that the overall level of students’ using learning strategies is pretty low, and they are commonly lack of learning strategies, so the existing problems of their mastering and using learning strategies are not so optimistic. Brief analysis of the scores of each sub-scale is listed as follows:

- (1) The total attitude and motivation of student’s pursuing the success of learning have great impact on the degree of their hard working in learning, especially in the situation of self-study. Concluded from the sub-scale of Attitude, the number of college students whose scores are below 50% takes 74.1% of the total number, which means 74.1 % of college students need to study in the scenarios of high-level objectives.
- (2) The number of college students whose scores of Motivation sub-scale are below 50% is as high as 84.1%, which means those students are not responsible for completing specific study tasks so that they need to study in the scenarios with objectives, while those who have high scores at the level of above 75% need to learn to owe the success of their study to their great efforts, not external powers, such as luck, disqualified teachers or inborn capabilities, etc. We can see from the sub-scales of Motivation and Attitude, the levels of college students’ learning attitudes and motivations are pretty low, probably because most students take the admission of universities as

their learning objectives in the phase of high school, once the objectives are achieved, they are lost in the direction and motivation of learning. Maybe some college students are influenced by inappropriate social morality, focusing more on the immediate interests for their own but ignoring the social value of study and its long-term value to their own, so that they have negative learning attitudes and motivations.

(3) Time management can both directly and indirectly affect students' learning performances (Yu, M.N., Chen, J. H., 1996) [12]. Effective time management is one of the important aiding strategies for study. Setting up and sticking to a practical time table is not only a powerful guarantee of study but also makes the students more responsible for their own study. The number of college students whose scores of this sub-scale are low takes comparatively smaller percentage, which is 29.2%, indicating that students can better deal with the relationships of entertainment, other competitive objectives and delay, making full use of the time.

(4) Students' worries about their capabilities, futures, interpersonal relationships and the possibility of success will distract their attentions to present study tasks or tests resulting in irrational fear, which will prevent them from showing their real knowledge and skills. In the investigation results, the number of college students with high degree of anxiety takes 51.1%, which may result from the change of environments, the disorder of interpersonal relationship, the pressure of examinations and employment, etc. which indicates that they need to learn some techniques to dealing with anxiety and decreasing their anxiety in order to concentrate on the study tasks instead of being over anxious.

(5) When people are thinking about or dealing with matters, their energies are limited. Concentration will help students to concentrate on learning activities, such as listening to the instruction in the classroom. The number of college students whose scores of Concentration sub-scale are low takes comparatively smaller percentage of 37.3%, which indicates those students need to learn the techniques of how to strengthen their concentrations and setting priorities as well as how to eliminate the interference of thoughts, feelings, emotions and scenarios in order to enhance the learning effectiveness and efficiency.

(6) The number of college students with low information processing capabilities takes 55.7%, which means they need to learn how to comprehend the meaning of learned information and how to organize information, such as repeating, summarization, analogy, outlining, and deduction, etc.

(7) Differentiating important information from unimportant or unnecessary information is a main task of learning. The number of college students whose scores of Select Main Ideas are low takes 57%, which means they are weak in selecting important information. Therefore, they need to learn how to select key information in order to focus their learning strategies of Concentration and Information Processing on the right materials to reduce the heaviness of information processing.

(8) The number of college students whose scores of Study Aids strategy are low takes 48.2%. So they may need to learn educational books or various approaches of study aids provided in class including special fonts, marks, summaries, etc. as well as learn to create their own approaches of study aids.

(9) To examine one's comprehensive degree is important to the supervision of knowledge acquisition and comprehension. The number of college students who are

lack of the awareness of the importance of self testing and have low levels of implementation takes up to 65.1%, so they need to realize the importance of self testing and learn some specific approaches such as checking a great amount of materials systematically, reviewing individual fragments, learning in reading, and raising questions before, during and after class, etc.

(10) The scores of examinations usually depend on the preparation for examinations and test strategies. 71.2% of the college students with low scores need to learn how to prepare for examinations and how to set up test strategies according to different characteristics of tests or test items, etc. so that their acquired knowledge and skills can be accurately evaluated.

3.2 The Correlation Analysis of Different Factors of Learning Strategies

As we make correlation analysis of the ten aspects of learning strategies of the subject college students, we find that there is significant correlation among ten components of learning strategies, except for Self Testing, Motivation, Concentration and Select Main Ideas. See the specific data in Table 3.

Table 3. The Correlation Analysis of Different Factors of Learning Strategies of College Students

	ATT	MOT	TMT	ANX	CON	INP	SMI	STA	SFT	TST
ATT	1									
MOT	.535(**)	1								
TMT	.497(**)	.421(**)	1							
ANX	.531(**)	.256(**)	.353(**)	1						
CON	.554(**)	.413(**)	.554(**)	.353(**)	1					
INP	.198(**)	.228(**)	.183(**)	.173(**)	.185(**)	1				
SMI	.467(**)	.352(**)	.397(**)	.417(**)	.470(**)	.361(**)	1			
STA	.110(**)	.190(**)	.200(**)	-.062(*)	.188(**)	.389(**)	.252(**)	1		
SFT	-.181(**)	.043	.080(**)	-.331(**)	.054	.270(**)	.031	.434(**)	1	
TST	.620(**)	.337(**)	.465(**)	.601(**)	.530(**)	.274(**)	.623(**)	.080(**)	-.134(**)	1

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

In order to further analyze the correlations among different factors of learning strategy, we use structural equation for analysis so as to set up corresponding model. After the comprehensive analysis and modification of several models according to our hypothesis, we find the goodness-of-fit indicator of the model in Figure 2 is qualified, whose indicators of goodness-of-fit is shown in Table 4, among which, the indicators of GFI, NFI, IFI and CFI are higher than 0.9, the indicators of TLI and RFI are higher than 0.8, and the value of RMSEA is 0.118. Therefore, it indicates that the model put forward by us is good of fit to the empirical data. The detail of the model is shown in Figure 2.

Table 4. Main Indicators of Goodness-of-fit of the Model

CMIN	CMIN/df	df	p	GFI	NFI	RFI	IFI	TLI	CFI	RMSEA	AIC
279.03	18.602	15	0.00	0.957	0.938	0.813	0.941	0.821	0.940	0.118	359.026

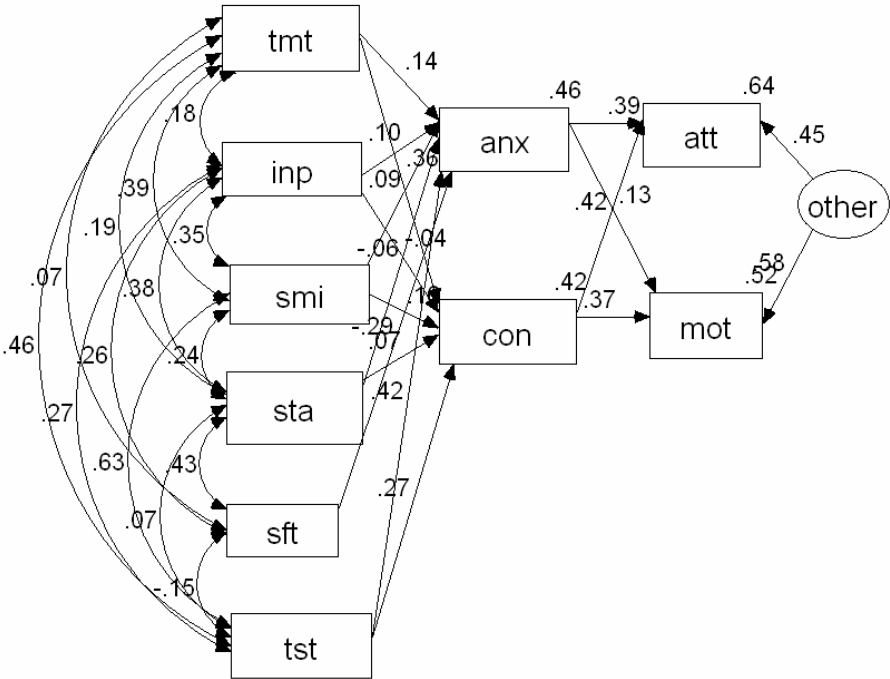


Fig. 2. The Structural Equation Model of the Ten Factors of the Learning Strategies of College Students

The model indicates that for those tested college students, their attitudes and motivations are mainly affected by learning strategies such as time management, information processing, selecting main ideas, self testing, study aids and test strategies via the intervening variables like anxiety and concentration. That is to say, (1) the attitudes and motivations are mainly affected by learning strategies such as time management, information processing, selecting main ideas, self testing, study aids and test strategies via the absolute intervening variables like anxiety; (2) the attitudes and motivations are mainly affected by learning strategies such as time management, information processing, selecting main ideas, self testing, study aids and test strategies via the absolute intervening variables like concentration. Thus, students' attitudes and motivations can be further strengthened by relieving their anxieties and enhancing their concentrations.

4 Conclusion and Suggestion

4.1 Conclusion

The research adopts the “Learning and Study Strategies Inventory (LASSI)” to carry out the investigation into the status quo of learning strategy level of college students from four regular institutions of higher education. The results indicate that (1) the overall level of the implementation of learning strategies by college students is not so optimistic, as their consciousness of using learning strategies is weak and they are generally lack of learning strategies; (2) for those subject college students, their attitudes and motivations are mainly affected by learning strategies such as time management, information processing, selecting main ideas, self testing, study aids and test strategies via the intervening variables like anxiety and concentration.

4.2 Suggestion

Above all, college students have weak awareness of learning strategies and are at low level of those implementation, which is negative for students to master knowledge and improve capabilities, so the teachers are in badly need of taking the relevant measures to develop their learning strategies before implementing blended learning. Detailed measures are as follows:

(1) Learning attitudes and motivations are important factors influencing the implementation of blended learning. Students with incorrect learning attitudes or weak motivations usually do not want to make efforts to seek for effective learning strategies. We can see from the investigation results that the learning attitudes and motivations of present college students have serious problems which need improving badly. First of all, the setting of learning objective is significant to promoting students' good motivations, so teachers should increase the education of learning objectives and tasks for students to help them set up positive learning objectives. Moreover, before carrying out specific instruction, teachers should clearly state specific instructional objectives to students in order to motivate their expectations of new study contents. As instructional objectives can play the role of pre-organizer, which can help students to analyze and organize learning materials according to the objectives so as to be absorbed in the knowledge structure. If students do not understand the specific learning objectives, their potential learning motivations have difficulty in changing into specific learning wills, so their learning activeness is hard to unleash.

(2) To adopt the instructional strategies of blended learning instead of traditional instructional approaches. It is essential to motivate students' learning interests, as they are the most active component of learning motivation as well as the starting point of learning activeness. According to the problem of overall low level of students' learning motivation and marked differences of other components, teachers can use collaborative and competitive strategies to motivate and maintain students' learning motivation, provide various interactive approaches and timely technical support in order to increase online interactive frequency and form good atmosphere of online learning community, clearly show the students teaching plans, study tasks, examination requirements and so on in order for them to make reasonable arrangement of time and strengthen their

concepts of time management, design learning activities such as drawing concept map in order to facilitate their acquisition of advanced knowledge and record the learning course in detail to help them to manage themselves and to reflect on themselves in order to help build up their consciousness of self-study(Huang, R. H., Zhang Y., Zhang J. B., 2003)[13].

(3) To inspire students' inner motivations, lead their learning motivation to develop to a higher level, help students to correctly coordinate the relationships of short-term motivation and long-term motivation and the relationships of cognitive drive, self-promotion drive and subordinate drive.

(4) To guide students to correct attribution and the elimination of attribution errors to form positive attribution methods and high leveled self-efficacy in order to help them to master and apply learning strategies for the effective implementation of blended learning.

(5) As a student, he or she has to enhance the level of learning objectives, form the idea of being the master, coordinator and creator of study with great ambitions and pursuing success, actively involve in learning activities, analyze and understand his or her characteristics of implementing learning strategies, focus on the exploration of learning strategies at different levels and be trained with good cognitive style in the learning process.

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Students' Evaluation of Websites in Hybrid Language Learning

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Abstract. The recent development of information and communication technology (ICT) has made it possible for students to access an enormous amount of up-to-date course materials and resources through the websites in and outside the classroom. However, for those who haven't had much online learning experiences, it is often difficult to locate the appropriate information within a limited time frame. They have problems of choosing websites which are appropriate for their needs and preferences. Various kinds of guidelines or checklists have been created to evaluate traditional paper-based educational materials, but not much has been written for judging the effectiveness of instructional websites in hybrid language learning environments. The purpose of this paper is to describe a research project in which Japanese university students evaluate English language websites and to examine their thoughts of the evaluation processes. This paper also suggests a series of criteria developed for successful evaluation of such websites.

Keywords: Evaluation, websites, language learning, hybrid learning.

1 Introduction

Recently, with an increasing use of the World Wide Web and a wide range of materials designed to support various course activities with ICT in the language classrooms, the introduction of web resources to language classroom is one of the most significant developments in the last decades [1] [2]. Millions of different kinds of language learning websites are being developed day by day and they are a valuable resource for students to use, on particular themes and topics, in or beyond the classroom [3] [4] [5]. Required by the course or its projects, students work on online resources and instructional websites for their own study or as supplementary materials for developing language skills. In addition, recent studies have suggested that these online educational sites have played an important role in pursuing students' lifelong development of language skills [6]. Although the website selection process has become more important for students [7], there is relatively little comprehensive research on how students evaluate learning websites from their point of view. In addition, there are few methods for evaluating websites [8]. In order for students to be able to choose the websites which match their needs and preferences, focus should be placed on the students' active role in evaluating these resources.

2 Research Background

It has been widely acknowledged that the evaluation of English language teaching (ELT) materials can play an important role in the success of language programs [9]. ELT materials vary in their linguistic design, focus, and objectives [9] and these factors should be carefully examined when choosing what kinds of materials to use for a particular teaching purpose [10]. Traditionally, the evaluation of ELT materials has been carried out by reviewers who develop specific criteria for detailed examination [10]. There is considerable literature which offers various kinds of instruments and methods for evaluation [11] [12] [13] and many of them have been targeted for the instructors who go through decision-making process about material selection [10]. Recently, as autonomous and independent language materials have been developed for computer assisted language learning (CALL) or hybrid learning systems, self-access or self-directed materials, including web-based language learning materials, have been systematically evaluated [14] [15]. Unlike classroom learning materials, website materials require students to engage in solitary activities and self-access the materials, and rely on their own judgment to choose appropriate learning resources for their own study. However, there are still few studies on the effectiveness of student-based evaluations of various instructional websites. In addition, little has been written on examining the website evaluation methods for students to make their own decisions regarding the effectiveness of a particular website. In order to maximize the quality of students' online learning experiences, critical analysis of these methods is of the utmost importance.

3 Purpose of the Study

The primary aim of this study was to determine how students, who lacked independent online learning experience, perceived the evaluation of English language websites from an English language learning perspective. The English language websites which were focused on in this study were ESL/EFL (English as a second language/English as a foreign language) listening websites. The present study was also aimed at determining how students were encouraged to discover effective ways of utilizing these websites to improve their language skills. The study sought to answer the following questions:

1. How can students review and evaluate the ESL/EFL listening websites by using criteria given the instructor?
2. What are the benefits and problems of students' evaluation of the websites?
3. How can language instructors encourage students to choose good ESL/EFL learning websites?

The answers to these questions will help instructors determine how to integrate ESL/EFL listening websites into their language course in a way that maximizes the specific student's learning opportunities.

4 Procedure and Settings

4.1 Participants

Twenty Japanese university students aged 19-20 years participated in this study. They were used to the traditional language learning approach taken in a large lecture-type classroom where the teacher tended to adopt predominately textbook-based teacher-directed instruction [16]. The focus in the secondary schools was on rote-memorization for better test scores rather than engaging in English language communication [17]. Although the students had general experience in using computers, they had no experience in online independent language learning in or beyond the conventional classroom. All the students had learned English for seven years and had attained a beginners' or a lower-intermediate level of proficiency.

4.2 Websites Evaluation Project

The course described in this paper was an undergraduate course one of the authors had been teaching, in the Department of Electronics and Information Engineering at a university in Japan. It was a semester-long hybrid language learning course which provided both a traditional face-to-face learning environment and an online environment. The course met once a week for 90-minute lessons in a computer lab. The course focused on the use of the navigational functions of web browsers, various software applications, and basic computer literacy. The course was mainly conducted in Japanese for students whose English skills were at a beginners' level.

At the beginning of this project, the instructor gave students an introductory guide of the evaluation, lasting for approximately one hour. This guidance included the procedure of the projects and a detailed introduction of examples of various listening websites which were targeted at divers ESL/EFL learners. The examples of these websites were given to the students as options to choose from. In this regard, the project didn't intend to direct the students to access them as pre-selected websites. After the students gained experience in browsing the web, they were then instructed to examine at least two ESL/EFL listening websites and to evaluate the quality and the appropriate use of these resources. The students finished the project by filling out the evaluation form and making comments concerning the advantages and disadvantages of the project. The students submitted their evaluation forms by a learning management system (LMS). A list of listening websites was available to help students make appropriate choices about what they wanted to work on. The list of websites included materials such as: *Randall's ESL Cyber Listening Lab* [18] and *BBC Learning English* [19]. None of the websites was previewed beforehand by the students.

4.3 Criteria for Evaluation

In order to facilitate website analysis and to provide students with a standard for evaluating sites, a list of criteria for evaluating English listening websites and a weighted point system to standardize site ratings were developed. Based on the measures for evaluating self-access materials [15], the criteria used in this study was divided into three major sections: 'Navigability', 'Achievable Challenge', and 'Attractiveness'. A student's sample evaluation is shown below in Table 1, 2, and 3.

Table 1. A student's sample evaluation: Navigability

Navigability	5	Comments
Is everything clearly indicated? Easy to read? Are the icons easy to follow?	4	Each color coded section helped me identify different types of exercises. While browsing this site I did not need any particular skills. The page layout was simple and basic with some use of pictures. Many of the written fonts were purple which made it a bit difficult to read the instructions.
Does the website link to other sources or information?	4	Available links were easy to access by clicking them. The author's site was also attached to this website.
Is the website well organized? Is format consistent? Are the files downloaded smoothly? Is the level of audio quality appropriate for language learning?	5	The exercises were arranged in a menu under each listening level. The instructions were clear enough for users to understand what to do. The sound quality was good enough to understand the conversations. There were both long and short conversations.

Table 2. A student's sample evaluation: Achievable challenge

Achievable Challenge	5	Comments
Is the language level clearly shown?	5	There was a clear description of the student level that each material was aimed at. The exercises were categorized into three groups: Easy, Medium, and Difficult. Students with different language levels would benefit from this site. For me even the Easy exercises were difficult.
Is Authentic English provided? Are the learning materials authentic?	4	The audio sounded like the site used standard American English.
When was the website last updated? Is the website updated regularly?	4	The site had just recently been updated. It was last updated in 2008.

Although the focus on what to evaluate is crucial for any evaluation process [10], this simple division was aimed to help students examine a site from different perspectives and to lead a more thorough analysis. Each major section was subdivided into three categories with each subsection worth 5 points for a total of 45 points. After reviewing the selected listening website students were required to rate on a scale of one to five for each subcategory with the site's title and URL, write a comment on it, and submit their files to the instructor electronically by using a learning management system.

4.4 Data Analysis

After the course had been completed, a 20-item questionnaire was distributed to the students for the purpose of gauging their opinions, attitudes and perceptions of the evaluation, including the advantages and disadvantages of the process. The questions sought information about familiarity with the search engines and attitudes toward the

Table 3. A student's sample evaluation: Attractiveness

Attractiveness	5	Comments
Does the website attract your interest? Is the website interesting to explore?	4	There were many types of conversations to choose from. I liked this listening site because the exercises were organized according to the levels of difficulty and on the topics. I used the exercises at the end of each topic to test my understanding.
Do they have a lot of practice examples? Is a large amount of selection available?	4	This site provided different types of exercises and quizzes covering a wide range of topics that could help me survive in English in the world. Many of the examples were in multiple-choice format with only one correct answer.
Do they have answer keys, hints or transcripts?	4	Although the site provided the answer keys and transcripts, hints were not available. In order to improve my English skills by listening, I thought hints were indispensable.

evaluation of the websites. The rating scale used in the questionnaire was a 10-point Likert Scale with 1 representing “strongly disagree” and 10 representing “strongly agree”. In order for students to fully understand the questions, the questionnaires were written in Japanese. For the purpose of attaining a mean response for each question, the responses were totaled and averaged. Standard deviation was then obtained for the purpose of examining statistically significant differences between students' responses. The data is presented in this paper as mean $\pm$ SD. The questionnaire was also analyzed by using Spearman's correlation to determine correlations between responses and significant factors underlying their responses. Correlation is significant at the .01 level (2-tailed).

5 Findings

The results of the questionnaire revealed the students' different perceptions of this project. The findings indicate that almost all the students used websites daily and the majority of them were required to use a computer for various assignments and a in other courses in and outside the classroom. The Average ($\pm$ SD) of this response was 7.25 ($\pm$ 2.38). There were only a few students who had used English instructional websites for their own English study. The Average ($\pm$ SD) of this response was 2.50 ($\pm$ 1.79). There were only a few students who were required to read websites in English both in and outside the classroom. The Average ($\pm$ SD) of this response was 2.90 ($\pm$ 2.10). Therefore, for most of the respondents, it was difficult to read English websites and finding information they needed for the evaluation. The Average ($\pm$ SD) of this response was 3.55 ($\pm$ 2.33). Obviously, the correlation of .582 is significant between the frequency of using English websites and the easiness of reading and locating necessary English information on the websites.

As for the students who felt the project was valuable and found the evaluation useful, there was a large degree of different opinions among the students. Those who highly rated this project had a moderate correlation using English instructional websites as a tool to learn English better ($r = .649, p < .01$).

Table 4. Correlation between factors for evaluating the websites

	Frequency of using websites	Locating information on the websites
Frequency of using websites	1.00	-----
Locating information on the websites	.582**	1.00

Notes: Correlation Matrix (N=20), ** $p < .01$.

Although many students found the project challenging, many respondents highly valued the criteria of the project. The Average ($\pm$ SD) of this response was 7.00 ($\pm$ 1.12). Those who highly rated this evaluation project had a moderate correlation rating the criteria of this evaluation as an effective measure ($r = .638, p < .01$). There was no significant correlation of students using English instructional websites as a tool to learn English and rating the criteria of the evaluation as an effective measure. Even those, who had never browsed English websites, were able to understand various features of search engines and the use of websites. The Average ($\pm$ SD) of this response was 6.15 ($\pm$ 2.01). It is interesting to see that there was a significant correlation of students understanding the various features of searching the websites and rating the effectiveness of this project for students' future development and the creation of the websites ($r = .752, p < .01$).

Qualitative data analysis also suggested what kinds of problems the students encountered during the evaluation process. Their representative comments taken from the students' responses to the questionnaire are divided into four groups as follows.

Table 5. Correlation between factors for evaluating the websites

	Highly rated the evaluation project	Websites as a tool to learn English better	Criteria as an effective measure
Highly rated the evaluation project	1.00	-----	-----
Websites as a tool to learn English better	.649**	1.00	-----
Criteria as an effective measure	.638**	N.S.	1.00

Notes: Correlation Matrix (N=20), ** $p < .01$.

Table 6. Correlation between factors for evaluating the websites

	Understood the websites features	Students' future development of the websites
Understood the websites features	1.00	----
Students' future development of the websites	.752**	1.00

Notes: Correlation Matrix (N=20), **p < .01.

“I didn’t have any experience of evaluating websites on my own, so the evaluation process took a lot of time. For the purpose of giving a fair assessment, I tried browsing a variety of other English instructional websites. This made me take even more time to complete the evaluation. The evaluation sheet was good enough for me to evaluate the websites.”

“I was not accustomed to browsing the websites, I had a hard time locating the information I needed for the evaluation. I wasn’t even able to see the difference between the instruction and advertisements on the screen.”

“I am not good at reading English websites and listening to English conversations. I tried looking up my dictionary every time I came across a word or expression I didn’t know. Since the number of these phrases was large, the evaluation process made me frustrated.”

“Different websites had different layouts and teaching approaches. Some websites required me to download the audio files to listen to them, and others needed me to work on a lot of listening exercises for the evaluation. The evaluation process involved a large amount of time and effort to complete.”

Table 7 shows the averages ($\pm$ SD) of the students’ responses to the ease of evaluating of the websites. With regard to the number of language exercises attached to the websites (Question 8), almost all of the students felt that the number of exercises to evaluate was not difficult. The averages ($\pm$ SD) of this response was 7.10 ($\pm$ 1.83). In response to Question 1, 3, and 4, students indicated that evaluating the layout of the websites, the usability of the icon, the consistency of the materials and the quality of the audio files was relatively easy for the students. In addition, the attractiveness of the websites was a feature that the students could evaluate easily. The only potentially difficult aspect of the evaluation may involve the evaluation of the authenticity of English. As students’ comments indicated, the amount of English they had experienced was small and severely limited.

Table 7. Averages of the students' responses to the ease of evaluating

	First Semester Mean (SD)
1. Layout of the websites and usability of the icon.	6.70 (1.95)
2. Availability of the relevant websites.	5.05 (2.31)
3. Consistency of the materials and the quality of audio files.	6.35 (1.95)
4. Availability of language levels for the materials.	6.25 (2.47)
5. Meaningful English in authentic use.	4.20 (2.70)
6. Availability of materials recently updated.	4.95 (2.56)
7. Attractiveness of the content of the websites.	6.65 (1.87)
8. Appropriate number of language exercises.	7.10 (1.83)
9. Availability of keys and feedbacks.	6.15 (2.48)
(N = 20)	

Table 8. Correlation between factors for evaluating the websites

	Experience of using instructional websites	Not difficult in evaluating authenticity
Experience of using instructional websites	1.00	-----
Not difficult in evaluating authenticity	.597**	1.00

*Notes: Correlation Matrix (N=20), ** $p < .01$.*

Table 8 shows that there was a moderate correlation between of students experiencing using English instructional websites and not feeling any difficulty in evaluating authenticity of English in the websites ($r = .597, p < .01$). With regard to the important aspects of evaluating websites, respondents stated that, in addition to the English skills they needed for reading materials and listening to audio files, they needed a variety of preliminary knowledge and information concerning searching the web was necessary. These comments from the students are as follows.

"It is important for us to determine whether the content of the websites we have chosen is appropriate for our needs. For example, we should ask ourselves if a certain instructional website that we are working on is designed to target learners who are going to take standardized tests such as TOEFL or

TOEIC, or those who just want to improve their conversation skills. Browsing various websites in our daily lives is one of the solutions for achieving this goal."

"Before evaluating the instructional websites, we need to learn the basics of using various search tools. Searching the web is challenging because the content of the web is extremely huge and is not arranged in any particular order. In addition, we should learn various techniques and skills to browse the websites, use the electronic dictionaries, and collect log data."

6 Discussion of Findings

Although the number of participants in this study was relatively small, the results of this study suggest that students' critical evaluation of the use of the websites can be by and large educationally beneficial to students and the instructor in three major ways. Firstly, it can be asserted that, despite the fact that all the participants had no previous experience of online independent language learning, many of them were more than capable of evaluating websites by using the evaluation checklist created for the present project. This checklist covers three areas such as 'Navigability', 'Achievable Challenge' and 'Attractiveness'. Although this simplified framework of evaluation contains in-depth criteria which address real language learning issues and problems, the findings have shown that the students found it relatively easy to evaluate the websites. However, for students who had not been accustomed to browsing websites at all, the evaluation process took a long time to complete. Owing to the fact that the language on the websites was too difficult for them, students' limited experiences of navigating the English web created problems in accessing and retrieving information they needed for their evaluation. It is also important to note that the students' English skills had a significant relationship to their appreciation of the web evaluation. Although this challenge the students faced when using the websites is a standard problem [4], web evaluation should not be limited to linguistically advanced students. Due to the fact that judging information and integrating it with prior knowledge is fundamental in everyday life [7], students at all levels should be encouraged to engage in the web evaluation and understand that these materials provide students with powerful learning tools and confidence in surviving in real-life situations [20]. The research also indicates that, as their knowledge of the target language increases in tandem with skills and strategies for effective navigation are properly developed, these students will gradually gain the ability to understand that the website is a valuable resource for their language learning [2]. This would be beneficial for their future.

Students' responses have shown that another advantage of this project is that the evaluation process not only promoted exploration and control over learning, but also had potential benefits to develop their self-awareness and independence in their language learning. Although many students had negative comments focused on difficulties resulting from reading English websites, their open-ended responses were positive. The students made favorable comments on the evaluation skills used in the present study. In addition, the students fully realized that these important skills would be required not only to access and select the websites but also to fully utilize them according to their own needs and interests in the future. Although hybrid learning has been incorporated into

many Japanese universities [21] and many respondents in this study indicated having previously been enrolled in a course which used computer assisted instruction, they didn't have any experience in evaluating any websites. The 'retrospective evaluation' [10], in which the students determine whether it is worthwhile using the materials again or if the material works for them or not, is important for their self-directed lifelong learning [6]. Students should be exposed to the wealth of language learning resources on the web and be adequately trained to develop the skills and strategies for evaluation.

Lastly, the students' evaluation of ESL websites will help instructors determine which websites deserve to be recommended to their students, and which sites can be used for a specific teaching purpose. In the present project, the websites examined by the students provided a number of quizzes testing vocabulary, grammar, reading comprehension, as well as miscellaneous exercises. In fact, many available ESL websites are limited to educationally old-fashioned activities, such as gap-fillings or multiple-choice quizzes [8], and these materials are more likely to be implemented only as a panacea for various language learning problems the instructor has in the classroom [22]. Engaging predominantly in these exercises can be dull and repetitive, and often do not appeal to students cognitively or in any other meaningful way [15]. In order for instructors to maintain and improve the quality of online teaching, they should gain 'experimental knowledge' which is defined as 'knowledge in action' [23]. The experimental knowledge gained by the students' evaluation of the websites based on their observation, surveys and critical reviews will help instructors become more sensitized to their online teaching methodologies and, therefore, will make significant contributions to the development of online language learning.

7 Conclusions

This study examines students' perceptions and attitudes toward evaluating listening websites for their own study. Although the number of participants in this study was too small to draw any concrete conclusions, the results of this study provided valuable insights into what instructors should determine when intending to utilize the websites in the language classroom. The findings also suggested that, despite the increasing popularity and availability of web-based technology in the educational field, not much emphasis has been placed on the technical skills required for students to successfully evaluate the websites and locate the information they need for their own needs and interests. In order for students to make maximum use of the instructional websites, simply to be given materials and educational content through the web is not appropriate for successful language learning. Further research based on a larger scale study should be conducted to draw more valid conclusions regarding various possibilities for effective learner training for the evaluation to measure student progress in online language courses.

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eLearning for Online Lecture, Chat Room, Forum and XML-Based Excises and Reporting*

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Abstract. This paper is based on previous works on eLearning Web Authoring System for Educators; making the eLearning web authoring system more comprehensive and powerful. It is the first open source on authoring system which introduces XML as the backend database system for storing question sheets made by educators and answers made by students. Furthermore, it provides a virtual area - allowing educators and learners to broadcast and attend the lectures over the Internet respectively - and enables educators and learners to communicate with each others via online and offline message passing. Since Educators may not be proficient in developing such kind of eLearning system for generating eLearning materials in web page format for students to use, this paper will give an overview of this system and demonstrate how the above features can be accomplished.

Keywords: Authoring system, online exercises, online lectures.

1 Introduction

In the previous work [14][15], we have developed and implemented an eLearning Web Authoring System allowing educators (who have lack of knowledge or time to create web pages on their own) to effectively and efficiently create question sheets in web page format by following simple steps and to post those question sheets for students to answer and practice over the internet. However, the functionalities are limited to perform basic actions such as dynamic web page generation and posting.

The advanced features such as online lectures, online chat and message posting have not been made available in the previous system. However, it is obvious that these features are crucial for more comprehensive eLearning Web Authoring System. To empower this system and provide more practical features to educators, we have successfully equipped this system with the following features:

1. Online Lectures – allowing educators to conduct lectures in real time via internet
2. Online Chat Room – facilitating real time communication between educators and learners

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3. Forum – messages passing between educators and learners regardless of the time frame
4. XML Documents – presenting the dynamically generated question sheets in XML format and storing the answers made by learners as XML documents to:
 - preserve the origination of contents
 - gain the query power of XML

This paper will be presented as follows. Section 2 is the system overview, brief introduction of the system architecture. Section 3 is the methodology, detailed explanation of each new feature including algorithms with examples and screen shots. Section 4 is conclusion, summarizing what we have been doing and what we should do in the future.

2 System Overview

For the online features, there are two approaches: centralized and decentralized. Centralized means the server manages all online activities. For online lectures and chat rooms, the centralized approach may cause extremely high overhead to the server since the server needs continually to:

- receive online lectures from the educators and simultaneously broadcast the lectures to the learners who are requesting them
- receive online messages and pass them to designated parties

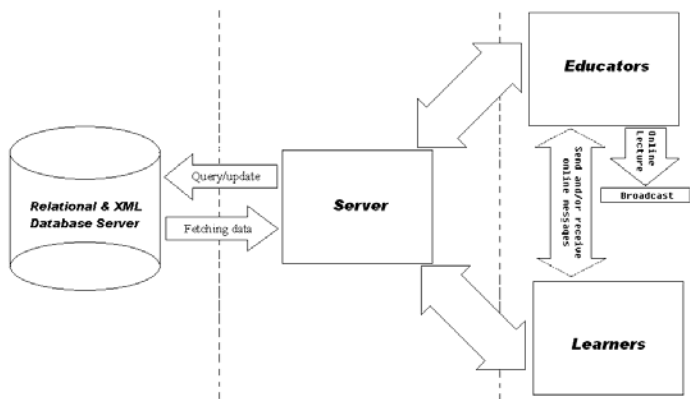


Fig. 1. System Architecture

This approach cause a longer time for the server to response requests and may result in response time out.

On the other hand, decentralized means the server will pass the online activities to the local computers. In other words, the online lectures will be broadcasted by the educators' computer, and the learners will make direct connections with the educators'

computer. The server will only act as an agent telling the learners where the online lectures are hosted. This approach greatly decreases the workload of the server and supports good service level by quick response to users.

The decentralized approach may not be applicable with static activities in such forum and XML documents. The demand (in terms of interactions between the servers and the clients) in these kinds of features is relatively small.

For our web authoring system, we have combined both centralized and decentralized approaches together. Different approach would be taken for different features. For example, online lectures and chat rooms are handled by decentralized approach whereas the rest of the features are handled by centralized approach.

In the database level, there are four relational tables for storing the educators' information and the details of the questions (note that underlined are primary keys and "*" are foreign keys):

```
Relation Educator (eid, password, email, identity)
Relation Exercise (eid, ename, description, ng, filename, footer, *id)
Relation Question (qid, description, content, type, action_c,
action_w, random, hints, continue, *eid)
Relation Choice (aid, content, correct, correct, type, action, *qid)
```

For the XML part, an XML database system is installed with the following DTD and scheme tree:

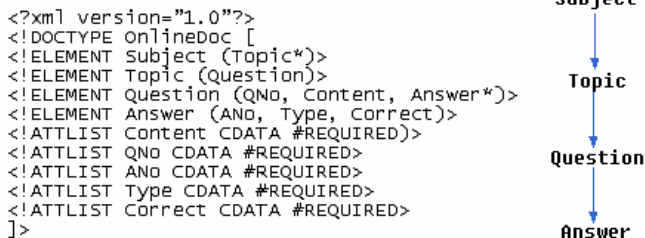


Fig. 2. XML DTD and Scheme Tree

3 Methodology

The new features introduced in this system enable this tool to be highly empowered, fully comprehensive and completely desirable. The following will explain each feature with its algorithm.

3.1 Online Lecture

This feature enables educators to broadcast lectures in real time via internet. The benefits of it are:

1. Educators can conduct lectures without the constraint of places as long as the internet connection and the computer equipped with microphone are available
2. Learners can attend lectures without rushing out or attending the classrooms in person as long as the internet connection and the computer equipped with video Camera are available
3. Minimize typical distractions such as seating arrangements and gender biases.
4. Utilize the lecture time since no distribution of handouts and collection of assignments are required

However, the quality of lectures may be greatly decreased by the performance of internet connections (such as slow connection) at learners' side. In order to minimize the effect of this, each online lecture is automatically recorded in AVI format and stored in the system. Educators and learners can replay the recorded lectures whenever they would like to. Furthermore, the replay function allows learners who miss the class to rerun the lecture.

Another problem of this feature is that it is an asynchronous communication to deliver course information to learners. Learners cannot voice out when they encounter questions during the lectures. To overcome this, the online chat is made available allowing learners to raise questions and/or express their options. This feature of online chat will be explained next section.

Algorithm:

Real Time Lecture

[Educator]

Begin

```

    upload "New Subject" function;
    if web page type is online lecture
        begin
            turn on the microphone;
            start recording the lecture;
            broadcast the lecture to attendees in every 5 seconds;
        end
    else start the Web Creation Management System;

```

end;

[Learner]

Begin

```

    request to join the lecture;
    if joined start receiving the online lecture;
    else error message displayed;

```

end;

Replay Lecture

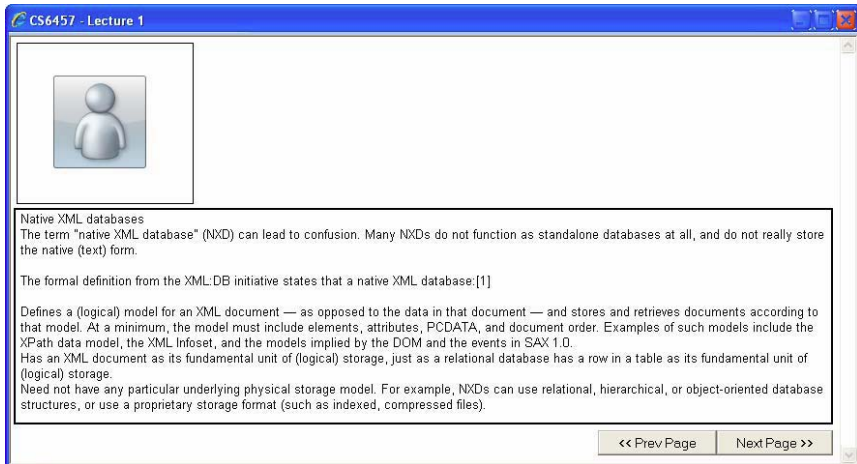
Begin

```

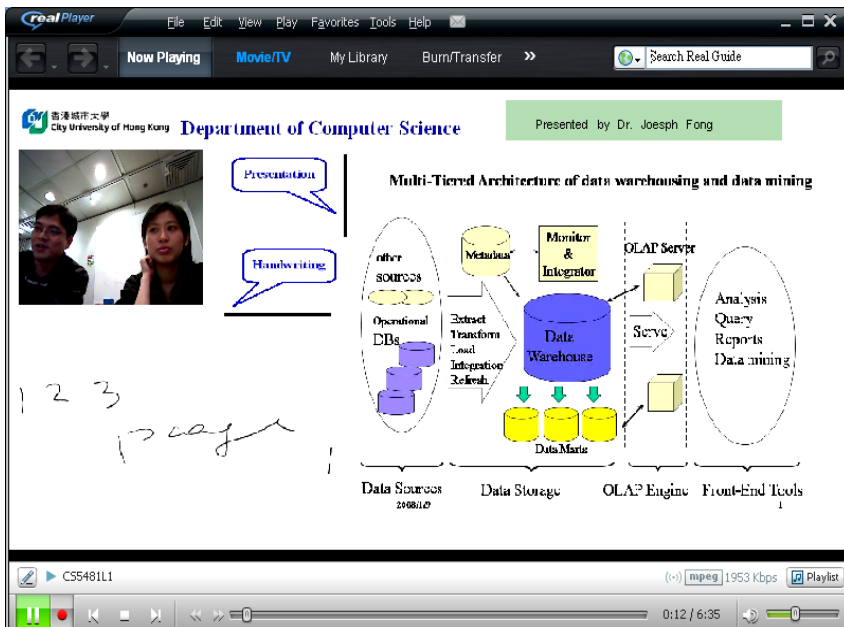
    request to download the lecture;
    if lecture exists start upload the lecture;
    else error message displayed;

```

end;



(a) Without handwritten notes



(b) With handwritten notes

Fig. 3. Online Lecture Screen layouts

3.2 Online Chat Room

Due to the shyness or self-consciousness, some learners might be afraid of asking questions or expressing their point of views in front of others. The online chat room provides a comfortable environment allowing learners expressing ideas and backing up facts instead of speaking in a lecture room. Studies have proven that online discussions can provoke more confrontational and direct communication between educators and learners.

As stated in 3.1, the lectures are basically provided in asynchronous communication, which means that learners are mere receivers; there is no communication between educators and learners. With this newly added online chat function, learners can raise questions and/or state their options whenever they would like to. Hence, the synchronous communication could be established by this feature. Follow-up questions can also be addressed immediately at an appropriate level of detail. Moreover, the educators can inquire as to whether the learners are clear on aspects of the course material. The immediate responses ensure that all lecture participants understand necessary information, thus making learners feel connected to the educators and the lectures.

Illustration:

- Step 1: go online by clicking on “Chat Room” first and “Online”
- Step 2: send a message to a particular person by first clicking on the designated person listed in the “Online List”, then typing the message in the message box and lastly clicking on the “Send” button
- Step 3: send a file to a particular person by first clicking on the designated person, then clicking on “Upload” button and lastly choosing the designated upload file in the following screen

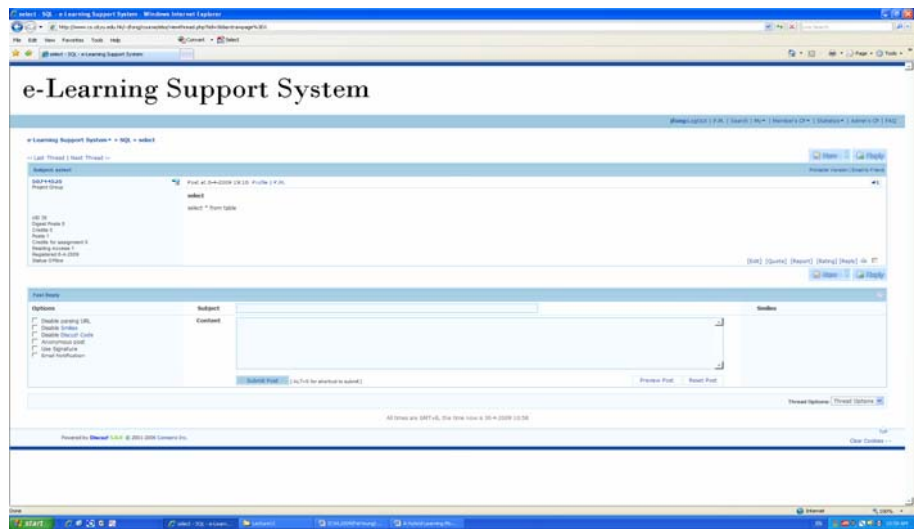


Fig. 4. Online Chat Room Screen layout

Algorithm:

```
Begin
  upload “Online Chat Room” function;
  << job 1 >>
  loop
    begin
      check new messages;
      display on the screen;
    end;
```

```

<< job 2 >>
if message
    send out the message;
else if file
    upload the file to the designated person;
end;

```

3.3 Online Open Forum

Since the online sessions are usually short and limited, the number of questions and opinions being answered and reviewed within the session is relatively small. As we all know, it is not feasible for educators to be online all the time replying questions/opinions. Similarly, it is not always possible for learners to be online in the particular timeframe for asking questions and/or exchanging thoughts. In addition, some questions may not be answered immediately. The forum feature enables educators and learners to post questions/answers in the later time.

Moreover, this new feature provides the place to share information. Each learner can view other learners' posts and can learn different perspectives. This benefits learners greatly because they can combine new and different ideas with their own, and develop a solid foundation for learning. Research supports that "as learners become aware of the variations in interpretation and construction of meaning among a range of people [they] construct an individual meaning [16].

Illustration:

- Step 1: Login Forum by providing the username and password
- Step 2: Choose Subject by clicking on the designated one such as "XML Database System"
- Step 3: Choose Topic by clicking on the designated one such as "XML Database System"
- Step 4: View the existing Posts

Algorithm:

```

Begin
    login Forum;
    retrieve subject from database;
    display subjects on users' screen;
    wait for user action
        begin
            if subject is chosen
                display the topic of the selected subject;
            else if topic is chosen
                display the posts of the selected topic;
            else if post is chosen
                display the contents of the selected post
            else if new post then
                submit the new post;
            else if refresh
                begin
                    retrieve subject from database;
                    display subjects on users' screen;
                end;
            end;
        end;
end;

```

hk-eLearning

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[View unanswered posts](#)

Forum	Topics	Posts	Last Post
CS6457 - Advanced Database System			
 Rule-Based Database System If you have anything related to this subject, let's discuss!	0	0	No Posts
 XML Database System If you have anything related to this subject, let's discuss!	1	1	Sat Oct 21, 2000 12:01 am root 

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[Profile](#) [You have no new messages](#) [Log out \[yeungf \]](#)

XML Database System

[new topic](#) [Advanced Database System -> XML Database System](#) [Mark all topics read](#)

Topics	Replies	Author	Views	Last Post
 XML Database System	1	root	8	Thu Jan 01, 1970 12:00 am root 

Display topics from previous: [All Topics](#)

[new topic](#) [Advanced Database System -> XML Database System](#)

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XML Database System

[new topic](#) [postreply](#) [Advanced Database System -> XML Database System -> XML Database System](#)

Author	Message
root Site Admin Joined: 11 Apr 2009 Posts: 1	 Posted: Thu Jan 01, 1970 12:00 am Post subject: What is XML?  quote XML stands for Extensible Markup Language XML is a markup language much like HTML XML was designed to carry data, not to display data XML tags are not predefined. You must define your own tags XML is designed to be self-descriptive XML is a W3C Recommendation Back to top  profile  pm  email
root Site Admin Joined: 11 Apr 2009 Posts: 1	 Posted: Sat Oct 21, 2000 12:01 am Post subject: For the excises, could you post the answers here?  quote Thank you! Back to top  profile  pm  email

Display posts from previous: [All Posts](#) [Oldest First](#)

[new topic](#) [postreply](#) [Advanced Database System -> XML Database System -> XML Database System](#)

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Fig. 5. Online Open Forum Screen Layouts

3.4 XML Documents

This feature is the most important and is the state of art of this system. There are a few reasons why we propose XML documents as the stored format of the question sheets and

answers made by educators and learners respectively. The first reason is that XML documents are both platform and application independent. We can deploy the XML documents in any platforms (such as Linux, Windows and Unix) and open them with any applications (such as Microsoft Internet Explorer, firefox and Netscape). The documents are always displayed in the same way whenever the same style sheets are used.

The second reason is that it keeps the origination of the structure in the question sheets and answers. This feature is important since the questions and answers in the question sheets can be organized in random order as well as the possible answers; that is, the questions in the sheets for each learner appear in different orders from the other even though the questions and the possible answers themselves in the sheet are exactly the same. In order to reconstruct the questions sheets in various question orders, great controls must be maintained in application and database levels and high techniques are required to achieve it. The beauty of XML documents is that no additional work is needed in either application or database levels; but the documents for each learner can be kept in original structure at the back end and presented in the same way at the front-end. Below is an example of the XML document stored in the system and its presentation format at the front-end.

```
<?xml version="1.0" ?>
- <OnlineDoc xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
- <Subject name="CS6457 - Advanced Database System I" author="Yeung Yin Fei">
- <Student id="194700487">
- <Topic name="Excise 1 : Introduction XML Database System">
- <Question QNo="2" Content="What does XML stand for" mark="1">
  <Answer>ANo = "3" Type = "RadioButton" Name = "Extra Makeup Language" Correct = "N"</Answer>
  <Answer>ANo = "2" Type = "RadioButton" Name = "Extensive Market Language" Correct = "N"</Answer>
  <Answer>ANo = "1" Type = "RadioButton" Name = "Exact Methology Language" Correct = "N"</Answer>
  <Answer>ANo = "4" Type = "RadioButton" Name = "Extensible Markup Language" Correct = "Y"</Answer>
</Question>
- <Question QNo="1" Content="What are the query languages for XML documents" mark="1">
  <Answer>ANo = "1" Type = "Checkbox" Name = "SQL" Correct = "N"</Answer>
  <Answer>ANo = "2" Type = "Checkbox" Name = "XQuery" Correct = "Y"</Answer>
  <Answer>ANo = "3" Type = "Checkbox" Name = "PL/SQL" Correct = "N"</Answer>
  <Answer>ANo = "4" Type = "Checkbox" Name = "XPath" Correct = "Y"</Answer>
</Question>
</Topic>
</Student>
</Subject>
</OnlineDoc>
```

CS6457 - Advanced Database System

Excise 1 : Introduction XML Database System I

Author: Mr. Yeung, Yin Fei

1). What does XML stand for?

- ☐ Extra Makeup Language
- ☐ Extensive Market Language
- ☐ Exact Methodology Language
- ☐ Extensible Markup Language

2). What are the query languages for XML documents?

☐ SQL	☐ XQuery
☐ PL/SQL	☐ XPath

Fig. 6. XML Document and its display

A question you may ask is that why not using other document formats such as text and word to keep the documents. That brings out the last but not the least reason of choosing XML. We could make queries directly on the XML documents by using the XPath or XQuery whereas other formats cannot accomplish this functionality. By using a single command e.g. `LOAD_FILE()`, XML documents can be easily inserted into the database system. We will illustrate how to initiate XQuery statements to query the XML documents and the corresponding query results.

Example:

Below are an XPath statement to retrieve the mark of each excise of each student and the query result returned from the database system:

XML document of the above returned result:

```
mysql> SELECT ExtractValue(@OnlineDoc, '//student[$id="*"]/Topic[$name="*"]/fn:sum($mark)');
+-----+-----+-----+-----+
| ExtractValue(@OnlineDoc, '//student[$id="*"]/Topic[$name="*"]/fn:sum($mark)') |
+-----+-----+-----+-----+
| 194700487 | Excise 1 : Introduction XML Database System I | 2 |
+-----+-----+-----+-----+
| 194700487 | Excise 2 : Introduction XML Database System II | 10 |
+-----+-----+-----+-----+
| 194700010 | Excise 1 : Introduction XML Database System I | 1 |
+-----+-----+-----+-----+
| 194760101 | Excise 1 : Introduction XML Database System I | 2 |
+-----+-----+-----+-----+
| 194760101 | Excise 2 : Introduction XML Database System II | 9 |
+-----+-----+-----+-----+

5 row in set (0.00 sec)

<?xml version="1.0" ?>
- <OnlineDoc xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
- <Student id="194700487">
  <Topic name="Excise 1 : Introduction XML Database System I">Result = "2"</Topic>
  <Topic name="Excise 2 : Introduction XML Database System II">Result = "10"</Topic>
</Student>
- <Student id="194700010">
  <Topic name="Excise 1 : Introduction XML Database System I">Result = "1"</Topic>
</Student>
- <Student id="194760101">
  <Topic name="Excise 1 : Introduction XML Database System I">Result = "2"</Topic>
  <Topic name="Excise 2 : Introduction XML Database System II">Result = "9"</Topic>
</Student>
</OnlineDoc>
```

Fig. 7. XML document retrieved by XPath

4 Conclusion

This paper shows how to empower the current web authoring system by adding four new features: Online Lecture, Online Chat Room, Forum and XML documents as storing format. With the previous features and the new features, this system is nearly perfect for educators to provide virtual lectures and online works. Educators can easily create questions in web page format, conduct online lectures, talk with learners via

the online chat room, and post messages via the forum. Learners can answer/practice excises, attend lectures, communicate with educators and raise questions and/or review answers via the forum. The implementation of these features requires rich experience and deep domain knowledge in related theories and technologies. For educators who are not proficient in this subject area, they may find that it is nearly impossible to develop such system. By using this system, educators can save plenty of time for other activities.

In the future, we would like to implement the online lecture with clipboard and video enabled. Also, message is not limited in text mode; but in voice as well.

In summary, we have explained how the new features could be developed and implemented by providing general algorithms. Also, this system supports the high level of user friendliness. Just by a few mouse clicks, educators can conduct an online lecture, chat with learners, post messages and review the performance of the learners. Likewise, learners can attend the lecture, ask questions, express/review their idea on forum, and work on exercises provided by educators.

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A Review of e-Learning Platforms in the Age of e-Learning 2.0

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Abstract. Online communication is changing the way instructors and learners interact and learn. Today, apart from providing an information repository or a place to search for resources, the new Web 2.0 allows us to find other people, exchange ideas and thoughts, demonstrate creativity and create new knowledge. Based on Web 2.0, e-learning 2.0 has evolved to provide a constructivist learning environment. In this paper, Web 2.0 applications, such as wikis, social bookmarking and podcasts, are reviewed on how they can provide a rich, interactive, user-friendly application platform effectively. The platform would allow teachers and trainers to empower learners and create exciting new learning opportunities. It is more desirable if Web 2.0 technologies can be well integrated into traditional e-learning platforms such as WebCT and blackboard.

Keywords: Web 2.0, e-learning 2.0, e-learning platforms.

1 Introduction

E-learning has been widely used in universities and higher education institutions as a supplement to the traditional face-to-face classroom learning environment as well as in the continuing education and distance education institutions [32]. Among many others, Blackboard, WebCT and Moodle are three best known web-based learning management systems [6]. Recently, there are increasingly concerns on the needs of evaluations for e-learning, in association with the availability of open source software [16] and the impact of social learning models [26, 12, 28]. As Downes [8] in his article stated that 'e-learning is firstly evolved from the World Wide Web, but now it has been transformed from the Read Web to a Read Wide Web which characterises the user-centered, social networked and open communication'.

With the challenges of social learning theories and the advances of Internet, no one can predict the future e-learning development. If traditional e-learning is changed into the new generation of e-learning platform, pedagogy is probably a major issue. The second generation of e-learning plays a big role on e-learning in terms of web applications. E-learning is still playing a prime learning key used in University and higher education as well as an adult education.

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2 Defining e-Learning

The definition of e-learning is controversial as it changes over time. In the past 40 years, e-learning has evolved in the sectors of education, business and training. It was used to support teaching and learning with computers [13]. In the previous days, as the teaching and learning was based on forms of local use of computer interaction and multimedia courseware, e-learning was referred as computer-assisted instruction or computer-based instruction [13]. Contemporarily, the term “e-learning” has been changed in different contexts that focus on internet-based learning, web-based learning and so on [3].

Manson and Rennie [21] pointed out that there should be differentiation between the content and process in e-learning. They found that the definition provided by the Open and Distance Learning Quality Council [33] seemed more comprehensive that cover the things they mentioned: ‘E-Learning is the effective learning process created by combining digitally delivered content with support and services.’

Just like other new technologies, e-learning has been developed rapidly in recent years and has become one of the most popular learning solutions in order to meet the changing demand for learning, especially in post-secondary education [36]. In 2006, a research conducted by Chapman [5] showed that 203 accredited online graduate degree programs had been delivered in United States in the year. In Singapore, a similar study was carried out by the International Data Corporation (IDC), showing that there has already been S\$19.31m spent on e-learning in 2004. IDC also estimated that there would be triple growth in 2008 [1].

3 e-Learning Platforms

Many researchers have found that interactivity is one of the key factors for the success of online instructional practice [15, 22]. Interactions can increase users’ learning motivations and make them experience more in the online world [18]. To ensure meaningful learning experience, Sims [31] suggested four types of interaction used in an e-learning platform : learner-teacher interaction, learner-learner interaction, learner-content interaction and learner-interface interaction. The learner-teacher and learner-learner interactions are usually provided in different e-learning platforms in the forms of e-mail, discussion board, chat room and so on in both synchronously and asynchronously ways [34]. Students will be able to experience the learner-content interaction by the use of multimedia technologies within an e-learning course. The learner-interface interaction allows users to fully utilize the e-learning tools in the interface such as graphical elements and navigational aids to do tasks and join in other e-learning activities [34].

In the following, a learning management system WebCT [2] is investigated. WebCT and Blackboard have been widely in Universities and higher educational institutions, holding 83 % market share in the higher education sector [11]. They cover comprehensive functional features including curriculum design, communication and discussion, performance assessment and course administration [6].

3.1 Background of WebCT

The Web Course Tool (WebCT) was originally designed by Goldberg in University of British Columbia in 1997 [6] and acquired by the Blackboard Corporation in 2006 [11], which is now renamed as Blackboard Learning System [2]. A research conducted by Valuisky [35] pointed out that the platform has been installed on about 9,000 servers in over 70 countries around the world in 2005. The number of users had already reached 9 millions [35]. WebCT has two editions, one is the vista edition (version 4.0) and another one is the campus edition (version 6.0). The campus edition is only sold for colleges or institutions which have already owned their registration system, while the vista version is fully featured that enables the instructors or administrators to create, edit and manage the course contents, create communication groups and generate reports. We will focus on the campus edition, WebCT version 6 which was a CMS client-server e-learning platform on Windows 2003 operating system with MS SQL server database or on Solaris with Oracle database.

3.2 Functional Features of WebCT

The functional features of WebCT are categorised into four areas, namely, curriculum design, performance assessment, course administration, and communication and discussion [6]

In terms of curriculum design, WebCT provides a platform for instructors to post announcements and distribute course materials with the support of templates. The course materials can be uploaded in variety of formats such as MS Word, Excel, Powerpoint, PDF and so on. It also allows instructors to organize course syllabus in the platform for course preparation and management. In addition, the learning schedules and activities can be set in accordance with their arrangements, for example, the course materials can be released on a specific day and time.

WebCT provides an online performance assessment function. Instructors can check student's login record, the date and time which they submitted their assignment, participation in forum and chat room in order to monitor their study progress. Self-test assessment in forms of online multiple choice and true and false questions are allowed. The scores would be generated automatically. For group work, WebCT enables teachers to assign student into groups automatically or manually.

In WebCT, the course administration function mainly includes student data management and authentication. Batches of student enrollment records are allowed to upload into the system directly. In order to protect and secure private and confidential data, an authentication function is built for access right setting.

For communication and discussion, WebCT provides asynchronous features like discussion rooms, e-mails, drop boxes and synchronous features such as chat rooms (text chat) for both instructors and students. The posts in discussion room can be viewed by time or topics. Files can be attached, and several file formats are supported. The drop box provides the functions for students to submit assignments and exchange documents. Instructors are also allowed to act as moderators of the chat rooms for them to control the discussions, such as suspending students from the chats.

3.3 Review on the Functional Features

In general, WebCT provides a flexible platform that allows students to study when they are off-campus, enables instructors to deliver course materials to students electronically, encourages instructors and students exchange their ideas easily, and facilitates them to perform even in group work [6].

For the curriculum design, Downes [8] criticized the course contents in Learning Management System such as WebCT and Blackboard are standardized and structured that a course is usually set with some modules and lessons followed by quizzes and discussions. There are limited choices for course and content selection. The learning process become relatively passive [24]. This seems to be agreed by MacManus [20] that, in terms of needs, the curriculum design of traditional e-learning platform is driven mainly by the needs of institutions rather than individual learners.

Furthermore, WebCT can only provide basic asynchronous tools and selective synchronous tools (text chat) for communication purpose [35]. MacManus [20] commented that it has not put too much focus on the community dimension, though discussion board and chat room have been included. According to the community of practice by [36], the relationship between teachers and learners, learners and learners should be interactive, connective and practicing. In WebCT, the communities are limited to a group of learners studying the same course in the same institution [8]. Heinze & Procter [19] suggested that instructors can make use of more technologies to facilitate the interactions between learners and teachers, apart from providing handouts and presentation materials in a single way.

4 e-Learning 2.0

In response to the rise of social constructivist theories in 1990s, educators strived to investigate more new features in e-learning in order to enhance teaching and learning, accommodate the learners' needs and enhance the functionality of existing platforms. Nicholson [23] described that the e-learning has now been shifted into a new generation that focuses on more learner engagement and social learning and provides learners with collaborative and learner-centered online learning environments. This new e-learning platform is called e-learning 2.0 [30, 11, 10].

4.1 Defining e-Learning 2.0

E-learning 2.0, according to Chow and Cheung [7], is an online environment emerged from the development Web 2.0. O'Hear [24] described that e-learning 2.0 refers to new ways of thinking for e-learning derived from Web 2.0. The Web has been transformed from a read-only World Wide Web to a web that enables people to read and write [14]. As Downes [8] stated, Web 2.0 is not a technology, but an attitude and social revolution which enables and encourage learners to participate in a socially open environment with rights of content creation and edition.

In the study of Duffy [9], five broad characteristics of Web 2.0 were identified. First, Web 2.0 is a platform that allows users to access and use via Internet. Second, it has a user-friendly and interactive interface. Third, its design encourages users to participate and publish ideas in it. Forth, it is a social networking tool that enables

users to provide feedback and exchange ideas collaboratively. Last, users have content ownerships in the site and rights to control over them. In other words, Web 2.0 represents ideas of learner-centered, collaborative and interactive learning [8].

E-learning 2.0 applies to a complex mix of the innovative and emergent contexts. Duffy [9] explained, although it is difficult to define e-learning 2.0, the purposes and uses in education worth to be considered. By linking the ideas of Web 2.0, e-learning 2.0 is characterised by learner-centre, content access and content creation [7].

4.2 Differences between Traditional e-Learning and e-Learning 2.0

Unlike the traditional e-learning, e-learning 2.0 is learner-centric rather than content or teacher centered [8]. In the traditional e-learning, curriculum design was structured and standardised as a book where contents are arranged and delivered to students, Downes [8] further criticized that activities in the platform were lead by teachers. The e-learning 2.0 promotes the great autonomy for learners, with a focus on the active learning that learners not only act as knowledge consumers but also as knowledge creators [27]. One key mark for the change from the traditional e-learning to e-learning 2.0 is the collapse of distinction between teacher and students and the decentralization of power. It moves the authorities and roles from teacher to students in the new e-learning that learning should be controlled on the hands of learners [7].

To facilitate learner-centered learning, e-learning 2.0 encourages learners to actively interact with other users in the learning process by using technologies such as social networking tools. Learning management systems like WebCT and Blackboard only provides partial communication tools - discussion board and chat room, in which interactions are limited to a given group of learners and topics of discussion are pre-assigned by teachers [8]. E-learning 2.0 emphasises open communication, freedom for sharing, social networked learning and socially constructed knowledge [7].

4.3 E-Learning 2.0 Applications in Education

According to O'Hear [24], it is time to explore more technologies such as blogs, podcasting and media sharing tools in order to enhance teaching and learning.

(a) Blogging. Blogging differs from the traditional e-learning that writing contents in the blog are created by learners. It allows learners to express their personal views and voices informally. Richardson [29] distinguished writing and blogging that 'Writing stops; blogging continues; Writing inside; blogging outside; Writing is monologue; blogging is conversation'. He pointed out that writing in a blog is an ongoing process, where students are encouraged to write down what they are thinking and readers will make feedbacks and responses.

Besides, the use of blog can encourage students to develop their interest in specific subjects. As Richardson [29] stated, instead of assigning a topic to students, it is better to assign them to read something and find out what they are really interested in, then ask them to write and explain. This leads students into a reflective learning process. This kind of learning, as Wilson, Ludwig-Hardman, Thornam & Dunlap [37] stated, is an effective collaborative learning that provides community members an opportunity to learn from others as well as to help other to learn. Most importantly, a blog is

not limited to one author, but multiple users. The contents can be remixed and reused [8]. Richardson [29] further commented that it is lesser costly as compared to Blackboard and WebCT.

Blogging is increasingly more popular in education. A study conducted by O'Hear [24] has provided several examples about the edu-blogging. One of the examples is a travel blog published by the Musselburgh Grammar School in Scotland, as shown in Figure 1. The blog is used to publish information of their annual trip to the Normandy beaches and Paris. It also allows others to read and provide comments.

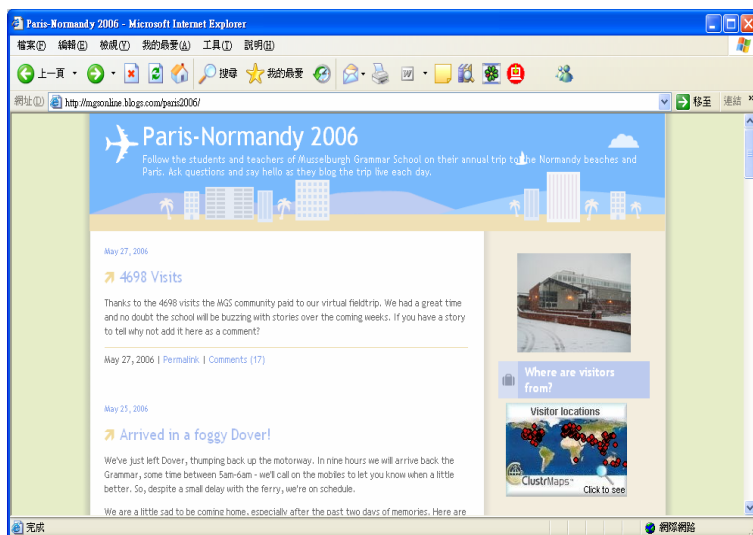


Fig. 1. Weblog of the Musselburgh Grammar School (<http://mgsonline.blogs.com/paris2006/>)

(b) Podcastings. The term podcasting is composed of two words, iPod and broadcast [4]. According to Campbell [4], podcasting is a series of audio or video digital-media files which can be published in Web and available for download and streaming to a portable media players, computers and mobile devices. He explained, although first used with iPod followed by the development of RSS (Really Simple Syndication), podcasting is also used in portable music players.

Podcasts allows students and teachers to share information via the Internet. To publish the podcast, they only need to upload the audio to the blog and create a link to the media content which can access from the blog. If a learner wants to download it, he or she can subscribe to the podcast to download the information. Learners also can transfer the information to portable media players or mobile devices. It can be the tools for teachers to record lessons and comments and for students to conduct oral presentation and sharing. Moreover, the new version of iTunes provides a function that allows learners to jump directly to the desire section within a podcast [4]. Figure 2 shows the iTunes used in the Stanford University.



Fig. 2. The webpage of Stanford iTunes University (<http://itunes.stanford.edu/>)

(c) Personal Portfolio Tools. The portfolio application provides a useful means for students to create and show their work. To apply to learning, the portfolio application provides a chance for students to collect, organize and present their document in a logical way and encourages them to take responsibilities for their own [8]. For example, Elgg (<http://elgg.org>) is social networking tool that allows learners to express their ideas in a space [24]. According to the study conducted by O'Hear [24], there are four main features in Elgg namely, weblog, online profile, RSS reader and file storage (with podcasting). Elgg also allows users to assign the access right for their uploaded files, blog item and profile which ensure the data of access are controlled by users themselves.

(d) Discussion. O'Hear [24] commented that the blogging, podcasting and portfolio tools have three common characteristics, namely, user-centered, social networked and flexible environment. These new e-learning tools provide flexibility to learners that enable them to collapse space and time [7]. They also provide learners opportunities to study with each other collaboratively [37]. More importantly, they all focus on student-centered learning that reflects the concept of choice and democracy in today's society [25].

A research conducted by Lea et al. [17] has pointed out that student-centered learning is effective. He elaborated that, with this approach, students are feeling exciting and interesting, and their study motivation can be enhanced. Lonka & Ahloa [19] in their six-year study found that activating leaning can develop better study skills for learners and help them understand more.

Although student-centered learning has difference advantages, it also has critics. Simon [30] pointed out that learner-centered learning puts the emphasis on individual learners. Each student is unique that requires specific pedagogical approach in order to adapt his or her need. It seems impossible in teaching, in a whole class. Another

study conducted by O'Neill & McMahon [25] also found that students who have experienced the content or teacher-learning method may reject the learner-centered approach as they are not used to.

5 Conclusions

Online information and communication is changing the way instructors and learners interact and learn. Today, the Web is no longer just an information repository or a place to search for resources. Traditional Web applications, which typically consist of browsing and searching on the Internet, are essentially a reading operation. In contrast, the new Web (Web 2.0 or Read/Write Web) is a place to find other people, exchange ideas and thoughts, demonstrate creativity, and create new knowledge. Web 2.0 applications, such as wikis, blogs, social bookmarking, and podcasts, have emerged in a rich, interactive, user-friendly application platform that allow users to read and write to the Web. Web 2.0 has transformed the Web into a global network community where every user is invited to create content. The Web is shifting from being a medium in which information is transmitted and consumed, into being a platform in which content is created, shared, remixed, repurposed, and exchanged. The unique feature of many Web 2.0 applications is that it harnesses the collective intelligence of users. Learners become part of a global human network which could not be possible previously. Through mutual interactions, learners gain from their experiences and construct their own knowledge. The advent of Web 2.0 technologies allows teachers and trainers to empower learners and create exciting new learning opportunities.

E-learning 2.0 is becoming more and more popular. E-learning 2.0 includes great resources to help instructors make the learning environment a more constructivist learning environment for their students. There is a lot of apprehensions from instructors to include tools such as blogs, wikis, and social networks into their instruction, because of their fear that they will lose control of their students. In our opinion, this is the wrong way to look at e-learning 2.0. As an instructor, it is his or her privilege to guide your students in experiencing what is available and to learn how to use these tools appropriately.

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Integrating Constructive Feedback in Personalised E-Learning

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Abstract. When using e-learning material some students progress readily, others have difficulties. In a traditional classroom the teacher would identify those with difficulties and direct them to additional resources. This support is not easily available within e-learning. A new approach to providing constructive feedback is developed that will enable an e-learning system to identify areas of weakness and provide guidance on further study. The approach is based on the tagging of learning material with appropriate keywords that indicate the contents. Thus if a student performs poorly on an assessment on topic X, there is a need to suggest further study of X and participation in activities related to X such as forums. As well as supporting the learner this type of constructive feedback can also inform other stakeholders. For example a tutor can monitor the progress of a cohort; an instructional designer can monitor the quality of learning objects in facilitating the appropriate knowledge across many learners.

Keywords: E-Learning, Tracking, Constructive Feedback, LMS, Personalisation, Knowledge Construction.

1 Introduction

The internet has created possibilities for transferring, sharing and reusing content. The increasing adoption of the internet use in higher education learning demonstrates its potential as a future learning medium. Educational providers are exploring the effective use of e-learning by incorporating it in their teaching. There are several factors that have influenced educational providers to incorporate Learning Management Systems (LMS) within teaching. These factors include the rapid increasing number of students, the need for learning and the need to prepare students to suit the knowledge economy [1]. The use of LMS has created better opportunities for learners to learn ubiquitously. The LMS are capable of creating, fostering, delivering, tracking and facilitating learning more effectively. However these learning tools have not yet fully realised the potential of learning standards [2, 3, 4] and technology by supporting stakeholders with constructive real-time feedback. The lack

of direct and immediate contact between the learner and tutor poses a threat to the quality of e-learning [5]. The teacher in a class setting is provided with a variety of opportunities for interacting and supporting learners. One of the key roles of the teacher is to support learners with constructive feedback during learning. The learners are able to reflect and improve on their knowledge construction. The difficulty with LMS to provide constructive feedback during e-learning has encouraged researchers to devise other effective methods.

The current LMS have been further developed to incorporate technologies such as reusable learning objects [6]. These RLO enable instructional designers to configure content to suit individual learners and allow effective tracking where constructive feedback can be integrated. Reusable Learning Objects have created better opportunities in the content instruction which allows personalisation of content. Learners can request for this personalised content which is dependent on their learning styles [7]. Learning styles are methods, through which learners perceive, interpret and processes information [8]. Jung [9] asserts that learners process information in different ways which is dependent on their learning styles.

The main focus of this paper is to describe how constructive feedback can be integrated within e-learning to support stakeholders. The constructive feedback depends on the tracked information from individual interactions with the learning activities.

2 E-Learning Process

E-learning is a process of knowledge construction that involves stakeholders participating in several online activities such as content authoring, assessment and collaboration. They participate in the different activities so that they can achieve their learning goals. As Constructivism states, learners play an active role and take on responsibility to construct their own knowledge and meaning [10, 11, 12]. This active role is clearly witnessed in e-learning environments which are designed to offer personalised learning process. A personalised learning process is one where learners use LMS to interact with learning content designed to suit their own learning styles with the aim of achieving new knowledge. These LMS are currently trying to cope with the paradigm shift from teacher-centred to learner-centred. In learner-centred learning, learners construct knowledge through inquiry, communication and creative thinking. They use different learning styles to make their own judgement hence making meaning out of the learning process. The different ways by which information is presented to the learners affects how they act on it. The individual learner's actions become the basis of what feedback should be generated for them. The seven principles of good practice [13] act as a benchmark for guiding e-learning implementation.

The theory of constructivism enables us to identify important features for the learning process. The features that can be identified include personalisation of content to suit the individual learner, tracking the learner's activities at each level of the learning process and generating personalised feedback. The features aim at helping the learners attain their individual learning goals from the learning process. The learning goals are determined by both the educational and personal learning requirements. The educational learning requirements are based on the Learning

Object (LO) concept [14] which represents the learning content. Wiley [6] defines a LO as any digital resource that can be reused to support learning. The LO has created a big impact on how learning content is stored, delivered, used and managed. The LO can be easily reused and configured for personal use.

During the e-learning process, the learners aim at achieving the set learning objectives. These learning objectives are set by the educational providers and their attainment measured by assessment. Tracking interactions with the assessment learning activity helps to monitor the student's progress, control the pace of learning and evaluate the teaching strategy. During the learning process learners need to know what they can do to improve hence require constant feedback. The learning content should be designed to reflect the objectives to be attained at each learning level. The instructional model for constructivist learning [15] separates the content into chunks at different levels. The content levels include LO, Information Object (IO), practical and assessment level see figure 1. Each level denotes the expertise the learner can attain at the end of the learning process. The learning levels are turning points for the learning process as they determine what happens at the next level. Personalised tracking [16] capable of monitoring the learning path at each learning level determines what feedback can be generated for stakeholders.

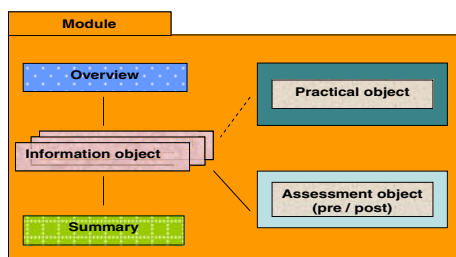
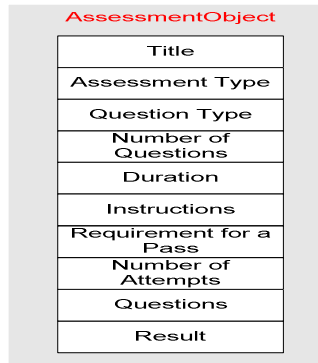


Fig. 1. Template for module package

3 Assessment

Assessment refers to the activities undertaken by both students and teachers to diagnose learning problems hence improving learning and teaching. Assessment enables students to fully understand how far they have achieved their learning goals through effective feedback [17]. Assessment can be carried out in several forms and for several purposes. However there are two common types of assessments used to diagnose learning problems within e-learning. The summative assessment is used as evidence of accountability on deciding if the learning was effective [18]. It is used for grading or ranking student performance hence informing them of their overall achievement. Formative assessment is one that is carried out in series during the learning process aiming at providing constructive feedback to the learners [19]. These two assessment types are usually designed electronically in form of multiple choice questions where learners select one answer from the list of answers offered per question. The multiple choice questions are linked to the learning objectives within the LO and IO. The summative assessment measures the attainment of the learning

objective at the LO level and formative at the IO. Sun and Fu [20] describe an assessment object model that can be used in higher education to measure achievement attained during the learning process, see figure 2. Wiggins [21] notes that the nature of assessment influences what is learned and the degree of meaningful engagement carried out by students in the learning process.



Title
Assessment Type
Question Type
Number of Questions
Duration
Instructions
Requirement for a Pass
Number of Attempts
Questions
Result

Fig. 2. An Assessment Object Model

3.1 Feedback

Feedback may be described as any communication or procedure offered to the stakeholder in response to the accuracy of their actions. Feedback is an important component between the learners and tutors during a learning process. Learners get feedback from their tutors to improve on their learning process. Feedback has a significant impact on the learning process since it adds value that results in improving quality and success in a course. Feedback is important to the tutors in that it reflects how best the student gained in the learning process. It is particularly emphasised by the learning theories [22] that feedback is the important instrument used in a learning process where progress, improvements and achievements are provided in real-time. In e-learning feedback is aimed at providing information about the learning process and the mastery of the learning goals especially in circumstances where there is no direct contact between learner and tutor. Feedback that provides information to reflect on the effectiveness of strategies taken during learning needs to be provided within LMS. Such feedback demonstrates to the stakeholders that there is always support for improvements in the absence of tutors. Successful feedback [23] focuses on the task, its objectives and the learner attention is directed to objectives. The learners always seek information related to their past action from expert sources such as tutors and forums for improvements.

It has been noted by Mory [24] that there has been frequent lack of feedback electronically generated by e-learning environments. There is less contextual, constructive and expert mediated feedback within LMS. In the face to face (F2F) teaching learners can easily receive direct feedback from their teachers in real-time. Within e-learning the learners rely on the LMS to offer the direct support which is difficult to generate especially for personalised learning. Generating personalised

feedback during knowledge construction [25] has great potential in improving e-learning. Non-specific feedback is deemed to be useless to the learners [26] as they progress with their knowledge construction. Feedback should be generated on timely basis when it is more relevant [27] if immediate improvements are needed.

With the increasing number of learners, techniques are sought to support them during their knowledge construction. Forums have shown that they are capable of supporting learners with effective feedback. Learners can freely visit the forums of their specified topic; ask questions or read answers related to their topic. Learners usually find answers which they can use to solve existing problems hence improving their knowledge construction process.

4 Tracking Process

Tracking functionality is considered to be very important because it generates the information from which feedback is offered. Tracking in relation to e-learning is the monitoring of learner interactions with learning activities during knowledge construction. The typical tracking information within LMS include: log files, duration of visit, learning unit visited by learner/time/frequency, collaborations and assessment. However not all traced information is currently used in improving knowledge construction. Some researchers have put to use tracked information from LMS in improving knowledge construction [28]. Other researchers have shown that tracked information can be used to detect weak learners, laggards and effects of particular learning activities such collaboration to e-learning [29, 30]. Tracking is on the increase within web applications and the aim is to learn more about users so that they can be served more effectively. It is noted that [16] tracking personalised learning activities helps in generating personalised feedback.

4.1 Integrating Constructive Feedback in LMS

Constructive feedback refers to the support offered to learners during learning and contains useful content links that can be used for improvements. For example constructive feedback offered to the learner after taking the assessment can include:

“You have successfully attained 60% of the learning objectives for this topic. You attempted 2 application and 4 theoretical questions correctly. However for a better achievement of the learning objectives, you need to consider reading the following content; Content One, Content Two and Content Three. You can also visit the following Forum to help you improve on your practical work.”

This advanced level of constructive feedback can be challenging to generate for stakeholders within LMS. Creating content in form of LO and linking the learning objectives to the assessment questions provides an easy mechanism on how to generate this feedback. Figure 3 describes a module containing three learning objectives interlinked to individual Information Objects. Each Information Object contains learning objectives which are interlinked to assessment questions within the assessment object. For example Information Object one contains learning objectives

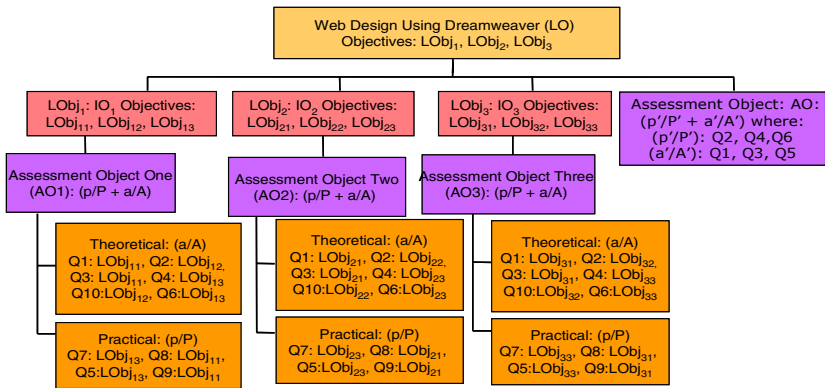


Fig. 3. An Example of a Module with interlinked objects

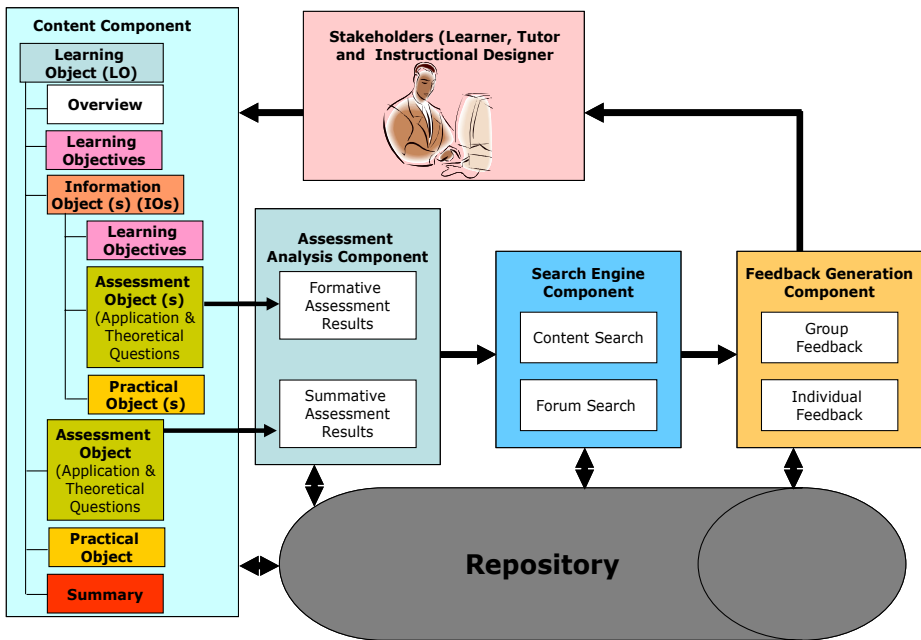


Fig. 4. Model Describing how to Integrate Constructive Feedback

LO₁₁, LO₁₂, LO₁₃. The assessment object contains questions that are designed to assess the attainment of the specific learning objective. The questions are designed to assess both theoretical (A) and application (P) understanding. For example Q1 in assessment object one is used to assess the attainment of learning objective one (LO₁₁). If the learning content is instructionally designed as shown in figure 3, results from the assessment can be easily transformed into constructive feedback.

The mechanism for integrating constructive feedback within knowledge construction contains four main components used in the process and these include

Content Component, Assessment Analysis Component, Search Engine Component and Feedback Generation Component. The figure 4 describes a model for the mechanism that integrates constructive feedback in e-learning by interlinking the different components.

4.2 Content Component

This is a component where the content design is configured to suit the feedback generation process. The content in form of LO is configured as described in figure 3 so that the objects are interlinked. The content topics, assessment questions and key words are linked to learning objectives. Anchors are used to locate content areas related to learning objective and allow easy search for specific content. On a single content page you can have more than one anchor to locate specific content. The module and topics can easily be searched within the repository by use of unique anchors placed on them. Therefore if the feedback required for improvement is related to a particular anchor, all content identified by that anchor will be retrieved and offered as content links within the constructive feedback

Forums can be created and named after key words such as “*palettes*” and anchors placed on them. It is the anchors that are used to locate the appropriate content and forums that are suggested within the feedback. When the content is properly configured and pre-planned, it is stored within the repository where it can be searched and reused during knowledge construction.

4.3 Assessment Analysis Component

This component is responsible for analysing the assessment results in different forms. It computes the results for the different types of questions (theoretical and application) and the overall results. The analysis is carried out for both the summative and formative assessments at the different learning levels. Once the assessment questions in form of multiple choices have been attempted by the learners, the correct and wrong questions are determined. The correct and wrong questions results are used to determine pass/fail rate which is incorporated within the feedback.

Sorting out the wrongly answered questions from the correct one is carried out in this component using various algorithms. There are several algorithms that can be used for the assessment analysis during this personalised tracking process [25]. The algorithms compute assessment results based on the type of question (theoretical/application), learning level (LO/IO) and user (individual/group). The analysed assessment results are then stored within the repository for future use during feedback generation.

4.4 Search Engine Component

This component aims at searching for content areas that will be offered within the constructive feedback. The search engine depends on the assessment analysis component to find suitable content. If no anchors are sent to the search engine for locating specific content, no content links will be included within the feedback. When the anchors are presented to the search engine, a search is carried out within the repository to locate content of interest.

When the content of interest has been found, a link is created on the keywords that were used originally during the tagging with anchors. For example if an anchor is searched and content titled “palettes” is found to be related to it, a link to the content is created on the keyword. The linked keyword (palettes) is then dispatched to the feedback generation component. Several linked words and forums may be created depending on the anchors presented to the search engine. These content links are the most important part of the feedback because they provide you with the knowledge on attaining the learning objectives.

4.5 Feedback Generation Component

This is the component that is responsible for integrating the assessment analysis results with the selected content links to generate constructive feedback for the stakeholders. Within this component there are several feedback templates that are designed so that results from the assessment analysis and search engine are easily integrated. The feedback templates are predefined by the instructional designers to suit a particular module under study. These feedback templates are stored in the repository and retrieved during the feedback generation process. The criteria for storing the feedback templates depends on the performance results in the type of questions (theoretical/application) and the overall attainment of learning objectives (0%, 10%, 20% ..., 100%). For example a template selected for an overall performance of 60% with 20% in theory and 40% in application will be different from one selected for the same performance but with 30% in theory and 30% in application. The feedback templates contain dynamic content where assessment analysis and search engine results are automatically integrated to generate the necessary feedback. When the results have been integrated within the feedback templates, feedback is immediately generated and dispatched to the stakeholder. The stakeholders respond to the feedback offered to them by visiting the content areas or forums suggested to them. An example to illustrate how assessment is undertaken and feedback offered to IT Degree students studying E-Business Module is shown in figure 5 and 6. The module (LO) “Designing Web Sites Using Dreamweaver” contains several topics (IO) as shown in the figure 6. Each topic contains an assessment that measures attainment of the learning objectives for that topic.

When the assessment has been taken by the learner, results are automatically computed by the system. The different algorithms within the system compute for the results attained with the theoretical and application questions, determine the questions which are correct and wrong. These analysed assessment results are immediately sent to the search engine component. The wrongly answered questions tagged anchors are then used within the search to locate appropriate content within the repository.

The search results locate content related to “Web Page Templates and Using Timelines” and links created on the keywords. These search results are immediately sent to the feedback generation component. The feedback component generates feedback for the learner containing the content links that were located. The content links are related to the unattained learning objectives content areas. Figure 6 describes an example of the constructive feedback generated for a learner who failed to attain the minimum learning objectives.

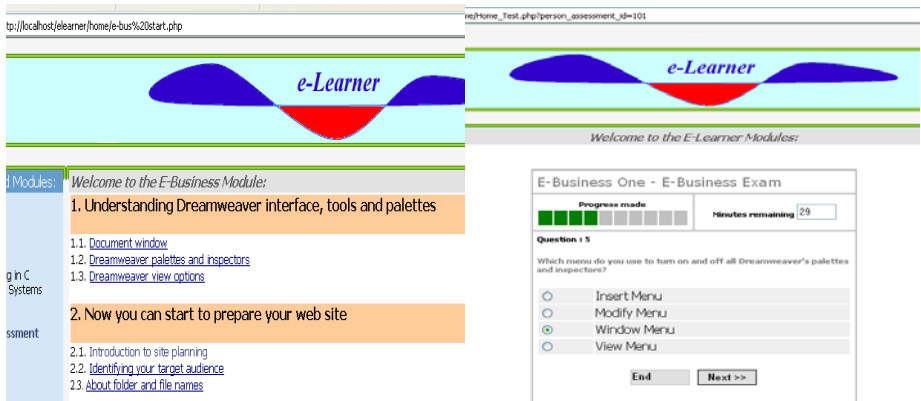


Fig. 5. Screen Shots for Content and Assessment for the Module

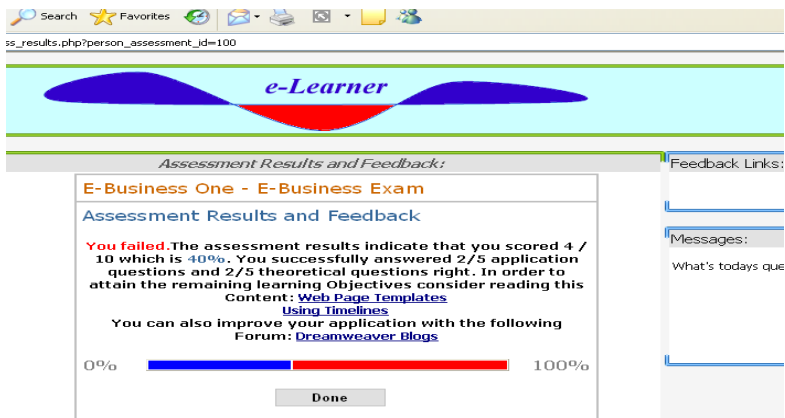


Fig. 6. Screen Shot describing a form of Constructive Feedback

5 Discussion

Personalised feedback offered to learners is so vital in transforming their previous knowledge construction process. Such personalised feedback is constructive because it directs learners to their learning weaknesses. This form of feedback has been applied in a Managed Learning Environment (TEMAI) which was used to educate employees of an industrial company [31]. The learning environment was designed to support a group of workers in a footwear industry with personalized feedback based on what activities they carried out during learning. The learning environment was built with a synthetic pedagogical agent called Vincent that would offer personalized feedback to the workers during learning. The architecture of TEMA included a set of micro-learning environments, a trainee model, learning material and Vincent - the pedagogical agent. The work of the agent was to foster the trainees' learning process through motivation as a form of personalized feedback. The agent contained sensors

and actors that could establish message-based communication while gathering information about the trainee's performance. Whenever a trainee's performance was not to the desired standards, the agent would send out an emotional feature on the screen either showing, sadness, disappointed, impatient or happy plus a spoken utterance. This form of feedback depended on what activity had been carried out or performance attained by the trainee hence being personalized to their knowledge construction process. It was noted that there was an improvement in the training by use of such personalized feedback.

This form of personalized feedback highlighted the importance of informing learners about their past knowledge construction process. When they are told their weaknesses they are able to adjust on how they learn hence improving the learning process. How the personalized feedback is designed, formulated and delivered may differ but its main purpose should be to enhance the knowledge construction process. The form of personalized feedback proposed in this paper is one that will direct learners to content areas of weakness or discussion areas of importance. These are spotted based on the assessments results which indicate the learning objectives that have not been attained due lack of expertise in a particular content area. Integrating such feedback within e-learning environments can be appreciated by many learners in the new learning paradigm.

6 Conclusion

This paper focused on the integration of constructive feedback within e-learning in view of offering further support to learners. The provision of constructive feedback needs to be regarded as a priority within LMS under the new learning paradigm (learner-centred). Within the new learning paradigm, learners are demanding for more support during their knowledge construction. Lack of direct interaction with tutors especially in e-learning, creates a big challenge on how to support learners ubiquitously.

The paper has discussed a mechanism that can be used to integrate constructive feedback within LMS. The constructive feedback was based on the analysis of assessment results which measure the attainment of the stipulated learning objectives. The wrongly answered questions indicated the learning objectives that were not attained and required further reading. The anchors placed on the questions were used by the search engine to locate appropriate content to be provided in the constructive feedback. The generated feedback described the learner's understanding in both theoretical, application and also provided useful links that can be used for improvements. The links within the feedback lead to the content areas and forum that are related to learning objectives. Such feedback provides the necessary support needed in absence of a tutor and should be encouraged if the quality of e-learning is to be improved.

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A Peer-to-Peer eLearning Supporting System for Computer Programming Debugging System*

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Abstract. While students are studying computer programming, they have to handle programming style questions or assignments frequently. They are mostly facing similar programming difficulties. Some of them can resolve the problems but some cannot. As such, it can be treated as a peer-to-peer learning opportunity for all students to share their experiences and knowledge. As sharing and teaching is a good process in the entire learning life-cycle, that is, learn to teach and teach to learn, such sharing and assistance should be encouraged with credits based on the recommendations of the students who are assisted. An open forum can facilitate knowledge sharing, but there are no features for maintaining the trace of peer-to-peer assistance. Therefore, this project aims to facilitate the peer-to-peer activities with an award system.

Keywords: Trace of peer-to-peer learning, eLearning, Share of knowledge.

1 Introduction

Traditionally, students were learning under spoon-feeding education model. Many of them might not acquire much knowledge without the help of teachers. However, nowadays, the story is totally different. Web-based education (WBE) has given a tremendous impact to the traditional learning method. It is obvious that the place and time independent feature of web-based education is the major benefit in education. Even better, it could trace users' knowledge. Once a web-based platform is created, students are allowed to communicate among themselves conveniently. For many computer science students, programming is a large barrier they would face. If other students could help in solving the problems, students would probably get a quicker response as well as more different ideas to approach the questions. This paper aims to provide a solution to achieve peer-to-peer learning by introducing a communication platform for a group of students.

A usual forum can facilitate knowledge sharing, but there are no features for maintaining the trace of peer-to-peer assistance. Therefore, a peer-to-peer e-learning supporting system is proposed.

The following is a complete life-cycle for handling an assignment, which involves the lecturer, tutors and students.

* The work described in this paper was substantially supported by a grant from City University of Hong Kong (Project No.: 6000167).

1. The lecturer designs an assignment that is then available from the e-Learning Support System. At the same time, the system creates a forum for the assignment.
2. Students get the assignment from the System.
3. If any student has any problem related to the assignment, the student can post a question to the system.
4. Another student would have the know-how can post a message or an advice via the System.
5. The student who posts the problem reviews the advices and values the advices by assigning a mark.
6. The marks assigned by all students are consolidated and credits are determined for all students who post advices.
7. The credits are considered to be part of the score of the assignment who post the advices.

The system is established based on the prototype of Discuz! Open Source forum solution. The development of e-Learning Support System will be divided into front-end and back-end based. For the front-end part, a user-friendly web-based interface is provided for the handling students' questions and statistics data of usage of the system. Also, each user will be provided a control panel to view and modify his personal particular. Besides, since the registration process for general application system is not easy for controlling number of users and the single unit registration at a time approach is tedious for teachers create account for numerous students, the system allows bulk adding of users. On the other hand, in order to allow consolidate the students' credits, and assigning mark automatically to their assignments, the database has to be modified so as to store teachers' marking record conveniently.

System features:

According to the above scenario, the following is a list of features of the e-Learning Supporting System(ELSS):

1. Release a new assignment with a forum created automatically.
2. Post questions.
3. Review questions and post advices.
4. Review advices with score as significance and correctness of the advices.
5. Consolidate the scores by individual students as credits gained by the students.

2 Methodology

The whole project can be split into three sub-systems: (1) Questions propose system, (2) Question response system and (3) Responses feedback system.

2.1 Questions Propose System

The system provides a platform for the user to propose their questions related to the assignment. If it is necessary, students could capture the screen layout or upload their programming source code which used to show the information about the problems they are currently encountered. On the other hand, teachers could limit the upload file types so as to maintain the security of the system (Normally, executable files may not be allowed to upload).

Algorithm:

Begin

Student raises a question to the teacher with providing source code

If there is sensitive information

Teacher filter out sensitive information in the source code

End If

Teacher place the question to the system which allow a pre-defined groups to response

End

2.2 Question Response System

Students who have been granted right to use the system could reply the questions, they are allowed to uploaded files as well.

Algorithm:

Begin

Student answer a question and may provide source code

End

2.3 Responses Feedback System

After getting the answers, system to allow teacher to remove non-related reply or give merit to the students who have give outstanding answers the questions.

Algorithm:

Begin

Teacher gets the answers of students from the system

If there is not necessary information

Teacher removes the post

Else

Teacher gives credit to the student according to the pre-defined scale

End If

End

The following diagram visualizes the system architecture of the System. The architecture of the Module is illustrated in Figure 1.

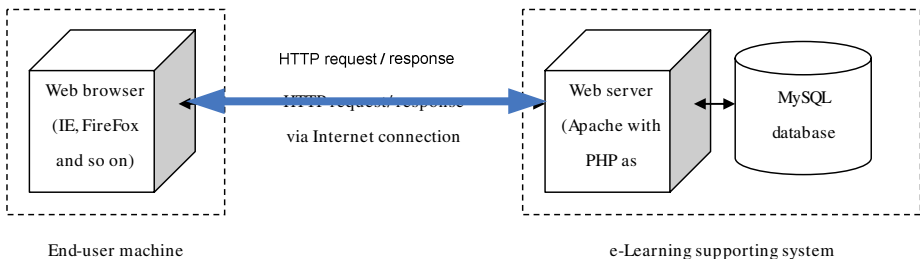


Fig. 1. Architecture of the Module

The following software is involved in the system:

- Web browser (such as Internet Explorer, FireFox and so on) – used by end users for accessing the System
- Web server (Apache web server) – hosted on the web server machine for handling the HTTP request by the end user
- Database server (MySQL) – hosted on the database server machine for maintaining all data of the system
- Scripting language (PHP) – executed by the web server for handling HTTP request and generating the dynamic web pages to be returned
- Operating system (Linux) – the operating systems to be installed on the web server machine and database server machine.

3 Prototype with a Case Study

The lecturer, an Associate Professor of the City University of Hong Kong, teaches several computer courses. In each course, he needs to give assignments to students. According to the experience of the lecturer, some students may not fully understand the questions and have no idea to finish the assignment at all. Hence, an on-line platform is necessary which acts as computer intelligent broker, providing a bridge to the edges and enhance the knowledge of the students themselves.

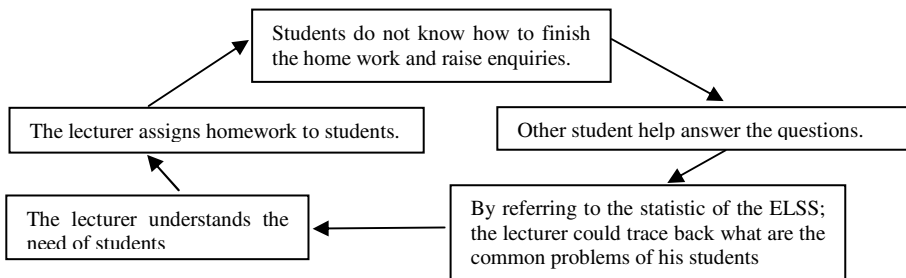


Fig. 2. Entire learning life-cycle

The following section would explain how the lecturer operates the ELSS (eLearning Supporting System) to achieve collaborative learning purpose (Figure 2).

3.1 Screen Dumps for Case Study

1. Before starting the course, the lecturer needs to login to the system by his account and create the account to his students.

The screenshot shows the 'e-Learning Support System' header. Below it is a navigation bar with 'Guest: Register | Login | Statistics'. The main content area is titled 'Test Forum Name > Member Login'. Under 'Member Login', there are two input fields: 'Username' and 'Password'. The 'Password' field has a masked input (dots). A 'Submit' button is located at the bottom right of the login form.

Fig. 3. Setting up account for eLearning Support System

Students can then choose the topic that users would like to post questions to a selected open forum as shown in Figure 4.

The screenshot shows the 'e-Learning Support System' header. Below it is a navigation bar with 'student_no: Logout | My * | Member's OP * | FAQ'. The main content area is titled 'e-Learning Support System > Report document'. Below this, it says 'Moderated by: "OPENING"'. There is a 'Report document' section with a table showing 'Subject', 'Author', 'Replies/Views', and 'Last Post'. The table is empty, with a message 'There have been no threads in the specified range or forum.' Below the table is a 'Fast Post' form. The form has a 'Subject' field and a 'Content' text area. There are checkboxes for 'Options': 'Disable parsing URL', 'Disable Smilies', 'Disable Discard Code', 'Use Signature', and 'Email Notification'. There is a 'Smilies' section with a button to insert a smiley. At the bottom of the form are buttons for 'Submit Post', 'Preview Post', and 'Reset Post'. The 'Submit Post' button has a tooltip that says '(ALT+S for shortcut to submit)'.

Fig. 4. Student post problem message with upload function in a selected open forum

2. As the lecturer receives a problem from the student, after filtering sensitive information (e.g. login account), he will upload the question to the system.

Post New Thread

Username

elssAdmin [log out]

Reading required access level

0 (Leave blank for "no limit")

Subject

Procedure for Demonstration of Data Binding

Icon

Message

Html **Disabled**

Smilies **enabled**

Discuz! Code **enabled**

[img] Code **enabled**

☐ Disable parsing URL

☐ Disable Smilies

☐ Disable Discuz! Code

☐ Anonymous post

☐ Use Signature

☐ Email Notification

☐ Stick this Thread

☐ Add to digest

☐ Add to blog

During running the program in virtual basic, the "Run time error 13 type mismatch" occurs in this statement:
" Combo1.ItemData(Combo1.NewIndex) = Adodc1.Recordset.Fields("City_id").Value"
Is that the "ItemData" cannot match with "City_id" as its data type is character?
How to modify the program so that The "ItemData" can match "City_id" when it use character type?

Check Length

Preview Post

Reset Post

Uploading New Attachments [+][-] (smaller than 2048 kb)

Reading Access: 0

Description: Sql for the dbms

Attachment:

Choose File

SQL.doc

Post New Thread

[ALT+S for shortcut to submit]

Fig. 5. A question was posted by a student on programming problem

3. Other Students with password assigned by the lecturer could answer the questions via the system

Subject: Procedure for Demonstration of Data Binding using Visual Basic

Printable Version | Email to Friend | Subscription | Favorites

elssAdmin
Administrator
UID 4
Digest Posts 0
Credits 0
Posts 4
Reading Access 200
Registered 26-2-2009
Status Offline

Post at 19-3-2009 08:52

Profile | Blog | P.M.

Procedure for Demonstration of Data Binding using Visual Basic

During running the program in virtual basic, the "Run time error 13 type mismatch" occurs in this statement:
" Combo1.ItemData(Combo1.NewIndex) = Adodc1.Recordset.Fields("City_id").Value"
Is that the "ItemData" cannot match with "City_id" as its data type is character?
How to modify the program so that The "ItemData" can match "City_id" when it use character type?

[Quote] [Report] [Rating] [Reply]

50222222
cs5483

Post at 19-3-2009 09:00

Profile | P.M.

Use array in vb 6

First you need to create an array which consists of the City_id you would like to display in the combo box
Then you may use the index of array as the combo box index
For more details, please refer to the document...

 Attachment: [Details solution explanation] questionExplain.doc (19-3-2009 09:00, 50.5 K)
Download count 0

[Edit] [Quote] [Report] [Rating] [Reply]

Fig. 6. Another student posts a solution to the problem

Students who have contribution in solving the problem will be given credits.

4. The credit assigned to the students would be consolidated and regard as part of the score of the assignment.

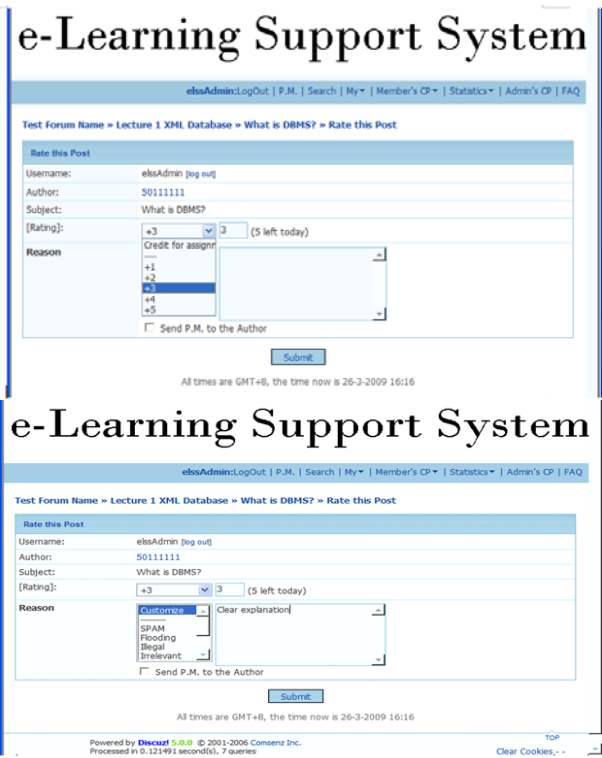


Fig. 7. Lecturer assigns rewarding credit to the student who posts the solution

Basic Conf. Forums Users Posts Extended Conf. Misc Tools									
System Conf. Index > Edit Member									
Tips									
• Bold means "System Group", italic for "Special Group", otherwise "Member Group".									
Def?	Username	credits	Credit for assignment	posts	Admin Group	User Group	birthday	edit	
☐	elsUser	0	0	0		cs5483	0000-00-00	[User Group] [Permissions] [credits] [Medals] [Detail]	
☐	50333333	0	0	0		cs5483	0000-00-00	[User Group] [Permissions] [credits] [Medals] [Detail]	
☐	50222222	3	3	5		cs5483	0000-00-00	[User Group] [Permissions] [credits] [Medals] [Detail]	
☐	50111111	3	3	4		cs5483	0000-00-00	[User Group] [Permissions] [credits] [Medals] [Detail]	

Fig. 8. A report showing the rewarding credits of all students helping their Classmates

The statistics of the students using the system will be stored. Hence, the lecturer could make the future teaching planning according to the statistics.

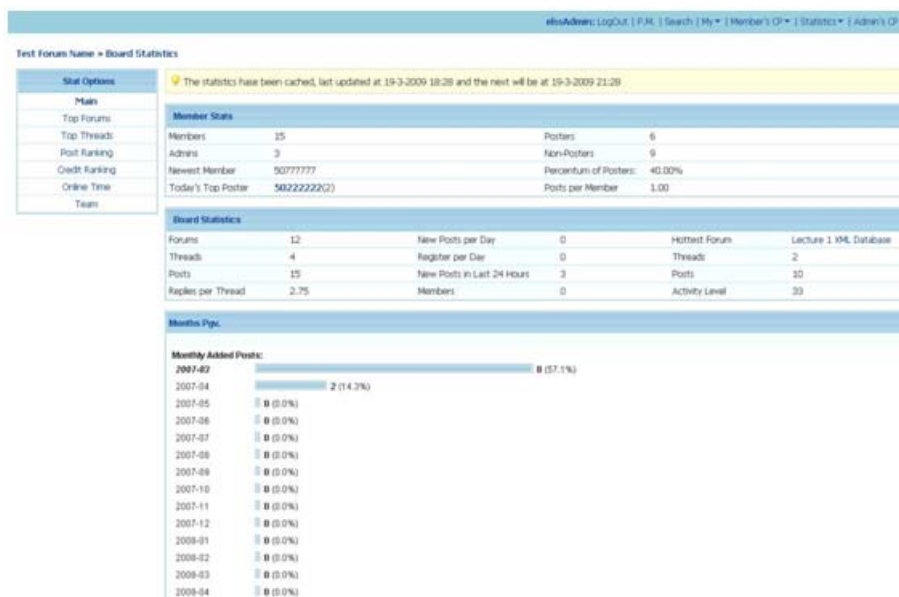


Fig. 9. Statistical figures of the history of students posting problems and Solutions

Table 1. The useful statistics data

Field name	Description
Member Stat	Statistics of users' details in the system
Members	Total number of users added in the system.
Admins	Total number of users with administrator role.
Newest Member	The latest added user.
Today's Top Poster	The user involves most number of posts in a day.
Posters	Number of users has posted via the system.
Non-posters	Numbers of users do not have any post in the system.
Percentage of Posters	Percentage of users who has posted via the system.
Posts per Member	Average posts per member.
Board Statistics	Statistics of boards' details in the system
Forums	Total number of forums created.
New Posts per Day	Number of new posts in a day.
Hottest Forum	The forum with highest number of posts.
Threads	Total number of questions are raised.
Register per Day	Average number of users registered in a day (if the system is set to be registered by users individually.)
Threads	Number of questions from hottest forum
Posts	Total number of posts.
New Posts in Last 24 Hours	Number of new posts in last 24 Hours
Posts	Number of posts from hottest forum
Replies	Average number of replies per questions.
Members	Number of users involved in the system in a day.
Activity Level	Measure of forum activity level.
Months Pgv.	Statistics of post adding month/day.

3.2 Extended System Function

As the e-Learning support system allow collection of students' intelligent, as well as keeping track the weakness of students, it could help improve education planning with focusing on the need of students. Consequently, the whole education system can be changed in order to train up our students to have the skills to suit the need of our society.

Here are some possible value could be added to the system in the future:

3.3 Sharing of Statistical Data

With more system data are analyzed, more understanding are what the need of students can be identified. In order to achieve this process, a platform could be provided for different users to upload their statistical data with hiding the information of students. Hence a boarder view of students' performance could be viewed across different units with maintaining the privacy of users.

3.4 Auto-filtering of Topics

For computer sciences courses, users from different stream may be interested in different topics. The system can be extended to collect information about the stream of user studying. Hence, users could filter out the topics according to his stream conveniently.

3.5 Evidence of Achieving the Student Learning Outcomes

Methods of collecting evidence

- The counter of the download frequency of students' access to the ELSS can be an indicator for the evaluation of the eLearning tool.

Findings and implications

- Encouraging peer-to-peer learning activities among students on campus.
- Motivate students to enter programming contest in Hong Kong and overseas.

Effectiveness / Efficiency of the project in achieving the outcomes

- Strengthen students' technical skills in computer programming.
- Use computer resource efficiently by the students doing programming work.

Impact on CityU teaching / learning

- Save computer time for students doing programming.
- Save lecturer time for teaching students programming.
- Improve student whole person development by helping other students.

Dissemination / sharing of good practices or deliverables

- The result of the peer-to-peer e-Learning project can be published in an International Conference Proceedings by a research student.
- A web site can be established to hold ELSS

4 Conclusion

e-Learning Support System is designed to demonstrate how to achieve knowledge sharing with maintain the trace of peer-to-peer assistance. With a simple platform, students can facilitate to learn in any places which have web service provided. The success of this system depends on the utilization of the system and the learning motivation of students. The contribution of this paper is to enable students to learn from their peers as well as to get the solutions in solving their programming problems quickly. More, it encourages students to think more ways when approach to a problem.

In summary, this ELSS[11] can motivate students getting a more rewarding learning experience in the process as a result of the mutual support they give one another.

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Learning Knowledge Management Concepts via the Use of a Scenario Building Tool on an E-Learning Platform

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Abstract. As e-learning or blended learning is more and more popular these days, but with the lack of certain tools, most of the e-learning objects are just simple power point files, pdf files, word documents, HTML files or simple flash files uploaded to a Learning Management System. On many occasions, instructors cannot devote sufficient energy nor time to develop more interesting flash or animations for their subjects. In this paper, we proposed a scenario building and execution tool that supports the learning and application of knowledge harnessing and sharing techniques for knowledge management subjects. This system takes a Web 2.0 approach which ultimately not only instructors but learners can also contribute to scenario building and executions.

Keywords: E-learning, Knowledge Management, Scenario Building Tool, Authoring Tool.

1 Introduction

How do we apply what we have learnt in Knowledge Management? How much can we apply what we have learnt from the course into real life experience? How do we know what we apply is correct or not? Most of us have lots of answer to that question for the particular subject we are teaching, but it does not always satisfy our audience. Occasionally, someone will get right to the heart of the matter by asking, “I understand what worked or didn’t work for the organization in the case study, but can I really build knowledge management skills simply by reading about what others have done and discussing on or by just attending a course?”

In short, students (aka learners), managers and employees want to actively practice skills and competencies as part of what they have encountered or learnt from a knowledge management program. They want to take active learning to a whole new level. Active learning certainly beats passive learning, but are case studies sufficiently active? Can we enrich the experimental learning that takes place in our organizations and thereby enable people to improve by actively practicing the art of knowledge management?

After working with both master level students and participants in executive in industry, the authors started to think about adding another new dimension to learning.

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Could one go beyond reading and talking about what the executives should have done in a case study and create a mechanism to give the learners more real-life experience and more visualization in knowledge capturing, knowledge sharing, knowledge discovering and knowledge application? How can they know and demonstrate their competency in a specific area?

All the above questions led the authors to experiment with a cognitive approach rather than a behavioral approach to online learning. Scenario building on e-learning platform, in which learners are able to use more interesting online technologies to acquire information, make decision, and obtain immediate feedback on their choices are those of their colleagues in a particular subject is a promising and interactive way of enhancing the demonstrating the learning experience.

But will instructors willing to devote their time, attention and energy to outline and build the scenario? How can we help them to get the most out of their time and energy to spend time in building one scenario? One of the main problems is the lack of tools to effectively build scenario(s) in the current market. Most of the tools need special training or skill in order for instructors to be able to build one scenarios. Besides, for the few KM simulation tools on the market, the very scenarios inside these tools are pre-built and cannot be changed by people other than the developers [1] [2] [3].

In this paper, our primary focus is on the possible ways to develop the potential of instructional design tool and authoring tool for building scenarios for Knowledge Management Subjects into an e-learning platform.

The content of the paper is as follows: In section 2 the authors describe what are Knowledge Management, Knowledge Management Scenarios, and sources of the Scenarios. In section 3, the proposed system and the conceptual diagram are briefly described. In section 4, the proposed scenario building tool is explained in detail. Section 5 explained on the tool deployment and target usage. We draw our conclusion and future work in Section 6.

2 Knowledge Management, Scenarios and Their Sources

In this section, knowledge management, knowledge management scenarios and sources of these scenarios are discussed.

2.1 Knowledge Management

Knowledge Management (KM) is an inter-disciplinary field with wide applicability in many industries and organization in today's knowledge-based economy. In contrast to many other academic disciplines which the validity and performance of a new found technique are vindicated by results carried out in laboratories, success in managing knowledge is often judged by the adoption and effectiveness of the deployed KM initiatives by the daily activities carried out by the involved parties, at the organizational, group and personal levels.

KM may simply be defined as doing what is needed to get the most out of the knowledge resources (e.g. people, repository, practice, etc.). KM is viewed as an increasingly important discipline that promotes the creation, sharing and leveraging of an organization's knowledge. Thus, it can be argued that the most vital resource of

today's enterprise is the collective knowledge residing in the minds of an organization's employees, customers and partners. Learning how to manage organizational knowledge has many benefits, some of which are readily apparent, others are not. These benefits may include leveraging core business competencies, accelerating innovation and time to market, improving cycle times and decision making, straightening organizational commitment, and building sustainable competitive advantage. In short, they make the organization better suited to compete successfully in a much more demanding environment. Organizations are increasingly valued for their intellectual capital [4].

In general, KM focuses on organizing and making available important knowledge wherever and whenever it is needed. The traditional emphasis in KM has been on knowledge that is recognized and already codified. This includes knowledge about processes, procedures, intellectual property, documented best practices, forecasts, lessons learnt, and solutions to recurring problems. Increasingly, at a personal level, KM has also focused on managing important knowledge that may reside solely in the mind of an organization's experts [4].

2.2 Knowledge Management Scenarios

According to David A. Kolb, experiential learning is a learning process whereby knowledge is created through the transformation of experience [5]. This learning and teaching philosophy had gained ample recognition over the years and is used in various educational and training settings in different forms. In this paper, we also classify the scenario-based approach that we use as experiential learning.

The scenario approach to knowledge management is an innovative participant-centered learning and teaching pedagogy, which emphasizes the use of experience as a significant source of learning. For example, in management courses, business simulation games have been used as supplementary teaching and learning tools to help business students apply previously acquired knowledge to solve real-world problems.

Learners enjoy watching more fancy flashes or animations while study using e-learning platform in which they willing to devote their time and energy to study online. This observation led us to explore the feasibility of using a scenario to supplement or replace the teaching of a variety of knowledge management subjects. We hope that we can improve learners' decision-making skills and knowledge application skills with KM scenarios. These scenarios often reflect the real world situation and practicality of some taught KM concepts.

However, in many business simulation cases, instructors often test learners on their knowledge of the material (aka the behavioral approach), but are left to wonder if they are actually able to apply the concepts [6]. According to previous research, one of the most difficult practical problems in teaching and learning with business simulation games is finding ways to get students to rigorously apply the knowledge and skills they have acquired in class or through online learning to their decision making in a game simulation [7]. From their experiment with business school students, Mandl et al (1992) confirmed that students using a computer-based simulation game had serious deficits in knowledge application and in problem solving using their previous knowledge or learnt knowledge [8]. In addition, one of the major problems of business simulation games is that learners often become very non-reflective and non-analytical about what they are doing during their game play [9].

Throughout our research, we have so far conceived three types of KM scenarios. The first type of scenario is to illustrate a single technique/concept in Knowledge Management e.g. After Action Review (AAR), Knowledge Café, Peer Assist. This type is analogous to the learners perusing some online content thereby gaining knowledge of a new concept. The second type of scenario is by staging a conversational role play among several subjects, the learner is asked to provide an assessment or some form of participative input in an interactive manner. This type of scenario often involves the learner to apply decision making and/or problem solving skills through which their learning of the concept is enacted and reinforced. The third type of scenario is a combination of the first two types and the learner may be further asked to provide a reflection of what he/she has learnt via some open end questions. This type of scenarios is the most complex of the three and requires the learner to recall and apply, among other things, what they have previously learnt in order to complete the current scenario.

2.3 Sources of the Knowledge Management Scenarios

Since sources of KM scenarios are quite scarce, after some further investigations, the authors have identified the following list as sources for developing the KM scenarios:

1. KM Method cards which provide many commonly used KM methods [10]
2. Knowledge worker archetypes[11]
3. KM competency framework [12]
4. Existing KM scenarios in HKCyberU Master Course in Knowledge Management [13]
5. New or simple scenarios as collect from consulting practices by KM specialists from the Knowledge Management Research Centre, The Hong Kong Polytechnic University [13]
6. Composite scenarios which is the combination of one or more of the above sources/scenarios

2.4 Problem Statement

This study starts from these fundamental facts and questions: KM scenarios are required to let learners to acquire the skills to understand the applicability, scope and limitations of a technique, as well as apply the learnt technique in pre-composed scenarios. But how can one encourage instructors to build scenarios? As things stand, it is not a must that instructors must build scenario for one course. Because it is not always clear that learners will learn what they are supposed to from accessing scenarios, or that they will be able to apply what they have learnt in class to real-life situations, either during or after accessing the scenarios. Besides, the most important fact is that without an appropriate tool, instructors might need to devote energy and time to build one scenario. They might need special training or skill or hire one designer to build scenarios for that course. Furthermore, the level of IT literacy among instructors can vary enormously and one cannot assume that all instructors are at ease with the use of scenario simulation and building tools. There are a lot of tools in the market that could be used for scenario building such as Adobe Flash Designer, Google sketching tool or others. The author's team has conducted a comprehensive evaluation of these tools and the results will be published in a different article. However, nearly all of the mentioned tools require special skills such as drawing skills or some might

need special training and/or commercial license in order to be useful. Besides, all the interaction in the scenarios such as conversation, character walking from one place to another place could not be done in one click or one drag and drop.

During our study, we found out that for KM course, only KM simulations or games are available in the market and all of these are prebuilt scenarios application such as KM Quest [1] which is computer based simulation or KM Game [2] which contains lots of pdf files or word documents which required learners to finish it as in normal face to face class. One famous computer-based business simulation game, titled *Launching a High-Risk Business* [3] is one example which started with a few informative video clips about the challenges of starting a new business. A guide introduces the simulation to the user and users just follow as per instructed or key in his/her own decision. All these are just pure computer-based simulation and fall short of what scenario building and execution systems can do.

3 Proposed System

In this section, the proposed system based on the above facts and questions from section 2.4 is presented.

This paper aims to provide a learning and simulation system to support the learning and application of many prevalent knowledge harnessing and sharing techniques commonly encountered in the workplace. In particular, specific scenarios can be easily and quickly created by an instructor or online facilitator to reinforce the learning outcomes for the learners. The same platform can be used for the learners to acquire the skills to understand the applicability, scope and limitations of a technique, as well as apply the learnt techniques in pre-composed scenarios.

All types of knowledge management (KM) techniques will be considered for inclusion as individual learning topics into the proposed platform. Such techniques may include, for example, technology-based KM systems, people-based (including both personal and team-based) KM, and process design.

It is assumed that a traditional E-Learning system will continue to serve as the primary platform for delivering the E-Learning environment. A learner would still pursue the necessary reading and activities as guided by the online learning content. The proposed learning and simulation system complements the above operation by demanding a learner to go through certain interactions and assessments before he/she is deemed competent to apply certain learnt techniques. Depending on the learnt techniques and achieved competency, a learner may be asked to tackle specific scenarios to attest their knowledge on applying the technique(s) with due attention to the specific constraints that are revealed, directly or indirectly, in the scenarios. Examples of constraints are the “knowledge is power” mentality, no budget for KM initiatives, subject matter experts in dispersed locations, core knowledge concentrated in a small set of staff, and high proportion of staff approaching the retirement age. Accordingly, there is a set of pre-defined attributes that governs the characteristics of each technique. Such attributes include the pre-condition, outcome, cost, time to yield, and accompanying condition(s).

A learner may be asked to “revisit” a learnt topic for an update or refresher. The gained competencies can also be “carried forward” from one subject/semester to another subject/semester reflecting the gradual maturity and gaining of experience of a practitioner in the real world. Several basic scenarios can be combined to form a

lengthy complex scenario. The competency card will be updated and can be ported across subjects (and eventually across E-Learning systems).

Up to now, the authors are unaware of any similar training and simulation system that is specifically on KM topics. KM is a very practical field but nearly all the training in this field is delivered in the traditional classroom environment¹. While this will no doubt remain a principal way of delivering effective learning, learners only have a limited number of opportunities to apply their learnt concepts and perhaps exploit new ways of solving real world problems. Right now these opportunities are manifested in the way of mini-projects, invited lectures and site visits. In a semester of training, there can only be a small number of these activities/events. The proposed system, with a growing library of pre-stored KM tools (which serve both as learning content and techniques to apply) and implanted scenarios, provide learners with a lot more opportunities to try out their learnt concepts and obtain feedback on the effectiveness and applicability of various techniques.

3.1 Conceptual Diagram

The conceptual diagram of proposed system is shown in Figure 1. Instructors can use the proposed tool to build and construct a scenario or can use rapid E-learning tools

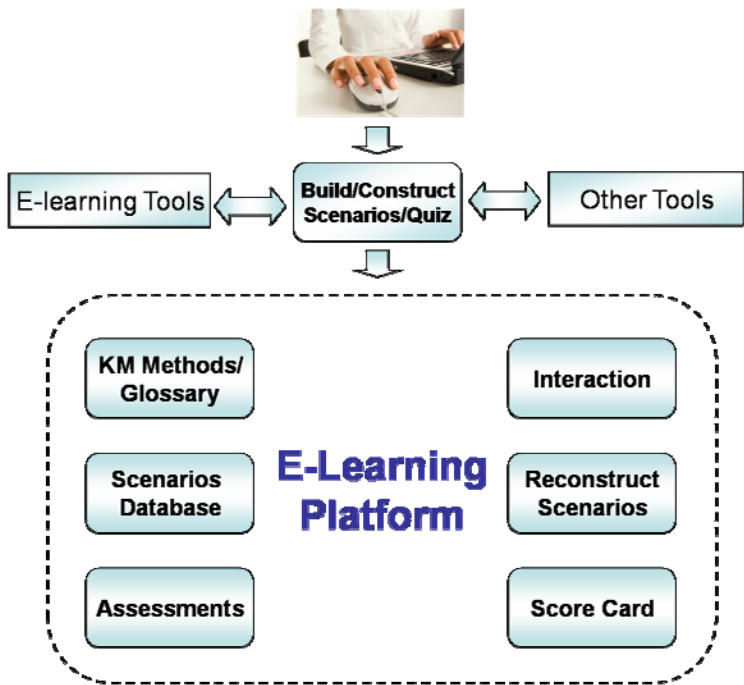


Fig. 1. Conceptual Diagram of Proposed System

¹ One exception is the HKCyberU's Master of Science in Knowledge Management program which is delivered in a blended mode (www.hkcyberu.com).

such as Raptivity [14], Respondus [15], Wondershare Quizcreator [16] and others to build the quizzes or assessment. Then all the built scenarios and assessments will be uploaded into E-learning platform. In the E-learning platform, we have different components which consist of KM Methods/Glossary, Scenarios Database, Assessments, Interaction, Scenario Builder and a competency score card.

As for KM Methods/Glossary component, it will contain all the necessary readings and activities for the learners before or while accessing the scenario databases. Scenario databases store all the built scenarios by the instructors. As for Scenario databases, we are planning to further classify into more details such as KM tools, KM methods, KM approaches etc.

4 Proposed Scenario Building Tool

In order to design and suggest an appropriate tool for building a scenario, the authors had come out with the requirements below for the proposed tool:

- Easy to use even for a non IT-savvy person
- Drag and Drop Script
- Artefacts library
- Scenarios library

The tool that we propose, to some extent, is an authoring tool to build a scenario. With refer to MIT scratch project [17]; we have redesigned the UI and functions of Scratch based on our requirements. The example of user interface (UI) of the proposed tool is shown as in Figure 2.

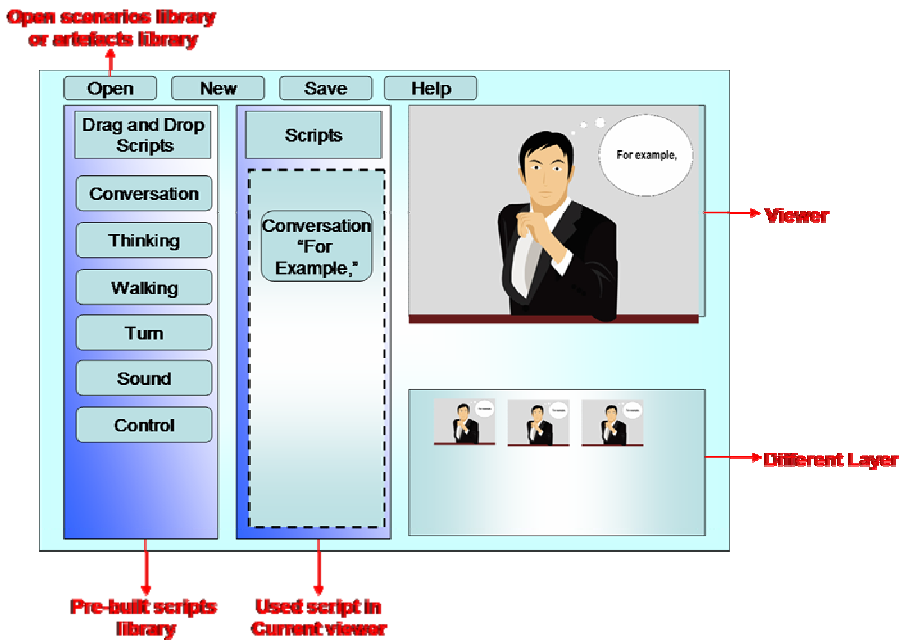


Fig. 2. Example of UI of Proposed Tool

As shown in Figure 2, the proposed tool should keep the required KM scenarios and artefacts libraries. While instructors click on Open menu, instructors can choose from the scenarios library for existing scenarios or from the artefacts library to build a new scenario from scratch. Besides, as shown in the left hand side corner it should also contains prebuilt scripts which allow instructors just to drag and drop all the required scripts to the scripts viewer besides it. On the right hand corner, it is a viewer of the current building scenario. At the bottom of the viewer is the viewer of different layer of the built scenario.

In conclusion, the proposed tool should be easy to use and the functions provided should be not complicated.

5 Tool Deployment and Target Usage

At the time of compiling this paper, the evaluation of the platform has been completed and a tool has been chosen. Drawing from the listed sources above, the authors are developing several scenarios to be encoded into the chosen tool. It is anticipated there will be a balance of the three types of scenarios in the initial version of the system. A separate Web-based interface is also being developed so that the user can perform manipulations on the scenarios and the competency score card in one single interface.

As for the deployment of the initial system, the authors intend to conduct trials with the participants (altogether 130+ as of May 2009) of the HKCyberU Master of Science in Knowledge Management program. This group of targeted users is considered to be very appropriate. Firstly, they are learners in the area of Knowledge Management. Secondly, as this master program already operates in a blended E-Learning and face-to-face mode, learners are also familiar with the basic operations of an E-Learning platform (in this case WebCT). Thirdly, as many of the learners in this program are also KM practitioners, they can also help in providing the much needed feedback as well as help in refining and contributing new scenarios to the library.

6 Conclusion and Future Work

In this paper, we have presented an analysis of what is the needed of scenarios in knowledge management subjects and also sources of knowledge management scenarios. Besides, we also proposed a system which integrates with our proposed scenario building tool for the use of instructors to build simple and complex scenarios in a go. From our study, to be successfully adopted by instructors, the scenario building tool needs to be very user friendly. Nevertheless, instructors can transfer their practice knowledge into scenarios with ease. Our challenges for future developments of this project are the identification of the various controls and pedagogical interactions needed for the targeted scenarios to be developed and also the development of a KM competency scorecard.

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14. Raptivity, <http://www.raptivity.com/downloads.html>
15. Respondus, <http://www.respondus.com/>
16. Wondershare Quizcreator, <http://www.sameshow.com/quiz-creator.html>
17. MIT Scratch, <http://scratch.mit.edu/>

A Descriptive Method for Simulating a Group Knowledge Building Process

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Abstract. Knowledge building is a new approach for students to acquire knowledge which they should involve in group learning and concentrate on creating new ideas and advancing their understandings. This paper introduces a descriptive method for simulating a group knowledge building process. A model of group learning process is simulated first as the base for this study. And then, a generic and a practical model of group knowledge building process are designed and created following. The results could be used for analyzing and designing a knowledge building process for facilitating students' learning.

Keywords: Group learning, knowledge building, collaborative learning, learning community.

1 Introduction

A classroom-based environment is quite a common place where the relevant learning activities are organized by schools or university teachers in accordance with group learning. Conventionally, the group learning is considered as a teaching or learning method, rather than to organize a knowledge building community. This perspective might be changed in order to improve group learning performance dramatically in a new human era – knowledge society [1].

Group learning was used as a knowledge building community in this study, where participants can engage in the relevant knowledge building activities. This was a big change comparing with the traditional group learning method. It was necessary to develop a new approach for it. The prerequisite of this work was to describe the group learning approach first in order to achieve this goal.

Researchers have explored how to simulate a group learning and knowledge building process. For example, Stahl proposes a diagram of personal and social knowledge building, which attempts to model the mutual constitution of the individual and the social as a learning process [2]. In the cycle of personal understanding, learning starts on the basis of tacit pre- understanding [3]. A new comprehension will be formed by repairing our understanding and resolving conflicts or filling in gaps, and will become our new tacit

understanding. In the cycle of social knowledge, the start point will be when someone's personal belief is articulated in words and this public statement is taken up in a social setting and discussed from the multiple perspectives of several participants, to then form a shared language which is created through the communication process. This language and analysis is negotiated by the public group and becomes their shared collaborative knowledge. Stahl also states that the resultant understanding of this social knowledge building exists only in the public communication, even though it can subsequently be incorporated into each participant's individual learning process [2]. Stahl's model of knowledge building can be described in Figure 1.

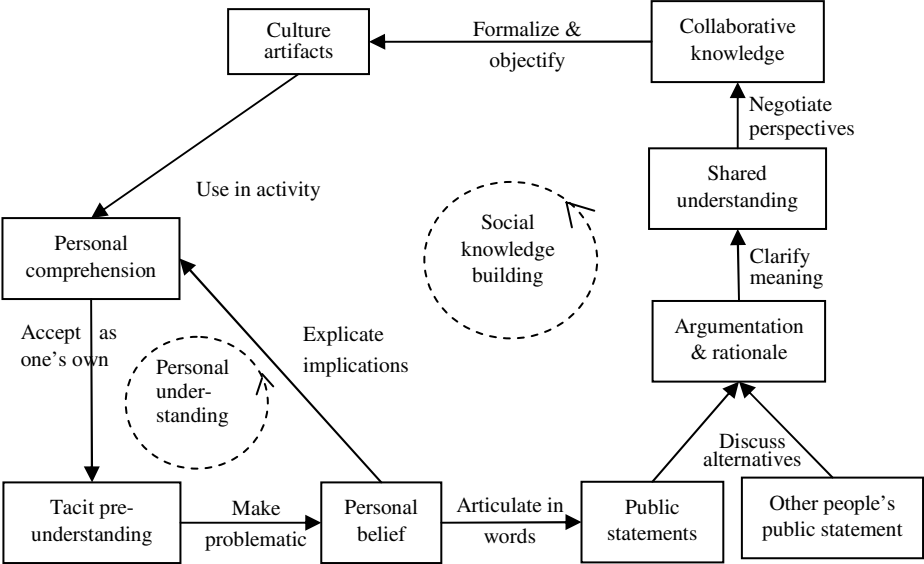


Fig. 1. A model of knowledge building process

Stahl's perspectives on collaborative knowledge building provide a significant conceptual framework on how to understand the process of knowledge building, which should involve the individual level (personal understanding) and social level (social knowledge building). That personal belief should be articulated in words is important for knowledge building in a social context.

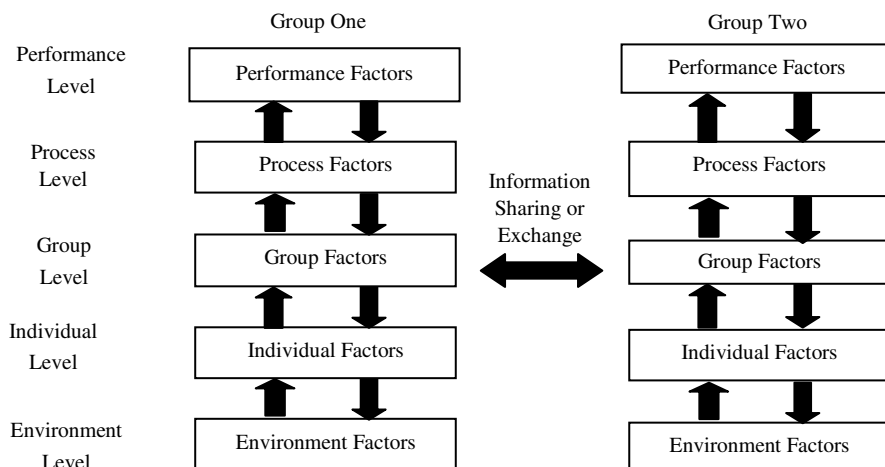
Wang, Laffey, and Poole propose a pattern of knowledge construction in iExpeditions through the comparison of the two teams' knowledge construction activities, including the types of knowledge constructed, when it was constructed, and the frequency of team discussion [4]. Their patten can explain how the two teams use computer-mediated communications and online activities to create the shared team knowledge. Three concentric circles are involved in this pattern. The inner circle is

comprised of the expedition guiding materials and online resources with which participants engage individually. The middle circle represents participants engaged in discussion, thinking, expressing ideas, exchanging views, and making decisions. The results of the interactions and joint activities -- the shared knowledge constructed, the team artifacts developed or not developed, and the developed and undeveloped ideas -- are represented by the outer circle. Meanwhile, this model includes the flow of knowledge construction, ideally from the inner to the outer circle. Ways of talking and mentoring strategies are analyzed to find out how participants interaction contributed to the social construction of shared knowledge. The important role of the mentor should encourage participants to articulate their own ideas and negotiate meaning and consensus as a part of the process of knowledge construction.

This paper introduces a descriptive method for simulating a group knowledge building process for analyzing how to organize knowledge building and how to facilitate students engaging in a knowledge building process.

2 A Model of a Group Learning Process

Architecture of a group learning process was proposed according to a conventional group learning process, which can be described at Figure 2 [5]. This is the five-level architecture of a group learning process.



Grounding of a Group Learning Process

Fig. 2. The architecture of group learning process

The influencing factors of group learning are combined and described at this architecture of the group learning process. These influencing factors of group learning can be categorized into five levels for a group learning process, i.e., environment level, group level, individual level, process level, and performance level. The single arrow

indicates the information transmission, which expresses the process of information delivering. Double arrow implicates the information is exchanged or shared between different groups, e.g., group one and group two. Grounding of a group learning process is the foundation, which is related to some theoretical, ideological, or political issues.

This architecture can be used to analyze a group learning process according to the influencing factors at different levels. It describes a group learning process from theoretical perspective, rather than practical aspect.

A generic model of group learning process is developed according to the architecture of a group learning process and it is described in Figure 3.

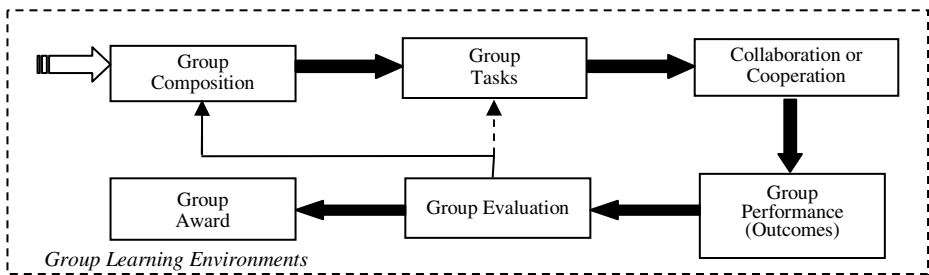


Fig. 3. The generic model of a group learning process

This generic model of a group learning process includes six components, i.e., group composition, group tasks, collaboration or cooperation, group performance (e.g., outcomes), group evaluation, group award, and group learning environments. According to the architecture of a group learning process, group-level and individual include group composition and group tasks, process-level include collaboration/cooperation, performance-level include group performance (outcomes), group evaluation, and group award. Environment-level is group learning environment. All of these components represent their participants are engaging, processing, and socializing in a group learning process and their property.

3 A Generic Model of a Knowledge Building Process

Stahl's model of a knowledge building process influences the field research a lot [2], such as Lin and et al. examine this model using SNS (Shadow netWorkspace) tools [6]. His contribution to the knowledge building process is to integrate personal understanding and social knowledge building together. According to his perspective, individual can form personal understanding. However, knowledge building can be achieved in a social context (e.g. a group or a community). This is an important viewpoint transformation to understand knowledge building. Tacit pre-understanding is considered as the prerequisite of Stahl's model. Personal belief is formed through making problematic. Finally, personal comprehension is achieved according to explicating implications. Personal

understanding is a stage of the social knowledge building process. However, in the practical field, individual as membership of a knowledge building community, such as a group, her/his updating understanding to the task or problem-solving can be emerged at any stage of the knowledge building process. If no discussion or controversy with other participants or no personal reflection, one's understand would be difficult to be changed. Therefore, discussion, controversy, and reflection, are the essential activities of the process of knowledge building.

The framework of a group learning process includes four components, i.e. engaging, processing, socializing, and property. They represent individual (i.e. engaging and processing) and community (i.e. processing, socializing, and property) activities as well when participants are engaging in the group learning process. Processing can be considered as a common component for individual and community, because their activities are all related to processing. This framework reveals individual and community activities are integrated together in a group learning process.

A generic model of a knowledge building process is developed and presented in Figure 4. This generic model of a knowledge building process includes the following essential stages.

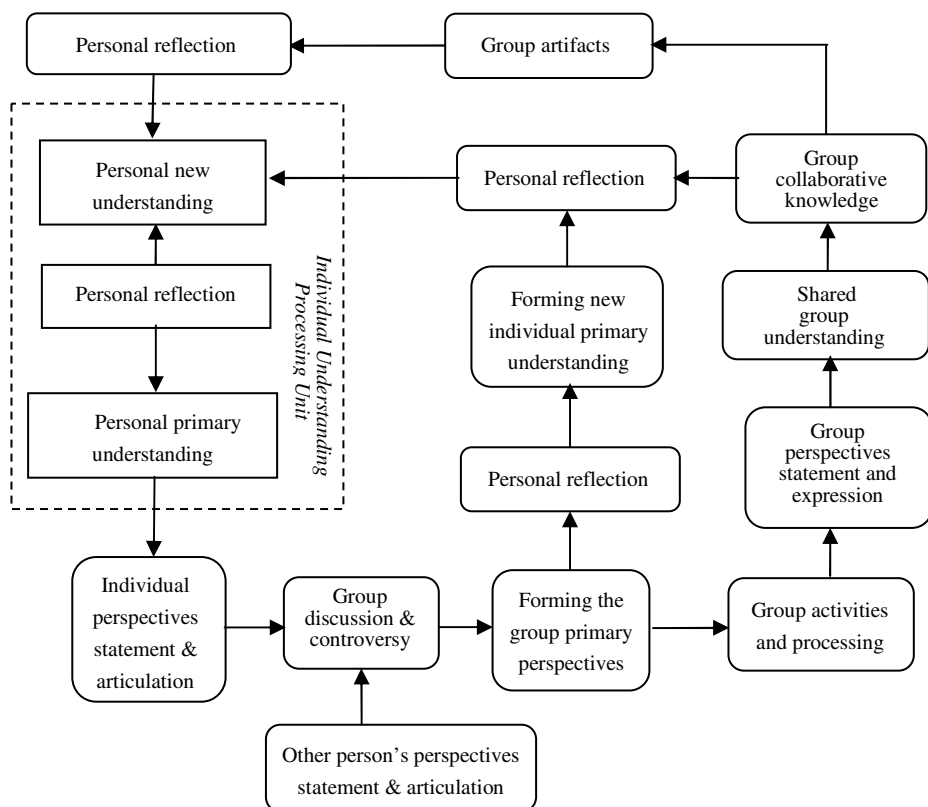


Fig. 4. A generic model of knowledge building process

3.1 “Personal Primary Understanding” Is the Origin of the Knowledge Building Process

Personal primary understanding can be generated when participants are engaging in the knowledge building activities, such as a group inquiry work or problem-solving activities. At the beginning of knowledge building, this understanding may be ambiguous. However, it would be gradually clarified and explicated along with the progressing of this knowledge building process.

3.2 To Clarify and Explicate Their Ambiguous Understanding

Group learning participant expresses her/his “individual perspective” when s/he is engaging in “group discussion or controversy”. Meanwhile, other participants’ perspectives also are articulated according to their personal understandings. The communication of their personal understandings can help them to form the “group primary perspectives”. This stage includes two aspects, i.e. one is for individual, and the other is for the social interaction.

3.3 Personal Reflection

“Personal reflection” can help students themselves to think about their current perspectives and compare with their primary understandings. If there were some differences or wrong understandings, they would be corrected or elaborated. Therefore, a “new individual primary understanding” would be formed.

3.4 The Group Primary Perspectives

“The group primary perspective” can help group to achieve their solution of the inquiry or problem-solving activities. Group participants are engaging in the “group activities and processing”, such as role playing, sub-task solving, resources searching, or interaction each other. These activities help them to propose the “group perspective” at this stage.

3.5 Group Understanding

Group members can bring their work (sub-achievement) together to further clarify and explicate the meaning of group perspectives. Group understanding is shared and elaborated among group members.

3.6 Group Knowledge Building Activities

Group knowledge building activities include group discussion, group negotiation, controversy, debate, or argumentation that can be used to communicate, exchange, or share information each other in a group. They are essential activities of “group knowledge building” and the prerequisite of group inquiry or problem-solving activities.

3.7 New Individual Primary Understanding

When group members are engaging in group learning activities, they exchange or share their primary understandings. Their personal understanding would be changed, refined, or elaborated and achieve their “new individual primary understanding” through these activities.

3.8 Group Artifacts

Many forms of group artifacts, such as reports, PowerPoint presentations, web pages publication, or experiments would be produced at the end of the group knowledge building process. These artifacts can be considered as group outcomes, which are normally used to evaluate or assess the performance or effectiveness of the group knowledge building process.

3.9 New Individual Understanding

Students’ new individual understanding is generated in terms of the artifacts production activities, e.g. reading, listening, operating, watching, or discussing. These activities can help them to reinforce, refine, or rectify their “new individual primary understanding” to “new individual understanding”. Reflection is playing an important role during this process, because it can connect these two understandings in terms of comparing, reinforcing, or elaborating.

The generic model of the knowledge building process is a continual, progressive, and elaborative model. This model explains how individual forms her/his new understanding from the group knowledge building process. It includes two processes: one process is the individual process and the other is the social knowledge building process. The individual process is to form or optimize her/his personal understanding. However, the social knowledge building process can produce knowledge building. Personal understanding is formed along with the group knowledge building process. These two processes are integrated together and cannot be separated each other.

4 A Practical Model of a Group Knowledge Building Process in a Blended e-Learning Environment

A group learning process can also be considered as a group knowledge building process because their purposes are similar, i.e. to construct individual understanding and knowledge. However, the prerequisite of a group knowledge building process is to build the community knowledge. A practical model is developed in order to analyze this process (Figure 5).

This practical model is simulated according to the generic model of a knowledge building process. This model includes four components: individual understanding, group knowledge building, group learning facilities, and a blended e-learning environment, which are introduced as follows:

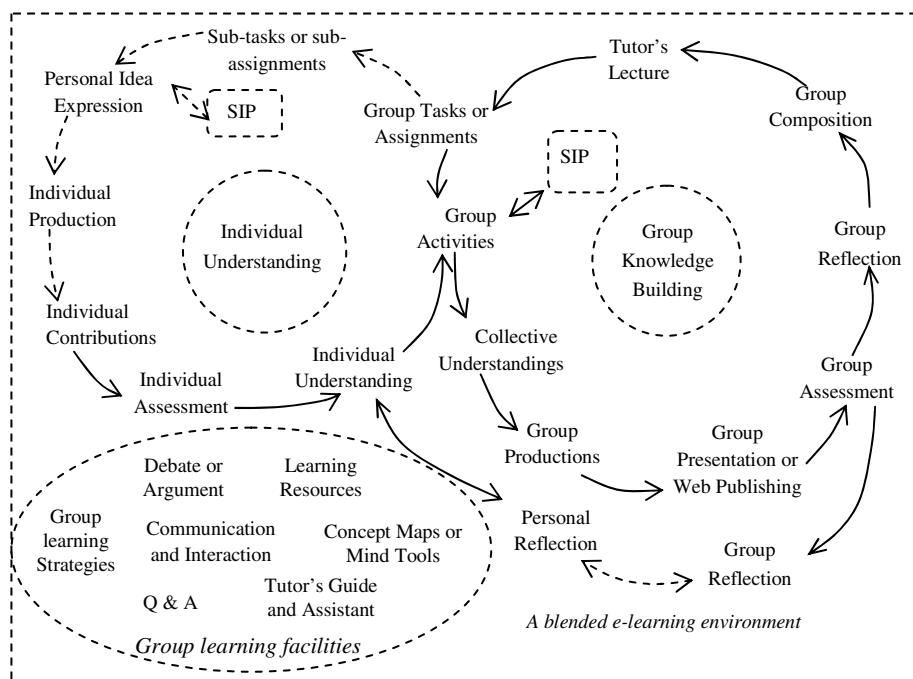


Fig. 5. A practical model of a group knowledge building process

4.1 The Group Knowledge Building Process

The group knowledge building process includes group composition, tutor's lecture, group tasks or assignments, group activities, collective understandings, group production, group presentation or web publishing, group assessment, understanding sharing, and group reflection. Group members can undertake the sub-tasks or sub-assignments in the group tasks or assignments stage. This is a transition point where the flow is going through to the group activities on one hand and it turns to the individual work on the other hand.

Group activities are connected to the SIP (solution inquiry process), which means the purpose is to find out a solution to the group task or assignment. Normally, these activities can be considered as an inquiry process.

The result of group assessment cannot be only used to evaluate the performance and effectiveness of a group, but also can be used to clarify which contents and experiences are shared among group members or with other groups. Therefore, this stage is considered as a knowledge filter, which means only the useful experiences and contents (i.e. positive attitude and helpful activities) can be shared.

Group reflection is the important stage of a knowledge building process. Participants synthesize their experiences, helpful or useless activities, and positive or passive attitudes at this stage. The results of group reflection are used to the other knowledge building process, and then return back to the start point (group composition). It is also

connected with individual reflection and provides satisfactory results to facilitate individual reflection.

4.2 Individual Understanding Process

When group members decide to participate in the cooperative activities, each member would undertake sub-task or sub-assignment. Group leader discusses with members for finding out the undertaker of the sub-task or sub-assignment. If they like, group members can choose their own task (or assignment) according to their personal interest.

At the personal idea expression stage, her/is activity is related to the SIP. Group member is engaging in the inquiring activities for her/is undertaking task, and to form her/is solution for it.

Individual production could be personal paper, report, presentation, or web publishing. It represents individual efforts to contribute to the group work. If group members are working collaboratively, individual contributions can be considered as s/he is engaging in individual understanding process.

Individual assessment is used to assess the individual contribution to the group work or group knowledge building. Tutor and group members are the evaluators of a group knowledge building process.

Individual understanding is occurred in the knowledge building process. During this process, they undertake the certain sub-task or sub-assignment and contribute to their group works. The new realization, feeling, understanding, or viewpoint would also be generated from this process. The results of individual assessment reveal the effectiveness and performance of individual understanding.

Personal reflection is the important stage of the individual understanding process. Group member can reflect the reasons why s/he is success or failure or what kinds of experiences, attitudes, or activities are the positive or passive. The results of personal reflection would be used in the next individual understanding process.

4.3 Group Learning Facilities

Group learning facilities include communication and interaction, debate or argument, concept map or mind tools, Q & A (question & answer), tutor's guide and assistant, group learning strategies, or learning resources. These facilities can be used in the group knowledge building and individual understanding process.

Communication and interaction are used for information exchanging and sharing, e.g. ideas, understanding, or resources among members, groups, and tutor. Communication and interaction are important in a blended e-learning environment. With respect to participants in the classroom-based setting, they can communicate FTF. However, when the relevant activities are taken place in the web-based setting, they have to use the e-communication tools effectively, e.g. email, chatting online, discussion forum, video conferencing, or internet phone.

Debate or argument is the effective approach to form a specific viewpoint. Normally, participants have different perspectives at the beginning of a group knowledge building process. If they form a common perspective, they can take part in the relevant articulated activities, e.g. debate or argument. Generally, the results of debate or argument represent the common perspective.

Concept maps or mind tools are used to articulate the relationship between different concepts. They are the common facilities to assist participants explicate their understanding in a knowledge building process according to the systematic concepts structure. The results of the group knowledge building process are to grasp a systematic knowledge, such as a course or a subject. Concept maps or mind tools can contribute to this purpose of the group knowledge building process.

Q & A is the general way to reply learner's question. Group members, groups, or tutors in a group knowledge building process could propose the question. However, the answer could be diverse very much. Any participants can give their answer to the question, especially for a discussion forum in a web context, and response can be easily made according to their own interests.

Tutor's guide and assistants are useful to groups and group members when they are at a confused situation, or deviate from their original goal. Tutor would give an explicit direction to them. In some cases, tutor need to discuss with group members together for some issues.

Group learning strategies are used to improve the group performance, such as organizing strategies, conflict resolving strategies, brainstorming, encouragement, or reinforcement. These strategies can be chosen and used in a group knowledge building process in a blended e-learning environment.

A group knowledge building process needs the support from learning resources, because participants would use them to articulate their perspectives. Many e-resources are available on the net. Learning resources may be retrieved from internet in a blended e-learning environment. It is easy to find the useful information on the net. Therefore, group learning participants should learn how to use the learning resources effectively.

5 Conclusion

The purpose of this paper is to simulate a model of a group knowledge building process. In order to do so, a model of a group learning process is developed first based on the architecture of a group learning process. 6 components are involved in this model, i.e. group composition, group tasks, collaboration/cooperation, group performance (outcomes), group evaluation, group award, and group learning environment.

A generic model of a knowledge building process has been devised according to the characteristics of knowledge building practical work. This model combines an individual understanding process and a group knowledge building process together. Reflection, discussion, argumentation, and controversy are the essential activities or events of a group knowledge building process.

Finally, a practical model of a group knowledge building process has been developed according to the analysis of the group learning process and the generic model of a knowledge building process. Four components are involved in this model, i.e. the individual understanding process, the group knowledge building process, group learning facilities, and a blended e-learning environment.

The models developed in this study could be used for analyzing a group knowledge building process in order to facilitating students engaging in a knowledge building process.

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Use of Micro-teaching Videos in Teacher Education: Computer-Supported Collaborative Learning

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Abstract. Micro-teaching has been used in teacher education over the years for student teachers to trial use educational theories and to receive comments from lecturers and peers in order to learn about teaching in simulated environments. This study analyzed how collaborative learning occurs in a blended learning design of micro-teaching in a method studies module. The blended learning design involved student teachers trying out teaching with a group of peers. The recorded micro-teaching videos were then uploaded for sharing among the class members on an online video database. The analysis of the flow of comments and feedback on the online platform illustrated the collaborative learning in this computer-supported learning community. The interview results also reflected the effectiveness of the sharing of micro-teaching videos for the social construction of understanding of teaching.

Keywords: Computer-supported collaborative learning, micro-teaching videos, teacher education.

1 Introduction

Over the years, micro-teaching has been used in teacher education for student teachers to trial use educational theories before arrangement of any clinical or practicum experiences. This is a valuable opportunity to receive comments from lecturers and peers in a simulated environment in order to learn about how teaching occurs, because learning to teach is no simple matter (Darling-Hammond, 2006). This simulated environment of micro-teaching helps to close the gap between student teachers' learning and practice before they step into a real classroom. Believing that online education is a good tool which can be used anytime and anywhere to benefit social learning (Shen, Hiltz, & Bieber, 2007), the review of teaching videos among peers through an online discussion platform seems to provide a precious opportunity for student teachers to receive teaching tips from their peers and experienced teachers, and to learn about teaching by analyzing, evaluating and improving upon individual teaching performance (Lee & Wu, 2006). However, how a combination of this blended learning design of micro-teaching and an online discussion platform supports collaborative learning has not yet been fully explored. Through interviews and analysis of the interactions on the online platform, this study aims to explore the following research questions: How active are the student teachers in contributing to the learning community? What types

of comments occur among community members? How useful is this blended learning design for the development of learning about teaching?

2 Use of Micro-teaching Videos in Teacher Education

To assist pre-service student teachers to apply teaching theories in the field, micro-teaching (teaching in a simulated classroom setting) in the teacher education institute, and teaching practicums (teaching in authentic classroom settings) in local schools are usually arranged. Student teachers usually receive feedback on their micro-teaching and classroom teaching from course instructors and their peers who participate in the lesson observation. However, due to limited course time and the ratio of student teachers to instructors, it is not always easy to carry out a comprehensive discussion among the class of student teachers with quality feedback following the teaching.

With the use of audio-visual aids in teacher education, the teacher educator or the instructor is typically the contributor or provider of teaching videos, for example, Pea (2001) developed a system to support teachers' reflections on classroom instruction videos or video-based case studies that illustrate and analyze exemplary teaching in real classroom situations. The use of such video-based teaching provides opportunities to connect pre-service teachers' course work more explicitly with actual classroom practices, and provides another way for student teachers to interact with each other (Friel & Carboni, 2000).

It has long been known that the learning strategy of passively watching video-based instruction generally results in poor long-term learning outcomes because learners are not engaged in a discussion activity or a learn-by-doing activity (Schluger, Hayes, Turino, Fishman & Fox, 1987). With the learning/practicing-while-watching strategy, learners or the learning group can pause, stop, forward, or rewind a video clip for self-paced learning by joining a discussion or learn-by-doing activity with learning partners; this provides a reflective opportunity to deepen long-term outcomes (Chang, 2004).

Recently, video has become a popular and important resource in teacher education and teacher professional development with its unique ability to capture the richness and complexity of the classroom for follow-up analysis (Brophy, 2004). There are growing research studies with videos in learning sciences. Goldman, Pea, and Derry (2007) have contributed to the in-depth video studies of human interaction in learning environments, either in classrooms or other contexts, and the use of video for creating descriptive, explanatory or expository accounts of learning and teaching. A study by Yung, Wong, Cheng, Hui, and Hodson (2007) stated that videos provide a lasting record of teaching and are able to be played again and again without the loss of any details concerning the complexity and subtlety of the classroom teaching. The record facilitates student teachers to observe their own teaching performance and to develop first-hand teaching experience by reviewing learners' actions, visual cues, and the language of the classroom in the video.

3 Social Construction of Understanding with Computer-Supported Collaborative Learning

Learners usually focus on the knowledge of course work and concentrate on self-learning, and may therefore neglect the need and importance of studying with and learning from peers. However, individual cognitive learning is internal and limited. Personal constructivists believe that learners construct knowledge, and explore and transform the complex information personally in their own personal world. Jonassen, Davidson, Collins, Campbell, and Bannan Haag (1995, p. 11) also stated that “knowledge is a function of how the individual creates meaning from his or her experiences; it is not a function of what someone else says is true. Each of us conceives of external reality somewhat differently, based upon our unique set of experiences with the world and our beliefs about them.”

Besides, feedback does not exist in personal constructivism. Students can reflect on their own work, yet their reflection will be restricted by their subjective perspective. Knowledge can also be constructed socially by receiving peers’ objective feedback. This feature of constructivism arose from social and linguistic studies (Soloman, 1994) and co-exists with personal constructivism, which is a social construction of consensual ideas describing how people exchange views using the multiple meanings of everyday language. It implies that not only is knowledge socially constructed, but also indicates its ‘life-world’ characteristics.

Individual study is one of the methods which allows learning to occur; however, Johnson and Johnson (1996) stated that involving the instructional use of small groups in which students work together can maximize their own and each other’s learning. Moreover, collaborative learning is an offspring of the social constructivist model, a learner-centered and team-oriented approach with an assumption that learning emerges as learners interact with each other (Shen, Hiltz, & Bieber, 2007). In traditional classroom settings, not many class activities are designed for students to interact with each other, especially in higher education. Besides, time limitations, teaching process and class size are the concerns of instructors for arranging interactions among learners.

A collaborative situation is a kind of social contract (Dillenbourg & Schneider, 1995). Small learning groups help the group members to learn from each other, benefit collaborative learning, and enhance social interaction among students. Collaborative learning describes the situation in which two or more subjects build synchronously and interactively a joint solution to some problem. It is also viewed as the result of a continued attempt to construct and maintain a shared conception of a problem (Roschelle & Teasley, 1995) and leads to deeper level learning, critical thinking, shared understanding, and long term retention of the learned material (Kreijns, Kirschner, & Jochems, 2003).

Kreijns, Kirschner, and Jochems (2003) found that although computer-supported collaborative learning environments can support communication and collaboration, neither the research nor field observations are always positive about learners’ performance. They identified the factors that cause this discrepancy, centering on two pitfalls that appear to impede the achievement of the desired results. First is the taking for granted that participants will socially interact simply because the environment

makes it possible, and second is neglect of the social (psychological) dimension of the desired social interaction. This reminds us that people are not only solitary information processors, but social beings as well. This means that they are not only looking for information; they are also looking for affiliation, support and affirmation.

The key to the efficacy of collaborative learning is social interaction (Kreijns, Kirschner, & Jochems, 2003). Social interaction helps develop social and communication skills, forms positive attitudes towards co-members and the learning material, and builds social relationships and group cohesion (Johnson & Johnson, 1999).

4 Methodology

4.1 Interface

An interface¹ which supports the language through which the members of the collaborating learning community interact was developed. The interface caters for the sharing and annotation of micro-teaching videos of up to 35 minutes in duration. The two essential features of the interface for community interactions are a) the Video Communication Panel, and b) the Bulletin Board.

In the Video Communication Panel, new and shorter video segments can be re-produced by using the 'Mark In' and 'Mark Out' editing buttons to highlight noteworthy video segments for discussion. Corresponding comments or suggestions can then be posted along with the marked and excerpted segments. To achieve knowledge building, other community members can also view and reply to comments or suggestions using the 'Video Bookmark'. The playback of the video is controlled by using the basic play, pause, stop, rewind and fast forward buttons. Besides, the time code of the video, the theme of the teaching objectives and the comments are all displayed in the Video Communication Panel. Figure 1 shows an interface of the 'Video Bookmark' with two areas: 'Mark In' and 'Mark Out', and 'Comment on Segment'. Though English is the language of instruction in the video database, users can use either English or Chinese (the mother tongue of the student teachers in the present study) to make comments.

The Bulletin Board illustrates a new technique for user management of digital videos by using a text-based retrieval technique. Figure 2 shows the Bulletin Board interface with three components: Bulletin Board Header, Theme Area and Discussion Forum. The Bulletin Board Header displays the video title, name of the video contributor, a button for further comment and a button for the conversion of feedback and comments into PDF file format. The Theme Area is for the display of the reply button and the hyperlink of the segment created by the users and community members. Through the hyperlink, the segment can be viewed for further comment and feedback. The Discussion Forum displays responses to the segment marked by members while watching the videos on the Video Communication Panel.

¹ Video Database, Centre for Learning, teaching and Technology http://citiimedia.ied.edu.hk/citie_video_library/index.php

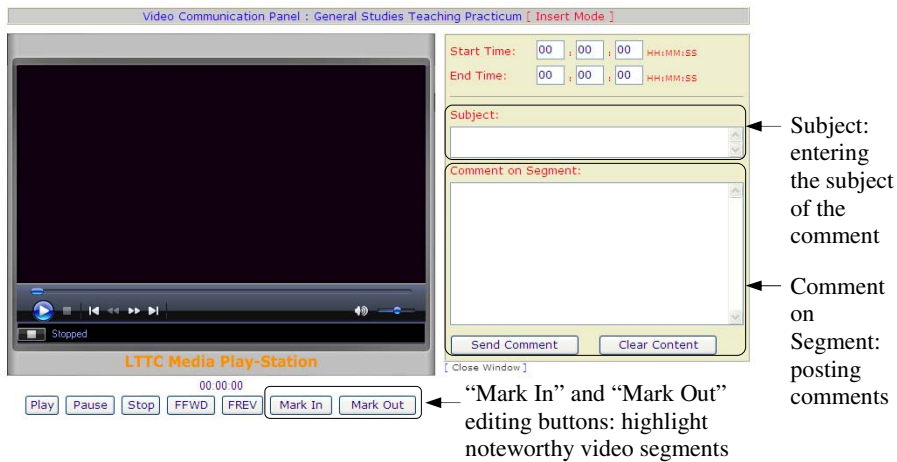


Fig. 1. Interface of the Video Communication Panel

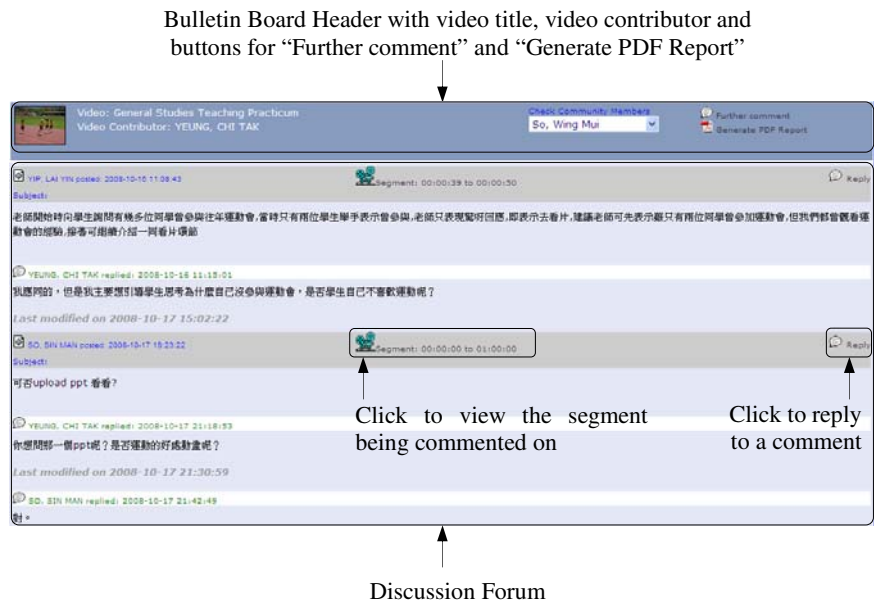


Fig. 2. Interface of the Bulletin Board

4.2 Participants

A class of 21 student teachers enrolled in the method course of the subject “General Studies” in the Postgraduate Diploma of Education programme (PGDE) at a teacher education institute in Hong Kong were invited to participate in this study. The study

started from the first lesson of the module which was about two months before the first teaching practicum. All the student teachers agreed to participate in the study, and consent forms were collected before the study commenced. The interface of the video database was restricted from public access and was password protected. Only the assigned community members could gain access to the system.

4.3 Design of Study

Right from the first lesson of the 10 session module, the student teachers were informed of the details of the important dates of the two key tasks in the study: 1) micro-teaching video uploading and 2) sharing comments, so that they could be well prepared for the tasks. A workshop was conducted by an experienced technician on the same day, explaining the details of the shooting technique, video uploading and the sharing platform, to better equip the student teachers with the necessary information.

The student teachers were required to prepare their teaching plans and teaching aids for the micro-teaching. They were also advised to provide support to each other in establishing the micro-teaching setting, together with the technical preparation of the camera setting and video shooting. A micro-teaching video which was around 15-30 minutes long was uploaded to the Transaction Bin of the video database on or before the fifth lesson, and the sharing platform was then opened for video viewing and commenting at a time and place of convenience for the individual student teachers.

4.4 Data Analysis

In order to have a better understanding of how the blended use of video and online community technology helps to establish collaborative learning about teaching within the learning community, analysis of the flow of posted comments and feedback on the discussion platform was carried out in order to answer the research questions. The 25-30 minute interviews with the participating student teachers were conducted to identify the effectiveness of the collaborative learning of the learning community, to capture views about the use of the video database, for instance, the constraints and advantages of using the online video database, and suggestions for improving the technical hitches.

5 Results

5.1 The Contribution of Student Teachers to the Learning Community

The 21 student teachers (ST1 to ST21) not only uploaded their micro-teaching videos to the online video database, but were also encouraged to give comments on the videos of other community members and to return feedback in response to the comments. The number of teaching videos viewed and commented on by the student teachers ranged from 1 to 5. Besides, the number of times each teaching video was viewed by individual community members ranged from 2 to 5. It could be observed that the average number of teaching videos viewed and commented on by individual student teachers and the

average number of times each video was viewed were both around three, which provides a hint as to the optimal number of viewings for a small learning community for in-depth and comprehensive communication among community members.

The analysis of the flow of comments and feedback also showed that a range of 1-7 comments were received by the video contributor and a range of 0-7 units of feedback were returned by the video contributors. A total of 148 units of comments and feedback were collected from the participants. Within the 148 units, 86 of them were comments and 62 were feedback. It showed that student teachers were both passive recipients of comments and active contributors of comments and feedback to the community members. The following example shows a video contributor (ST3) receiving a comment from a community member (ST9) and then returning feedback in response to the comment:

Comment received by ST3 on Video 3:....., it was difficult for grade-two pupils to finish the reading task assigned in the worksheet within ten minutes, it would be better if the teacher could design some simple tasks.

Feedback returned by ST3 in response to ST9's comment on Video 3: Thanks for your suggestion. I agree that the reading information should be simplified and re-organized to allow pupils to do matching or filling in blanks. This might help to lessen pupils' difficulty in reading.

The overall picture of the flow of comments and feedback in the learning community was studied. For instance, when ST1 was a video contributor, she received two comments from ST12 (who was a community member) but she gave no feedback to ST12. When ST1 was a community member, she gave three comments to ST12 (who was the video contributor) and received three units of feedback from ST12. Moreover, ST1 also gave comments to ST16 but did not receive any feedback. When compared with other community members, ST1 was not an active contributor, only making comments on two teaching videos; nevertheless her video was watched by three other members in the community.

5.2 The Categories and Nature of Comments among the Learning Community

Since the participating student teachers were using micro-teaching videos for comment and feedback, very little comment could be found on pupil behavior or classroom management in such a simulated environment. The 148 comments were analyzed and grouped into the four categories of teaching techniques, teaching design, teaching content, and use of resources. Besides, the comments were classified into "Good", i.e. positive comments on satisfactory teaching performance (50%), "Good with suggestions", i.e. positive comments of satisfactory teaching performance with recommendations for improvement in teaching (25.6%), and "Suggestions", i.e. recommendations for improvement to solve the problems identified in the video (24.4%), showing that the student teachers were positive towards their peers' performance. Table 1 shows examples of the categories of comments and feedback.

Table 1. Categories and proportions of the comments/feedback with examples

Categories	Percentage	Comment	Examples
Teaching Technique	18 %	Good	<i>Comment given by ST20 on video 17:</i> It was good to deliver questions to guide pupils' thinking. Besides, this could also help to cultivate a good learning environment. This was an effective teaching technique.
Teaching Design	22%	Good with suggestions	<i>Comment given by S17 on video 18:</i> The teaching was quite good. If time allowed, the teacher should let pupils do some group discussion so that they could find the answer to the questions and construct understanding by themselves.
Teaching Content	36%	Suggestions	<i>Comment given by ST8 on video 10:</i> Since Primary 2 pupils did not know the functions of the National flag and logo, more explanation had to be provided.
Use of Resources	24%	Good	<i>Comment given by ST6 on video 14:</i> It was good to use pictures to make the comparison before matching with the thermometer and pictures. This could help pupils to have a clear understanding of the teaching content.

5.3 Building Collaborative Learning with the Computer-Supported Community

In the individual interviews, student teachers were asked about their opinions concerning the blended learning design of the micro-teaching videos and the interface of the online communication panel as a platform for learning about teaching. Most of the opinions given by the student teachers were positive and encouraging, implying that the sharing of and commenting on micro-teaching videos was useful and helpful in the aspects of enhancement of social interaction, active learning to reflect on one's teaching, identification of both good and inappropriate teaching behaviours, and building of confidence in teaching.

The sharing of comments and feedback on the video database promoted social interaction among peers in the learning community. The student teachers realized that the usual face-to-face classroom setting restricts them to receiving comments and feedback from the instructor only, instead of also being able to share and discuss with their peers. They also agreed that they and the community members would benefit from sharing comments and experience with each other, for example, ST8 stated that she communicated well with peers whom she did not know well using the discussion platform. Another student teacher (ST2) stated that his/her interactions with peers were increased.

Student teachers were becoming more active to share their experience and learning with the use of the video database. For instance, one student teacher (ST8) stated that the sharing of the teaching videos provided an opportunity to reflect on one's own and others' teaching. The videos provided a demonstration of some good teaching practices and propositions for alternative teaching strategies for the student teachers (ST18). The student teachers (for instance, ST5) also reported that by viewing the teaching videos

provided by the community members, they could identify some inappropriate teaching behaviours. This reminded them to avoid those behaviours in their future teaching.

The student teachers reported that the community members were friendly and supportive and were willing to offer help in both tasks. The sharing of experiences and problems in teaching through the online platform also helped them develop confidence in teaching, as stated by ST16.

6 Discussion

6.1 Developing the Habit of Reflection in Computer-Supported Collaborative Learning

One of the major uses of micro-teaching videos is that self-reflection on one's teaching can be done by repeating the observation and analysis of the video segments by replaying the videos without time limitations or geographical barriers. The computer-supported collaborative learning systems provides a combination of several media like email, chat, discussion forums, instant messaging, etc. (Sawyer, 2006). Thus, student teachers can develop the habit of reflection more effectively. Besides, the comments and feedback on the micro-teaching seem instrumental in providing some foundations for student teachers to reflect on their own teaching performance. Darling-Hammond (2006) indicated that recent studies of teachers' learning suggest that when teachers study and reflect on their work and connect it to theory, they are better at identifying areas needing improvement, considering alternative strategies for the future, and solving problems of practice. Teachers' abilities to reflect can also help the student teachers to continually revise their skills, so that they are more effective in observation, inquiry, diagnosis, design and evaluation of learning and teaching (Darling-Hammond, 2006). The habit of reflection developed by student teachers in giving comments to members' micro-teaching videos and the returning feedback to members' comments is important in initial teacher education.

6.2 Extending Personalized Learning to Socialized Learning

Collaborative learning involves individuals as group members, and also involves phenomena such as negotiation and sharing of means – including the construction of the maintenance of shared conceptions of tasks (Stahl, Koschmann, & Suthers, 2006). The sharing of micro-teaching videos in an online community technology facilitates collaborative learning among the community members, allowing student teachers to collect views from different perspectives by their peers. It agrees with the idea of Darling-Hammond (2006) which stated that collaborative learning activities contribute to one another as members of a professional community. This expands student teachers' personalized learning to a more socialized learning environment, and broadens their scope of learning about techniques and design in teaching, teaching content and use of resources. Another meaningful outcome in the process of constructing social understanding about teaching is that student teachers are able to create a broader

knowledge base regarding teaching by learning and adopting techniques that they find successful and effective, and identifying and understanding unfavourable teaching behaviours in class. Apart from this, interacting groups can also provide feedback and support, and monitor the work of each another (Sawyer, 2006).

7 Conclusion

The main objective of a subject method studies module in a teacher education programme is to equip student teachers with the ability to integrate theories and practices, as well as to prepare them to teach in authentic classroom situations. Before that, the arrangement of micro-teaching sessions provides opportunities for student teachers to try out their first teaching in a simulated environment so that they can experience what teaching is going to be like. The use of micro-teaching videos in the present study extends existing research work on the use of videos in teacher education (Borko, Jacobs, Eiteljorg, & Pittman, 2008; Lee & Wu, 2006; So, Pow, & Hung, *In press*; Yung et al., 2007;) which is an important area that requires further exploration to understand its effectiveness in helping student teachers to learn about teaching before they walk into real classrooms.

Based on the views collected from the interviews with the participating student teachers, a number of recommendations are raised for future study. Since student teachers encountered different technical difficulties during video shooting, converting and uploading, more technical support is suggested to be offered to the student teachers to help them solve the problems facing them at the different stages of the study. This at the same time will help them develop the necessary information technology (IT) skills and cultivate a positive attitude towards IT, which is critical to the implementation of IT in their future teaching (So, 2002).

As for the lack of quality comments/feedback given by the community members, the idea of involving the instructor in the online discussion remains debatable. Although learning in a web-based environment is influenced by the quality of the postings (Jiang & Ting, 2000), the participation of an instructor in the discussion may hinder student teachers from sharing their true thoughts and eliciting their conceptions about teaching.

Moreover, recognizing that difficult or negative experiences when interacting with interfaces could reduce learning (Hewitt, 2003), a more user-friendly design of the user interface of the online video database is advised to be developed in our future study so that users can be more at ease manipulating the interface, as Chang and Smith-Jackson (2007) also stated that user interface systems have to be developed such that users' learning activities are supported.

Last but not least, in spite of the variety of types and nature of comments/feedback communicated between community members, one student teacher raised the issue of the quality of the comments/feedback. She felt that the quality of the interactions between community members might not be good enough to support improvements in teaching and learning because they were rather superficial and were limited mainly to the teaching performance of the video providers. This suggests future investigation into this issue of doubt.

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Using a Narrative Blog to Support Reflection in a Blended Course

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Abstract. Despite many potential benefits, hybrid learning is not yet very diffused, because of the issues entailed by a thorough institutional change in this direction. In this paper, we suggest that changes at activity or course level, on the other hand, is not very difficult and onerous to implement, even in absence of a thorough institutional change. To this end, we present the case of a face-to-face course run in a very traditional school setting, that was turned by the teacher into a hybrid one, using as only resources a careful methodological planning and free blog space. The positive outcomes of this experience encourage the application of a similar approach in other situations, thus helping to prepare the ground for a wider transformation in the educational system.

1 Introduction

Hybrid (or blended) learning, which combines in many possible ways classroom and ICT-mediated learning activities [1], has been attracting increasing attention in the past years. It is credited to improve student engagement and learning achievements [2], and has the advantage to reflect the blended nature of our world [3] much better than any single-style learning approach.

A real realization of hybrid learning, however, where the face-to-face (f2f) and online components are integrated and equally important (even though of different lengths), is usually considered difficult to set up and run, requiring significant institutional change [2]. It is certainly true that changing in this direction a whole institutional system would prove rather complex, because it involves a high number of organizational and people-related variables, but couldn't an interested teacher start blending her/his own course, without waiting for the whole program or institution to be ready for change? How realizable, and how onerous, would be such a choice?

We suggest that this could be done, in many cases, with a limited effort and little or no extra cost, relying on a careful methodological planning and on a suitable choice of conceptual and technological tools. We argue this claim by presenting the case of a traditional course that was turned by its teacher into a hybrid one in order to better achieve the learning aims that she had in mind. This transformation was planned based on the learning needs of her students; in other words, integrating the f2f lessons with an online activity did not aim to dilate the course schedule or to offer easily

accessible complementary activities, but rather to provide a more suitable context for a number of activities, first of all shared reflection.

In the following section we describe the context and organization of the course, analyse its outcomes and discuss its achievements. Finally, the conclusions spot the key elements to successfully implement similar experiences.

2 A Blended Course in Teacher Training

2.1 Context of the Experience

The considered experience was carried out in the school year 2007-2008 within the course “Multimedia technology in the classroom” of the Teacher training school (SSIS) of the University of Genoa. The course was addressed to (French) language teachers of the second (and last) year of the school. It lasted 6 weeks, for a total of 21 hours in class. It aimed to present various possibilities to use Information and Communication Technologies (ICT) in language teaching and to make the trainees reflect on the teacher’s profession. It was followed by 11 women between 28 and 52 years of age (average age 35): not freshly graduated, therefore, mostly with some years of teaching experience in private schools but not wide familiarity with ICT.

It was clear from the beginning that the “new technologies” were not much appreciated by the trainees: even though they had already followed two basic courses on ICT in the first year of the SSIS, they had a superficial knowledge of a few tools and did not really consider ICT a useful support to learning. As concerns language learning, in particular, their knowledge was limited to drill-and-practice educational software suitable for individual use. Only two trainees had availed themselves of Internet in their teaching, yet without structuring an educational path and simply letting their students work with the exercises and games proposed by some web site, obtaining rather deceiving learning outcomes.

They had not experienced a wise use of ICT to support their own learning during the SSIS, as this was conceived in traditional way and based almost exclusively on f2f lessons: apart from the two mentioned courses on ICT, just in one case they had been asked to use a blog, yet without paying attention to technical or application issues. They were not familiar with social networks and mobile learning, nor did they know the main reference sites for teaching French as a second language.

The main (institutional) aim of the course was to deepen the use of ICT in language teaching, with particular attention to social environments. Second level aims, based on the knowledge of the trainees’ learning needs in relation to the course and to the SSIS in general, were:

- to help them become aware of their conceptions of what makes a good language teacher and how she can raise motivation in her students;
- to foster reflection on the potential and requirements of ICT use, based on practical experience;
- to let them practice with collaborative work, since this is a skill that is scarcely fostered in the Italian school system but is very useful in the teaching profession;
- to give an opportunity to practice with written French, which is an activity mostly neglected in the SSIS.

2.2 Organization of the Experience

In order to achieve these aims, the teacher, who is one of the authors, following a suggestion of the other author, decided to integrate the f2f course by means of an online module that could allow the trainees to practice with the use of an online collaborative environment and with written French, while stimulating reflection on the work of French teachers. Such online activity should be obligatory, not an optional complement to the f2f lessons, and would substitute a written task that had to be assigned to the trainees to fulfil credit requirements, hence it would not result in a big amount of extra work. This activity would allow her not only to concretely acquaint the trainees with several aspects of online technology (which represented an application of the conceptual work carried out in class), but also to grant a space suitable for reflection, and to call attention on the fact that commercial educational software is not the only option for a language teacher: good opportunities are offered by non-specialized tools, provided the activity is structured by means of a suitable methodology. To this end, we decided to create a blog and devised a narrative activity to be carried out on it.

2.2.1 Blog for Teaching and Learning

We decided to implement the online environment by means of a blog since this kind of platform is very ductile and straightforward to use, is suitable for many kinds of situations and is easy to implement, free blog space being offered on many web sites.

Blog can be seen as an environment between a personal web page and a shared, asynchronous discussion space [4], because it has an owner who decides the line of its content but is open to other users' contributions. Since its creation in 1996, it have been widely used as diary on personal experience [4] or as notepad for projects [5].

In the educational context, blog has been mostly used to support meta-reflection [6], as well as to share written intercultural productions [7], [8], or in the framework of collaborative writing activities with literary aims (as, e.g., at the Universities of Léon, <http://edufle2006.canalblog.com/>, and Grenoble, <http://nassvet.blog.lemonde.fr/>).

2.2.2 Methodology of Use and Choice of the Contents

In order to make the trainees become aware of possible problems related with using blogs in the classroom, we created a real situation, that is, a blog running in parallel to the f2f classes, on which they had to carry out some assignments that would contribute to the end-of-course evaluation. We created the blog during a lesson, so as to show how to take advantage of this possibility. The blog owner was defined as "French teacher", so as all trainees could access the space with equal rights.

Then we assigned a 3 step *task* that could give meaning to the use of the blog and raise the interest of the participants: 1) narrate personal memories of good and bad teachers you experienced in school, characterize yourself as student, and comment on your colleagues' narrations; 2) narrate the origin of your interest and passion for the French language and culture, and comment on your colleagues' narrations; 3) with the whole group, synthesize a shared characterization of the good French teacher, based on the narrations and comments collected in the previous steps. Designing this articulated activity we relied on the theory of *task-based learning* [9], a methodology increasingly used for language teaching, which stimulates students' motivation and

creativity by involving them in complex tasks that are meaningful in out-of-school life [10].

The requested narrations aimed to provide a concrete basis for reflection, and to help the trainees become aware that they had (possibly unconscious) conceptions about being a language teacher, rooted in their student's experience. Paying attention to trainees' conceptions is increasingly recognized important in teacher education, since conceptions appear to deeply influence teachers' instructional practice [11]. The second assignment also aimed to highlight cultural contents that could turn out useful in classroom work.

Since it is recognized [12] that often blog users read contributions but find it difficult to comment on them, we decided to associate the comment phase with a kind of game: narrations had to be posted anonymously (each as a separate blog entry) and the trainees were requested to guess the authors while commenting the posts. This had the aim not only to create a playful atmosphere (which is a useful manner to decrease stress and increase motivation) but also, and especially, to stimulate the trainees to look with attention their colleagues' productions, remarking similarities and differences and by this means favouring awareness of personal conceptions and boost reflection.

2.2.3 Reflection through Narration

Why did we ask to share narrations, rather than, right away, reflections? The answer to this question is suggested by many research studies that underline the cognitive and motivational value of narrative (for a concise overview see [13]). Stories and narrations represent an expressive form which results natural, informal and pleasant to people of any age and culture [14], [15]. The narrative form conveys logical connections among the narrated facts, even if these are not explicitly expressed [14], [16], [17]. This transforms a sequence of events in what many authors call a configuration [18], i.e. an organic whole in which each part contributes to the global meaning and at the same time takes meaning from its position within it [19]. This leads the narrator, and those who receive a narrative, to become aware of more or less implicit connections, hence favouring thought organization and content understanding.

Hence, what better starting point could we chose to boost awareness and reflection? Reflections are thoughts, mostly abstract and often mood-dependent; narrations, on the other hand, refer to concrete facts and can therefore give concreteness to thought, grounding reflection in personal experience. It is not surprising, therefore, that narrative activities are increasingly used in teacher training (see, e.g., [20], [21], [7]).

In our case, narrative appeared a particularly suitable methodology to turn the blog into a learning tool. Telling personal, and hence well known, facts did not require trainees to concentrate on the acquisition or production of content knowledge, hence letting their attention and creativity focus on expressive aspects and on giving meaning to personal experience.

2.3 Analysis of the Outcomes

When the activity was proposed, the trainees were not enthusiastic about it. They lamented that some extra time was required and did not think that an activity of this

kind could be useful for their own learning or as an example of task to carry out with their students. Since the activity was obligatory and contributed to the final evaluation, however, the trainees accepted to accomplish it and participated diligently, respecting all deadlines. All of them successfully passed the final exam.

2.3.1 Data from the Productions

For the first 2 assignments, each trainee posted her narration as a blog item, to which her colleagues added, as comments, their guesses on the author as well as their observations, comparisons and reflection. All the 11 texts posted were rather long, well above the minimum requirement, and mostly showed pleasure to narrate, despite the initial distrust concerning this activity.

The memories about teachers included a variety of aspects, both positive (e.g., *"His strength relied in his deep sense of impartiality"*; *"I remember a smile, a funny word that made us forget for a moment our tiredness"*) and negative (*"what was missing was the relational side"*; *"I thought she was a person with no competence"*). They also spotted what triggered learning and motivation (*"teaching not only some topic, but also the how and the why"*; *"Objectivity,..., enthusiasm,..., discipline"*) and expressed missed opportunities (*"I feel very sorry for what I have not been able to learn"*), and regrets (e.g., *"I would have liked to have more opportunities to get to know my class mates"*). Understanding of strengths and weakness of which the trainees were not aware before was often acknowledged (*"Today I understand the aim of all this"*).

Also the personal characterizations as student and the second assignment where thoughtfully written and show sincerity, passion and a good amount of insight.

The comments, 98 in total, were always constructive: besides guessing the post's author, similarities and differences of points of view were spotted and were used as starting point to work out suggestions to successfully communicate with students and raise motivation (*"Teaching means entering into a personal relationship"*, *"listening to the learners is essential"*, *"eye contact is very important"*).

Both narrations and comments show freedom of expression and appear to be written to communicate with the course mates, rather than addressed to the teacher to accomplish the assignment. This suggests that the narrative activity performed in that environment was perceived as part of real life rather than as an academic work. This marks a point in favour of using narrative for learning and indicates that the tasks were well chosen.

The outcome of the third assignment was a PowerPoint presentation to be posted online. Each trainee was in charge of presenting part of the agreed content in a slide, which they made with great creativity, using different presentation styles: meaningful combinations of pictures and text, graphs and diagrams with data retrieved from the web to complement their contributions, sketches, even a poem and a tautogram. Discussion on what to include in this presentation was very live and did not remain limited to the online environment but extended to classroom lessons, which underlines a continuity between the two components of the course.

Only two trainees did not contribute a slide to this presentation. Unfortunately it was not possible to learn if this was due to lack of time and work overload (this course being the last before the school's final exam), or if they felt scarcely interested

for a task that appeared simply a presentation of the ideas worked out in the two previous, more meaningful, tasks.

2.3.2 Data from an End-of-Course Questionnaires

At the end of the course, we inquired into trainees' opinions by means of a questionnaire which included 5 closed questions and 7 open ones concerning the narrative activity on the blog, plus 2 on trainees' attitudes toward the use of ICT to support language teaching that are not relevant for this study.

The closed questions were to be answered on a 5-point Likert scale from 1 (not at all) to 5 (very much). We consider as positive the answers expressing at least average satisfaction, i.e. above or equal to 3. These questions aimed to investigate the enjoyment of the experience and how much the narrations had contributed to self-knowledge, reflection and professional growth. The answers were clearly positive: all averages are above 3 and the lowest value was never chosen by anyone for any of the question (see Table 1 and Figure 1).

Table 1. Answers to the 5 closed questions of the end-of-course questionnaire. Answers are on a Likert scale from 1 (not at all) to 5(very much).

#	Question	Average	St. dev.	Median
1	Did you enjoy narrating?	3.64	0.92	4
2	Did narrating help you to know yourself better?	3.18	1.17	3
3	Did reading your peers' narrations help you to recall and understand better your own experience?	3.73	0.90	3
4	Did these narrations help you spot aspects of your experience that might help you become a better teacher?	3.91	0.83	4
5	Was this narrative experience relevant in the framework of the training school to reflect on the teaching profession?	3.64	1.03	4

The answers to the first question ("Did you enjoy narrating?") confirm the impression given by the trainees' productions that the task had been carried out with pleasure, despite the scarce enthusiasm shown at the beginning. Answers at least average resulted over 90%, with over 50% in the 2 highest groups, which leads to a median equal to 4. These data are in agreement with the literature, where it is claimed that narrative activities are apt to raise people's interest and motivation, being a natural and pleasant expressive form.

Less positive, but still with an average above 3, were the answers to the second closed question ("Did narrating help you to know yourself better?"). Appreciation at least average was expressed by over 50% of them. The presence of some very positive answers matches with the written productions, where some of the trainees explicitly expressed the positive effect on self-knowledge of this kind of activity. A rather high number of answers in the second lowest group, however, determined a median equal to 3.

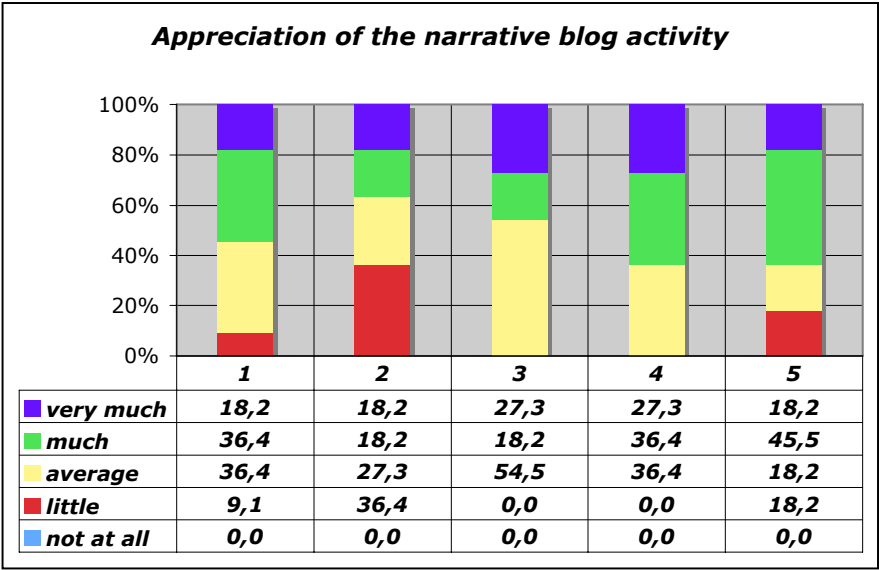


Fig. 1. End-of-course questionnaire: percentage answers to the 5 closed questions. The questions and mean values are shown in Table 1.

The same median value, but coming from a more positive answer distribution, characterized the third closed question (“Did reading your colleagues’ narrations help you to recall and understand better your own experience?”). Here, no respondent claimed that reading their colleagues’ narrations had been of little use and a bigger number of respondents expressed the highest appreciation, hence leading to a higher average value and lower standard deviation. These positive data are confirmed by the richness of the comments posted in the blog and by the answers to the open questions (see below). The greater importance attributed to reading peers’ narrations over narrating one’s memories is explained in the open questions as providing the possibility to make comparisons, hence adding perspective to one’ experience. This marks a point in favour of using a narrative blog to stimulate reflection rather than assigning an individual reflection task; as one trainee observes: “*Reflection is rooted in writing; reading what others write implies deepening and comparing*”. Sharing, and hence confronting, personal experiences likely led our trainees to look at aspects that they had initially not considered but that were recognized as important also for them. One of the trainees explicitly comments: “*This experience is the proof that sharing can only bring positive effects*”. And another remarks: “*Comments obliged us to repeat on the same points and this supported reflection: brainstorming without looking in each others’ eyes brings about deeper concentration*”.

The forth closed question (“Did these narrations help you spot aspects of your experience that might help you become a better French teacher?”) received the best answers in this group of questions. One trainee comments in this respect: “*I could share with my students some experiences as a strategy to set up an empathic relation, stimulating them to voice their own experiences and by this means giving them a*

central position in their own learning". This appreciation confirms the possible positive impact of narrative activities for teacher training, and stresses the importance of sharing and discussing personal narrations.

The last closed question ("Was this narrative experience relevant in the framework of the training school to reflect on the teaching profession?"), finally, marks one more point in favour of choosing a narrative approach to reflection, since the influence of this activity appears not to be limited to the course environment. How this can happen is explained by a trainee: "*Thinking back about our student's experiences, at the light of the teaching experiences that we are having now, made us focus more precisely which behaviours and attitudes a teacher should or should not have. This has been a powerful way to reflect on our pedagogical knowledge and on the contents we have been learning in the training school*".

It is interesting to note that, among these questions, the two with a lower median answers (Questions 2 and 3) concern increased self knowledge as a consequence of the narration activity, which suggests (and is confirmed by several comments) that the trainees were not new to self-reflection and already had a good level of self-knowledge. This gives even more value to the median 4 obtained by the three questions concerning appreciation and usefulness of the activity.

As concerns the open questions, the activity was considered useful for a number of reasons: to communicate, to reflect, to write in foreign language, to understand each other, to practice with computer use, and also to learn to use a blog for classroom activity or to better understand ICT potential.

The most appreciated aspects resulted to be: reading peers' narrations, sharing one's own and guessing the authors, followed by: reflecting on the role of the good teacher, narrating about oneself, making comparisons and communicating. Analysing experiences, recalling, reflecting on oneself and writing comments were also mentioned.

The trainees enjoyed the proposed game which contributed to create a relaxed atmosphere in the workspace and helped them realize that blog users need to be somehow pushed to write comments, since this heavily influences the learning potential of such communication environments. They also appreciated the challenge implied by the game, which makes it an interesting approach to motivate students. Finally, engaging with the game was seen as the key to give rise to real collaboration and to teach the participants to "*listen to peers more carefully*".

The trainees appreciated as a useful source of learning the joint creation of the blog, which significantly improved their technical knowledge, as well as the opportunity to get to know their peers better, understand their points of view and needs, collaborate with them. This attention to the relational aspects appears very important in a teacher training course, as starting point for the development of a collaborative attitude towards one's colleagues.

The narrative tasks assigned and the request to comment on each other's narrations led our trainees to reflect not only on teacher's role but also on themselves as people able to raise their peers' interest. This is again an important point in teacher training, because it contributes to trigger self-efficacy, which is very necessary in the teacher profession [22].

Narrative was perceived as a useful pedagogical tool able to stimulate individual self-reflection, but also as a teaching methodology facilitating expression and communication, providing opportunities to write in foreign language, fostering students'

reflection, developing creativity and motivation, as well as supporting shared construction of knowledge.

Using a blog was considered crucial for the good realization of the experience because it allows immediate and long-lasting sharing, which makes activities of this kind suitable to be used also with teenager students, who particularly appreciate immediacy of communication. The environment, moreover, was perceived as facilitating communication, as well as easy to use and informal, which again makes it suitable for school application. Carrying out a simple but meaningful activity on the blog was viewed as very important to appreciate the use of this kind of tools and revise their opinion on using ICT for language teaching.

No respondent complained for the extra work load introduced by the online activity.

2.4 Discussion

Was the integration of this online module successful? Did it bring an added value to the originally planned f2f course?

In order to evaluate online courses, Saadé et al. [23] spot several factors that can be taken as indicators of success: affect (i.e. pleasure or discontent), learner's perception of the course, perceived learning outcomes, attitude, motivation. The data in the above section show that all these aspects were positive features of our case. We found evidence that the trainees appreciated the experience, despite the negative initial attitude, getting much involved and keeping their motivation high throughout the whole course. They acknowledged learning of technological aspects and appreciated familiarizing with them through a practical, interesting activity that made the use of ICT a means toward a pedagogical aim rather than an end in itself. They also expressed appreciation for the occasion to reflect on each other's experience as a help to become better teachers. Finally, they admitted having changed their attitude as concerns the possibility and suitability of using ICT in their future profession.

These good results were made possible by the chosen setting and methodology.

The narrative approach led to a meaningful and pleasant use of the communication space and at the same time received emphasis from the fact that narrations could be, and actually were, read and commented by the classmates. In other words, we can say that it is the combination of a conceptual tool (narrative) with a technological tool apt to value it (blog) that determined the success of this experience. It is also important to remark that the choice of a meaningful topic for the narrative activity appears crucial, because, as Goodson [24] points out, using narrative should not be considered an unquestioned good that always provides benefits independently of its focus and organization.

Sharing and commenting personal narrations would obviously be much more difficult to organize and time consuming in a f2f environment, if at all possible. Doing that online, on the other hand, was rather easy and also required the trainees to put their thoughts into writing, which, according to the literature, leads to deeper reflection and involvement [25]. Working with a group created a stimulating context to ground reflection in a plurality of voices, which helped move the personal stories beyond self-referential individual narrations to a wider, contextualized perspective [24]. This is an important point because, as Masie [3] points out, context takes great importance in favouring learning.

The blog received attention and appreciation as technological object of study for the fact that using it as a tool for thoughtful communication provided a tangible proof of its interest. The possibility to post comments facilitated reflection sharing and made the blog a place for cognitive activity, non simply a repository of assignments. At the same time, the proposal of a game to carry out in this space was a useful method to bring about comments.

The connection with the f2f module was assured by the fact that the online activities had been shaped so as to complement the lessons and answer to the same learning needs. Thanks to the interlace of methodological planning and choice of suitable tools to implement it, the two components, together, contributed to satisfy the original course aims.

3 Concluding Remarks

The described course appears to be an experience of hybrid learning in the most proper sense attributed to this term [2], in that the online component was an obligatory part of it devoted to the construction of shared meaning, rather than simply a repository of materials or an optional seminar. It was not simply informative but cognitively loaded.

The use of an online environment for the proposed reflection activity was not a fancy choice but in fact crucial for its good development, giving rise to a learning experience more stimulating than it would have been possible with traditional means. At the same time, the work carried out in class, consisting in joint analysis of technological tools and resources to use in French teaching, would likely have been more complex to realize in an online environment. The considered situation, therefore, was ideal to realize a hybrid learning experience.

Was the effort required worth the results achieved? Certainly, especially since the resources required were not many. As argued in the previous section, the success of the activity relied on its careful design and on the choice of a number of tools - of both technical and conceptual nature - that could best help implement such design. The kind of tasks proposed, moreover, did not require much tutoring in the online environment, hence from this point of view no extra effort was entailed. Some more work was required of the students, but, as pointed out before, in limited measure, since the online module went to substitute the written production that would have been otherwise assigned. This extra work was, however, compensated by a more stimulating and enjoyable activity. Also the technical realization did not entail any extra cost, since free blog space was used and the implementation was simple enough not to require technical assistance.

It is therefore clear that simple experiences of blended learning along these lines are feasible and not much onerous. They require of teachers attention to the learning needs of their students and a careful analysis of which technological and conceptual tools could more profitably be used to meet them.

The interest for realizing similar activities is obviously not limited to teacher training courses, since a collaborative task or a phase of shared reflection can result beneficial in a wide number of situations and can often be advantageously realized in collaborative online environments. A widespread implementation of experiences of this kind could help prepare the ground for a wider transformation in the educational system.

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Lectures from My Living Room: A Pilot Study of Hybrid Learning from the Students' Perspective

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Abstract. This study examines the pedagogical benefits of and issues arising from the use of a synchronous conferencing tool (ie. *Wimba Classroom*TM) in the hybrid delivery (ie. students attending either face-to-face or remotely) of a postgraduate degree programme in advanced clinical paediatrics. Specifically, we examine why students choose to participate virtually and the impact of the virtual classroom on learning and communication. Data was gathered from the students using an online survey, supported by regular discussions, observations and email exchanges.

Keywords: Synchronous conferencing, *Wimba Classroom*TM, virtual classroom, hybrid, blended learning, e-learning, NHS, nurses, advanced practice paediatrics.

1 Introduction

The Advanced Paediatric and Neonatal Practice (APNP) Programme is a Master's level development that is exclusive to Liverpool John Moores University (LJMU) and as such, LJMU has become a centre of excellence for the development of paediatric advanced practitioners (a new role innovation within the National Health Service [NHS] of the United Kingdom). In order to widen access to these pioneering courses of study for students living or working outside of the Cheshire and Merseyside region of England, a blended learning or 'hybrid' delivery approach was adopted which combines face-to-face lectures with synchronous internet based video conferencing. Whenever physical attendance is not compulsory, *Wimba Classroom*TM (a virtual classroom, accessible via LJMU's *Blackboard* course management system) enables students to attend live sessions remotely from their own homes or workplaces, thereby transcending geographical barriers. The software also allows for students on different routes within the APNP programme to collaborate and share learning (either synchronously or asynchronously) for content that is common between routes. In addition to this, individual sessions can be recorded, archived and revisited at a later date, providing all learners with a rich 'on demand' resource for revision and an opportunity to catch up if they miss a session.

The APNP programme has been piloting the *Wimba Classroom*TM software extensively in order to create a 'best practice' model for rolling out the technology to a wider variety of programmes and support services in the University. Building on the

initial adoption and introduction of the software by LJMU's Learning Development Unit in July 2008, most of the technical issues have been ironed out with the installation of a 'Wimba-Ready Room' and the software has been embedded into all of the APNP programme modules. It is now used to deliver and record every lecture and group tutorial, thus offering students the flexibility to attend in person or virtually from their own living room or workplace and affording lecturers (including senior clinicians based at Alder Hey Children's Hospital) the opportunity to deliver sessions directly from their workplace. The software has also been used for a wide variety of other learning activities such as: student presentations, role play and review, student assessments, one-to-one tutorials, communication with off-site clinical staff, and for students to work collaboratively in between taught sessions.

2 Background

Prior to the introduction of *Wimba Classroom*TM the APNP programme was delivered in a traditional face-to-face format (with some *Blackboard* support). However, with the sharply rising trajectory of advanced practice roles in the NHS and the important modernisation agenda for children's services, it was thought that widened access to paediatric-specific education and training (through the exploitation of new, web-based learning technologies) could lead to real improvements in care quality for children and their families. However, from the outset, it was acknowledged that a balance would need to be struck between the obvious advantages of wider programmatic access and the quality of teaching and learning within the APNP programme. It was felt that incorporation of web-based technologies into a clinical training programme had to maintain both the social learning components of the course (e.g. problem-based learning, small group work, case study analysis etc.) and the hands-on practicalities of teaching advanced clinical care (albeit in a different format). Hence, it was from these pedagogical roots that the blended delivery of the APNP programme was derived.

2.1 Research Aims and Objectives

This study aims to examine a variety of different research questions, covering pedagogical, technical and practical aspects of using *Wimba Classroom*TM and more generally, the issues related to dual delivery / hybrid lectures. Building on published literature and existing research on synchronous conferencing and blended learning, the study aims to:

- Investigate why students choose to attend a lecture via synchronous conferencing rather than attend face to face
- Measure the impact of the virtual classroom on learning and communication
- Examine the social implications of the virtual classroom
- Explore how *Wimba Classroom*TM promotes inclusivity
- Identify improvements that could be made in the continued implementation and utilisation of *Wimba Classroom*TM

2.2 Research Method

An online survey was chosen so that participants could complete it at a time and place convenient to them. There are a number of other benefits in using *Bristol Online Surveys*:

- The proposed respondents can be reached immediately by email and invited to participate in the survey by clicking a link
- There are no problems or associated costs related to survey distribution and collection (as compared with traditional, paper-based surveys).
- Responses are accepted directly into a database, thus avoiding the need for subsequent data-entry (as with traditional survey methods).
- Ease of completion and return improves survey response rates
- Invalid responses are minimised, where possible, by immediate data validation
- *Bristol Online Surveys* enables immediate cross tabulation of results and ease of data importation into statistical software packages.

The online student survey was open from 18th to 30th March 2009. It was comprised of three sections: (1) About you; (2) Technology used to access the virtual classroom; and (3) preferences relating to *Wimba Classroom*TM. The survey was supported by regular discussions, observations and email exchanges with students who use the software.

2.3 Participants

All 26 students currently enrolled on APNP modules were sent an email inviting them to participate in the online student survey once their Semester 2 module examinations had been completed. There was a response rate of 73.1% (19 students), with 16 students completing the full survey and 3 only getting as far as the end of the second section 'about you'. This suggests that the 3 students who didn't complete the survey may not have known how to proceed past the second section, (although they had managed to proceed past the first section); were potentially put off by the technology-related questions (two of which involved visiting an external website to check broadband speed on the computer they usually use for access to *Wimba Classroom*TM); or perhaps they were unable to complete the survey within the identified time frame.

Of the 16 students who successfully completed the questionnaire (61.5% of those who were invited to take part), 87.5% were women, the majority (62.5%) were in the age range 36-45 and all fell within the ages of 26 and 55, classifying them as 'mature' students. 13 students (81.2%) were studying on the Paediatric Ambulatory Care route of the programme and 3 (18.8%) were studying on the Paediatric Critical Care route. 11 students (68.%) were studying on a full time basis, 3 (18.8%) were studying on the 2 year part time route and 2 (12.5%) were on the 3 year part time route. 1 student had special learning requirements (relating to speech and mobility).

87.5% of respondents had a commute of over 1 hour each way to attend University. 4 of these students (25%) reported an even longer journey of over 2 hours each way and one student had a trek of over 3 hours each way to University.

2.4 Ethical Considerations

All participants were given a Participant Information Sheet which detailed what the purpose of the research was and how the data would be used. They had the opportunity to consider the information, ask questions and have these answered. A consent form was built into the first page of the online survey. Before starting the survey, they had to complete the consent form and agree with statements that their participation was voluntary, that they were free to withdraw at any time, without giving a reason and that this would not affect their legal rights. They were advised that any personal information collected during the study would be anonymised and remain confidential. In addition, *Bristol Online Surveys* provides the following data protection systems:

- All data collected in the questionnaire is held anonymously and securely at *Bristol Online Surveys*' servers
- No personal data is asked for or retained
- Cookies (personal data stored by participants' web browsers) are not used in the online questionnaire

2.5 About Wimba Classroom™

Wimba Classroom™ enables lecturers to deliver live teaching sessions to remote students via a virtual online classroom using synchronous conferencing, Powerpoint slides, Application Sharing and instant text messaging. The online tools support a diverse range of learning styles and can be used simultaneously. In addition, *Wimba Classroom*™ has the capability for (online) small group work utilising virtual 'break-out rooms'. Students can create collaborative images via a shared eBoard (electronic whiteboard) and save them for presenting to the whole group and/or uploading to *Blackboard*.

In the interface design, students can see who is online, share their status (via smileys, tick or cross) and send written texts either to the main room or privately to individual participants. Texts to the main room are archived and appear in synch with the presentation on playback. Students also have the option of speaking in using the Talk button and if they have a webcam, their video stream is transmitted, overriding the lecturer's video, while they speak.

The pilot study group uses the software for hybrid learning where lecturers deliver sessions to students attending face to face at the same time as students participating remotely. Students access the virtual classroom and associated archives (recorded sessions) via *Blackboard* (a course management system), along with other content for the session including downloadable slides and articles. At the beginning of the pilot, students were given training in using the software and took part in some test sessions from home to give them confidence in using it.

2.6 Software and Hardware Costs

At the time of writing, the cost of *Wimba Classroom*™ software (available from *Wimba UK Ltd*) ranged from £9,500 + VAT for 25 concurrent users seats to £30,000 + VAT for up to 24,999 FTE (full time equivalent) users (however, anyone who is

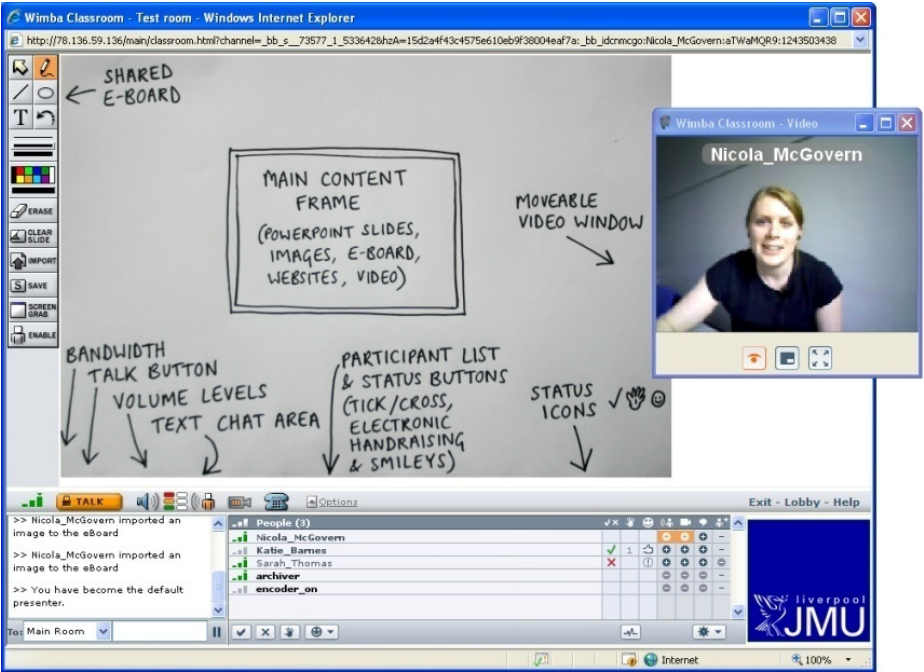


Fig. 1. Screenshot of Wimba Classroom™ from the student's perspective

looking for pricing options, should consult directly with Wimba UK Ltd sales teams; Wimba reserve the right to change their pricing structure at any time and the prices indicated are not binding). This cost is based upon a 12 months service that is permanently switched on and available 24x7 without any throughput limitations. It includes ASP hosting, professional services, free 24x7 technical support, full implementation upon start of service, 3 hours initial online training and integration with Blackboard, Moodle and Angel VLE / LMS / CMS as required.

The cost of hardware required to run a hybrid lecture using Wimba Classroom™ can vary, depending on an institution's needs. For a basic mobile equipment set up, all

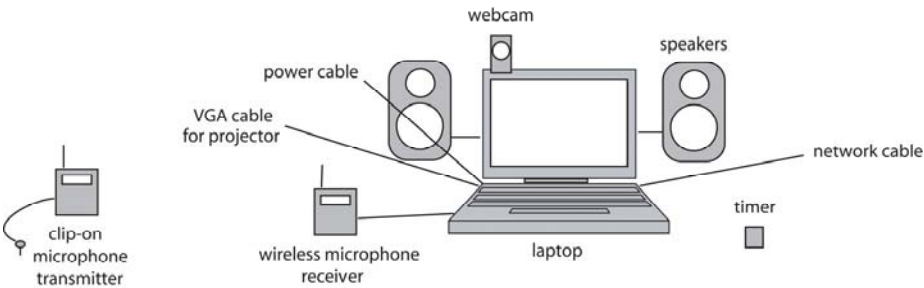


Fig. 2. Mobile equipment set up

that is required is a microphone, speakers, a webcam and a PC or Mac with the following system requirements: Windows 2000+ or Mac OSX 10.3+, 256 MB RAM (higher recommended), IE 6.0+, Safari 1.2+, Firefox 1.5 - 2.0 (web browser must be Java and JavaScript enabled), Broadband Internet connection. This basic set up can be purchased for under £600. However, a dedicated high-spec *Wimba-Ready Room* with built in interactive whiteboard, short throw projector, room microphones, secure desk, desktop PC and monitor, networked laptop, audio mixer, wireless clip-on microphone with mains receiver, timer and high quality pan, tilt and zoom camera can cost around £9,000.

3 Choosing to Participate from Home

Most students (81.2%) primarily use *Wimba Classroom*TM for participating in live sessions, with all of them preferring to take part from home rather than attend in person at some time or other. 3 students (18.7%) also participate occasionally from work, although this happens less frequently than participating from home. Ipsos MORI's 2008 study of ICT expectations in 1,111 first year students in Higher Education aged 17-19 revealed that, although ICT in teaching is perceived to be a good thing, 'Face to face interaction is still seen as the best form of teaching.' [1] So, when given the choice of attending face-to-face or participating remotely, why do half of all the survey respondents choose to participate from home on a weekly basis and an additional 37.5% of students choose to participate from home 1-3 times a month? Taking into account the broad geographical span of the students, it would be reasonable to assume that the longer it takes a student to travel to University, the more likely they are to participate remotely [2]. However, the data for full time students (part-time students, by default, participate less frequently) indicates that this is not the case. Surprisingly, the longer the journey to university, the less frequently the student chose to participate from home (although it is acknowledged that participant numbers in this pilot study are relatively small).

In fact, there was a wide variety of other reasons why students chose to participate from home on a regular basis (respondents could select more than one answer):

Table 1. What reasons influence your decision to participate remotely the most?

Reason given	Number of respondents
Distance/time taken travelling	14
Traffic/transport issues	8
Weather	6
Childcare	5
Illness	4
Carer	1
Mobility impairment	1
Cost of travel	1
Other commitments	1

Comments included:

- “not getting travel expenses”
- “time spent travelling for 2 hour session could be spent studying”
- “need to get back for shift”

These results reflect the various additional commitments of the student group on a professional postgraduate level course in clinical practice. Many students are also on clinical placements and have family responsibilities, juggling study with work and childcare. Students often attend university in person if they have a full day of lectures, but prefer to participate remotely on days where they only have one lecture: “I would travel in if for more than one session, takes longer to travel than spent in lectures”.

Similar personal issues were raised in Dawes & Handscomb’s study involving 313 NHS nurses and allied health professionals on an e-learning staff development programme, indicating common values with professionals across the wider health care sector. The study confirmed that ‘for a professional development programme to be successful, it must: fit around peoples’ existing work-life balance, not demand a large time commitment, be cheap or free.’ [3] Their study also found that when NHS staff had the choice of studying an online course at work or at home, the majority preferred to study at home, even if they had access to a computer at work. Handscomb suggested one of the reasons for this was that “nurses found that they obtained more support in their learning from the people around them at home, than they could expect from teachers and trainers.” [4]

The aim of opening up the APNP programme to offer flexible learning for health-care professionals through an accessible blended learning approach is supported by nationwide and local educational strategies. The Department of Health’s *Working Together, Learning Together* framework, which outlines the role that e-learning will play in the government’s vision for lifelong learning, states: ‘The Government believes that access to education, training and development should be as open and flexible as possible - with no discrimination in terms of geographical location. The infrastructure to support learning should also be accessible in terms of time and location and should draw on new educational and communications technology.’ [5] Similarly, the Department for Education and Skills (DfES) believes that, as a learner, you should be able to choose where you study: ‘you will have more choice about where, when and how you study, making it easier for you to create your own mix between studying in a place with other learners, learning at work, learning at home, and learning online.’ [6] Meanwhile, on a local level, Liverpool John Moores University Learning, Teaching and Assessment Strategy also focuses on ensuring inclusivity and an accessible curriculum in its Key Objectives [7].

4 Impact on Learning and Communication

Following ‘participation in live sessions,’ the students’ second most frequent use of *Wimba Classroom*TM was for revision and third most frequent use was for catching up. Both of these are made possible with *Wimba Classroom*TM’s archive facility (recorded sessions), which 3 students (18.8%) reviewed more than 4 hours per month and half spent 2-4 hours per month reviewing. Those who used the archive facility

more frequently also gave the highest overall rating for *Wimba Classroom*TM as a learning tool, indicating either that students value the ability to review a session very highly, or that students who rate *Wimba Classroom*TM highly are more likely to use it in their own time (i.e. outside of live sessions).

Some articles suggest that students and lecturers have a stronger relationship and a better quality of education when interacting online than in class [8], [9]. Yet, answers to the question “When participating remotely, how do you rate your interaction with the lecturer compared to when attending face to face sessions?” were very mixed. 4 students (25%) said that they had more interaction when participating remotely, 5 students (31.2%) noted ‘no difference’ and 7 students (43.8%) felt they had less interaction with the lecturer when interacting remotely. 2 of the students who said that they had more interaction when participating remotely explained that they found it easier to participate using instant text messaging “can feel that it is easier to text in messages and ans [sic] that you may not feel comfortable with in a large group of people”, 1 student who reported no difference said “I think that the opportunity to interact with teaching staff is as good as face to face.”, while 1 student who said they had less interaction preferred to speak in as “sometimes your comments are missed” by the lecturer. 3 more students also commented that the level of interaction was dependent on the lecturer “if the lecturer uses wimba all the time...they are very interactive and don’t forget the people at home.” Therefore, it appears that its not simply a question of whether students interact more or less via the virtual classroom, but how do students and lecturers interact with each other. In order to actively engage students in their learning [7], and encourage deep approaches to learning to take place [10] lecturers need to encourage and respond to students’ contributions. ‘It is imperative not to allow anyone to remain inactive for too long and therefore it is vital that the session is interspersed with questions, observations and suggestions.’ [11]

Another factor affecting the level of interaction between student and lecturer is the teaching style itself. For formal, teacher-centred lectures and large class sizes, limited interaction with short text based answers, polls and yes/no icons is acceptable as long as the lecturer acknowledges remote students’ contributions. By their nature, large group sizes result in reduced direct interaction between students and lecturer due to time limitations, so any opportunities to improve interaction between students and lecturer are welcomed. Using instant text messaging gives all remote students the opportunity to participate at a basic level and there is less chance of one person monopolising the conversation. However, for small to medium sized groups (such as on the APNP programme) where sessions often involve discussions and small group work (including breakout rooms), spontaneous conversation is less likely to take place in the virtual classroom than in the physical classroom [12] and chat messages tend to be short and, at times, difficult to follow or understand. [13] As one student commented: “time delay in typing responses prevents bigger comments being made. would be better to use voice, but this is difficult if several of us try to speak at once.” Students participating remotely need extra time, management (turn taking) and feedback from the lecturer to enable them to interact fully in this type of delivery.

Furthermore, successful management of the interaction between remote-learner, classroom-based learner and lecturer provides a number of advantages such as: the inclusion of formative assessment and feedback as an integral part of programme

design and delivery [7]; facilitation of ‘learning conversations’ as described by Laurillard [14]; and provision of valuable feedback for the lecturer with regard to the degree of student engagement and what they are learning. [2]

Despite the students’ mixed levels of interaction with the lecturer (when participating remotely), the majority of students felt that *Wimba Classroom*TM had a positive (68.8%) or very positive (25%) impact on their learning. Interestingly, the majority of students (75%) also felt that *Wimba Classroom*TM had a positive or very positive impact on their learning when attending face-to-face (the remainder indicating that there was no impact).

Student comments included:

- “allows you to communicate with colleagues that have not attended face to face sessions.”
- “I don’t often notice it is there.”

Table 2. What 3 things do you like most about *Wimba Classroom*TM?

Benefit	Number of respondents
Ability to participate in live sessions from home	15
Archive facility	15
Ability to ask questions by text message	14
Ability to ask questions by voice	2
Ability to take part in live sessions from work	1
Its flexibility	1

Survey participants were asked to rate a variety of functions of *Wimba Classroom*TM on a scale of 1 to 4 (with 1 being ‘very useful’ and 4 being ‘useless’). They found texting in, breakout rooms, speaking in and using a tick/cross the most useful tools.

Table 3. How useful do you find the following functions in *Wimba Classroom*TM?

Function	Usefulness (1 being very useful and 4 being useless)
Texting in	1
Breakout rooms	1.3
Speaking in	1.4
Tick/cross	1.4
eBoard	1.6
Electronic hand-raising	1.9
Smileys	2.4
Showing my webcam	2.7

Students rated ‘smileys’ (emoticons such as ☺ or ☹) and ‘showing their webcam’ as the least helpful *Wimba* functions. However, some research suggests that richer mediums (which are able to communicate emotion) reduce some of the distancing effects of online learning: ‘If the communication medium allows for human emotions, gestures, body language, and other cues, it will replicate some advantages of face-to-face teaching.’ [15] Student-side webcams can provide the lecturer with some insight

into the student's emotional state (which is often unavailable in online education [15], [16]) and additionally, they fulfil a valuable role in improving comprehension for lecturing staff and fellow classmates when students are speaking in via poor quality microphones.

Overall, the pilot study group claimed that *Wimba Classroom*TM had a very positive (62.5%) or positive (37.5%) impact on their learning. In addition, when rating the software as a learning tool, they gave it an overall mean rank of 8.8 out of 10.

Comments included:

- "I can actively participate in study with tutors and other students, whilst maximising the rest of my time. I wouldn't like to lose Wimba but it doesn't fully replace face to face learning."
- "Found Wimba very disruptive initially but now myself and tutors are familiar with it I find it really useful."
- "I think after many teething problems that this is invaluable, there is no need to miss any session as long as the internet isn't [sic] playing up!!"

5 Social Implications

'Physical isolation in Web-based learning is a given. Students are accessing information from a location other than the classroom. However, physical isolation does not need to transfer into mental, social, or emotional isolation.' [17]

As the APNP programme is delivered through a blended learning approach, students don't face the same barriers (creating learning communities without ever physically meeting each other) that 'pure' distance or e-learning students face. The pilot group attend face to face sessions in addition to learning remotely, so they already have friendship groups from the 'real' world that can be developed and strengthened in the virtual classroom.

Townsend et al. [18] highlight the direct relationship between student satisfaction and social experience when using desktop video conferencing, while Littlejohn and Pegler [2] promote online opportunities for students to socialise informally, outside the teaching space. With this informal social experience in mind, the *Tea-Break Room* (a virtual classroom) was introduced to the student group. The idea behind the *Tea-Break Room* was to have a virtual space available at all times, and in which students could meet up to 'chat' away from the prying ears of lecturers. Students were given full control of presentation tools within the room (for creating their own archives, snapshots and sharing the eBoard) and invited to use it via a *Blackboard* announcement. Initially, a few students visited the room and left immediately as no-one else was present. In the survey, one student commented "I chat to other students thru Wimba after sessions have ended" (contrary to the Kapp Notes blog which reports that students don't hang out in virtual classrooms outside of taught sessions) [19], however for practical reasons, students preferred to stay in the room they were already in rather than move to a private room.

However, since the survey took place, the *Tea-Break Room* has proved to be extremely beneficial for task-driven activities. Students were asked to collaborate in groups in between taught sessions to research and prepare a presentation. This kind of small group work provides opportunities for socialising, as well as presenting an

opportunity for students to synthesize content and improve their communication skills [17]. Some of the groups decided to use the *Tea-Break Room* to complete the task, working together to create slides using the eBoard, without having to travel to meet up in person “Wimba was really good to complete the work as it meant we could work from home but get the task done especially due to all the other demands on us APNP students all the time.”

In addition to sending text messages to all participants, *Wimba Classroom*TM allows students to send private text messages to each other during live teaching sessions. This function has occasionally been a contentious issue with staff (private texting can be disabled by the lecturer) and with good reason; one student was caught out when a private message was inadvertently sent to the whole group “Do this [texting] very little since getting into trouble over it posting a private remark re tutor to main room”. But would disabling the private text function have a negative impact on learners? Anderson et al. [20] state ‘any constraint of the freedom to communicate privately during sessions may impede the creation of an efficient community of learners’ and the online survey results reflect this view; of the 93.8% of students who admitted to interacting with other remote students via the private text tool during sessions, 73.4% felt that this had a positive or very positive impact on their learning (the remainder indicating that this *Wimba* function had no impact).

Explanations included:

- “social side of course is just as important – sharing experiences”
- “usually in relation to topic or clinical placements/support”
- “it provides opportunity to ask questions of other students that you may feel stupid asking openly, because you think you may be expected to know the answer. also if experiencing a problem I can check if it is universal or just me without interrupting the flow of the tutor which must be distracting.”

The students’ comments emphasise the importance of peer learning when interacting online, reinforced by Qu et al. [21] and Littlejohn and Pegler [2]: ‘Most students would benefit from the *opportunity* to interact with peers and tutor as they need to, for example to ask questions or to share understanding’. Learning from each other is particularly beneficial for people with less experience who learn through association and social interactions with more experienced colleagues [22].

6 Promoting Inclusivity

*Wimba Classroom*TM offers students a variety of different ways to participate and supports a variety of different learning styles. As discussed earlier, some students prefer to text comments and questions while others prefer to speak in using a microphone or webcam. Visual learners can also convey visual information (drawings/diagrams) via a shared eBoard (electronic whiteboard), if this function has been enabled by the lecturer. The archive facility supports students who have difficulty understanding the language, or reflective learners, who can pause the lecture and review it at their own pace. *Wimba* have also incorporated keyboard shortcut keys, hot keys, and screen reader compatibility for visually impaired users and closed captioning for the hearing impaired (although this requires a trained closed captioner to key

in captions during live sessions). The *Wimba* website claims that it may also be possible to use a client-side speech to text system trained for a particular speaker.

The survey respondent with special learning requirements in speech and mobility gave *Wimba Classroom*TM an overall rating of 8/10 as a learning tool and said that it had a positive impact on learning. The student found being able to text in very useful when compared to speaking in (rated as not very useful) and felt that they had greater interaction with the lecturer when participating remotely versus attending face to face “More confidence due to speech issue”. Although the student had a journey of under an hour to University, the decision was made to attend lectures remotely (rather than face-to-face) once a week or more. The reason cited for this preference was often (but not primarily) related to mobility problems. While acknowledging that this was a small pilot group, it appears quite clear that *Wimba Classroom*TM promotes inclusivity by providing flexible learning opportunities.

7 Identifying Improvements

Although there are standard systems in place to support those with hearing and visual impairments, the survey highlights the fact that many students who aren’t hearing impaired often have local audio problems “loss of sound on some (though becoming fewer) occasions” and have trouble hearing either the lecturer “Sound problems with mobile mic when moving around classroom” or other students attending face-to-face “If it’s a one off lecturer vister [sic] they need to be reminded to repeat a question or comment from people in the room without a microphone to the people online as sometimes miss things because cannot hear.” Audio problems such as these were identified as some of the students’ least favourite things about *Wimba Classroom*TM. This is concerning as the audio component of the software is critical to the success of synchronous conferencing [23] and therefore the sound quality (or lack thereof) needs to be a delivery priority in order that students who choose to participate remotely receive the same quality of education as those who attend face-to-face.

Table 4. What (if any) are your least favourite things about *Wimba Classroom*TM?

Issue	Number of respondents
Can’t hear students in class	6
Other technical problems (ie. own PC crashing)	6
Audio problems	5
Disjointed sessions (archive breaks)	5
Lecturer not interacting with remote students	2
Not participating fully with the group	2
Irrelevant text messages	1
Other students using it as an excuse not to attend	1

In order to resolve some of these issues, the APNP programme has moved away from a flexible mobile set up of equipment (consisting of a laptop, webcam, wireless microphone set, timer and projector) and created a dedicated *Wimba-Ready Room*

with built-in interactive whiteboard, microphones to pick up audio from students attending face-to-face, a high quality camera and a laptop to check audio and video transmission from the remote student's perspective.

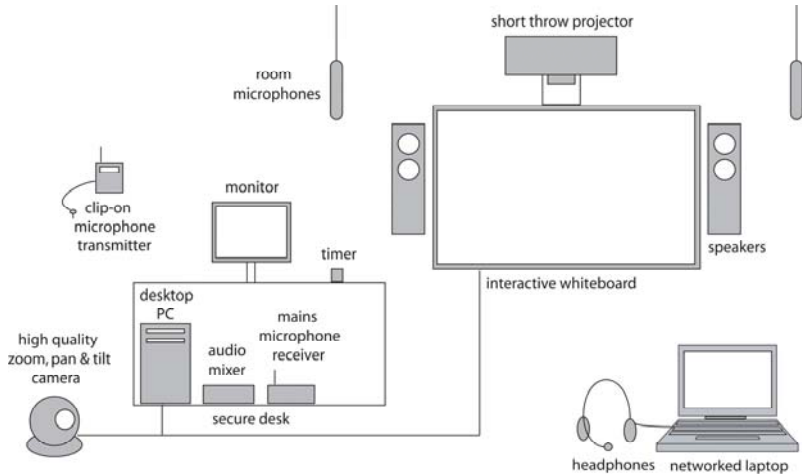


Fig. 3. Wimba-Ready Room equipment set up

The aim of the room is to ensure that students who interact remotely can hear and see everything as clearly as the students who attend face-to-face (i.e. no one is disadvantaged by participating remotely). It also enables lecturers to use their usual teaching styles (e.g. drawing with a pen onto a physical whiteboard with class discussion) to interact with remote students seamlessly without the need to repeat audio or visuals separately for those working remotely (facilitated by support staff which results in time delays).

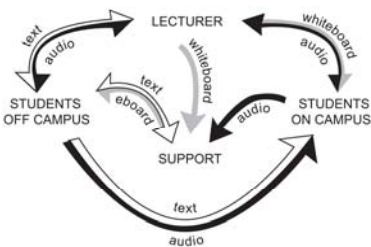


Fig. 4. Mobile equipment communication

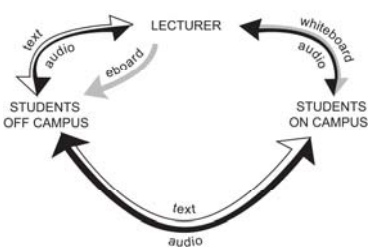


Fig. 5. Wimba-Ready Room communication

Feedback from the students on improvements made so far has been very positive “I think that the single room (2.17) as a permanent room has helped a great deal – there seems to be less technical problems now.” At present, the APNP programme team are currently experimenting with different ways of improving the archiving function and

encouraging interaction with remote students via direct questioning, increased use of student-side webcams and student feedback.

8 Conclusion

The flexible educational delivery that the virtual classroom offers, as promoted by national and local educational strategies, has been welcomed with open arms by this pilot group of postgraduate students. As burgeoning, advanced practice clinicians, they value the practical time and cost saving aspects of participating in the virtual classroom as it enables them to juggle their study with other commitments such as clinical placements and family responsibilities. In summarising, one student commented “[I] would be unable to participate at all if this was not available.”

The students appreciated the opportunity to interact in different ways (text, speech, eBoard) and the various tools in *Wimba Classroom*TM support the diverse learning needs of the group. However, the students felt that levels of interaction were largely dependent on the extent to which different lecturers encouraged and responded to their contributions.

Despite some remote students feeling that they didn’t participate fully with the group and some students commenting on the occasional technical problems, there was unanimous agreement that *Wimba Classroom*TM had a positive impact on their learning. Students also found the ability to communicate with each other, via the virtual classroom, was very important in supporting their learning and fulfilling their need for social interaction and peer support while studying remotely.

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A Study of Using Blended Learning in Teaching and Learning Modern Educational Technology

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Abstract. Modern educational technology(MET) curriculum teaching always is a question which is worth discussing. With our many years teaching practice and related research foundation, we adopted Blended learning way to carry on the educational reform in this curriculum, obtained some good effect. This thesis begins with all kinds of its definitions of blended learning and then analyzes the characters of blended learning under the environment of the Internet. We presents related study in Met curriculum teaching. Some of students and teachers in Suzhou University of science and technology are surveyed in order to know the condition of college students and MET curriculum teachers in using computers and Internet. According to the findings from the survey, the researcher concludes that it is feasible to use blended learning in college MET curriculum teaching.

Keywords: Blended learning, MET curriculum teaching, Instructional reform.

1 Introduction

With the advancement of technology, it is possible to revolutionize the way people learn and to present the information to them. Most of the traditional instruction, students learn from the instructor-led approach. Usually in a traditional classroom setting, students have access to the experts, involved in questions and discussion, exposed to social interaction and have the opportunity to learn from others. Some students prefer an individualized or less structured environment. In other words, they need self-paced learning material. At the same time, educators are now facing with the challenges of integrating traditional and emerging technology as to balance various students learning styles.

Blended Learning(BL) is an educational method that combines the advantages of cyber education and traditional face-to-face education to optimize the learning effects by using the new paradigm of a remote educational system. Today, numerous cyber education institutions are adopting BL, recognizing the limitations of cyber education, and to increase the educational effects. (Kim & Choi, 2004; Kim & Choi, 2006).

MET curriculum is one of the basic courses for each college normal program. Students experience difficulties in studying MET since they have to understand the theories and memorize many knowledge points. Studies have shown that attitude to

be one of other reasons why learning introduction of educational technology is not easy. Because the introduction of educational technology curriculum covers more learning contents, more knowledge points, updating more frequently and involved more foresighting.

The objective of this paper is to determine if BL approach which combines the traditional classroom learning, tutorial with the developed courseware and web-based learning will help the students in learning MET. The paper reports the effect and influence factors we adopted BL in our teaching and student's learning.

2 Blended Learning Concept and Need at Universities

Blended learning (BL) or hybrid learning describes a learning environment that either combines teaching methods, delivery methods, media formats or a mixture of all these. It also refers to the integrated learning activities such as a mixture of online and face-to-face learning. In other words, BL is a mixture of e-learning and traditional types of learning. It is mentioned as the integrated combination of traditional learning with web-based online approaches, the combination of media and tools deployed in an e-learning environment and the combination of a number of pedagogical approaches. elaborated BL as a set of learning strategies or dimensions that mixes various event-based activities, including traditional instructor-led training, synchronous online conferencing or training and asynchronous self-paced study.

BL means many things to many people, even within our relatively small online learning community. It is referred to as both blended and hybrid learning, with little or no difference in the meaning of the terms among most educators. In general terms, BL combines online delivery of educational content with the best features of classroom interaction and live instruction to personalize learning, allow thoughtful reflection, and differentiate instruction from student to student across a diverse group of learners.

The Blended Learning environment is the teaching-learning environment that is becoming increasingly more common at universities and life-long educational institutions. In general, BL refers to an optimized strategic learning process (Mantyla, 2001) that mixes at least two learning strategies.

Adoption of BL in universities integrates the e-learning method to the existing lecture-centered classes to complement the limitations of the latter with the end result of optimizing the effect of teaching-learning. In other words, BL presents flexibility that can cast away teachercentered standardized education to support student-centered self-initiated learning (Khan, 2005).

As a means for effectively integrating lecture hall-centered education and e-learning, Khan (2005) proposed that it is necessary to consider eight factors when planning BL – the institution, strategy, technology, interface design, evaluation, management, providing resources and ethics. This is indeed emphasizing the notion that diverse elements need to be reviewed to provide a meaningful learning environment.

Moreover, Driscoll (2002) proposes diverse strategies for the application of diverse BL methods including conducting and grading tests or evaluations online, the use of a community to share student questions, discussions and thoughts, presenting reference materials for learning on the web, and enabling the students to obtain the latest data.

These strategies are resourceful for the design, operation and management of blended learning classes, and they are organically interrelated. However, although these researches present ways to use BL, they are not able to present detailed strategies for the effective adoption and operation at universities.

3 Research Objectives and Methodology

3.1 Research Objective

Some people have realised the importance of BL in education, and some universities become do some practices in using BL in network education in Chinese mainland, such as there are some courses teaching using blended learning merhod in the network education college of Shanghai Jiao tong University, Beijing University of Posts and Telecommunications, Beijing Normal University etc.. But at present, BL is more emphasized on introducing and discussing theoretically and few applied in practice. Since there are few study on whether BL is feasible in Chinese education and how to get started BL when the specific subject is concerned, my study is going to research the feasibility and application of BL in college MET curriculum teaching.

The specific objective of this study is to research the application of BL used in college MET curriculum teaching, and learning. The specific survey questions are as follows:

- (1) What is the present situation of students in using computers and the Internet?
- (2) What is students' attitude toward present MET curriculum teaching and learning?
- (3) What is the tendency of MET curriculum students' learning style?
- (4) What is the tendency of MET curriculum students' communicating style?
- (5) What is the present situation of MET curriculum teachers in using computers, Internet and other information tools?
- (6) What is the present situation of MET curriculum teaching and learning?

3.2 Research Design

According to the literatures we have studied, BL is a kind of learning which combines online and face-to-face(F2F) approaches. So the realization of BL depends an both students and teachers' convenience of using of computers , the Internet and other information tools, students' learning style, the tendency of communication and teachers' concept on technology. Therefore, we designed a questionnaire to know about students' conditions of using computer and Internet and students' learning style, the tendency of communication, etc. A semi-structure interview is conducted among teachers to know about teachers' current situation of using computers and the Internet and their cognition on technology in teaching. The present study employs a multidimensional approach for data collection combining a qualitative and a quantitative research design.

Two different research methods are adopted in the present study: survey (quantitative research) and interview (qualitative research) to collect data.

The questionnaire we designed has a series of questions or statements to which subjects individually respond. A questionnaire can gather many discrete pieces of

information about individual attributes such as attitudes, values, habits, and background characteristics including age, education, and income (as cited in Seon-hwa Eun, 2001).

After the survey have been finished, five MET teachers are conducted as the interviews in order to know about their current situation in the application of education technology and solved some problems met in MET curriculum teaching. These teachers use the same courseware, the web based instruction platform and the same blended learning approach.

The strength of an interview lies in providing a great deal of information gathered directly from the respondents. Further, an interview is much more flexible and open in form than survey, because the respondents are free to answer in their own words and can answer either briefly or at length during the interviews.

3.3 Subject Selection

The target population for the present study is teachers and students in Suzhou University of science & technology.

3.3.1 Questionnaire Participants

Since some questions in the questionnaire is concerning about students' access to computers and the Internet, only the sophomores are chosen because they have been familiar to the environment and can find the most convenient way to use the internet. In order to avoid the influence by their major, the participants come from four departments. 15 participants are from the department of Chinese; 15 from the department of chemistry; 15 from the department of geography and 15 from the department of physics.

3.3.2 Interview Participants

All the interview participants are MET curriculum teachers in Suzhou University of Science & Technology. Their ranks range from teaching assistant to professor. Five teachers participate in the interview, three lecturers, two associate professors. All these teachers teach MET curriculum. Both of them have rich experience in teaching the MET curriculum and participate in the producing and revising the multimedia courseware we used, and two of them and participate the writing the textbook which we have used.

3.4 Data Analysis

3.4.1 Questionnaire

In the data analysis phase, we mainly used the descriptive statistics like frequency, percentage, central tendency (mean) and variability (standard deviation, rank) through the SPSS for Windows software. Those responses were numerically coded and interpreted based on the mean scores of each item.

The items in Part One, which consisted of dichotomy questions and blank fillings questions, could not be summated to constitute one variable, so assessing reliability for the Part One was not possible. Data in this part was analyzed with descriptive statistics such as frequency and percent.

The data analysis in Part Two was divided into three steps-item analysis, reliability check, and descriptive analysis.

3.4.2 Interview

As for the information got from the interview, it was used to compensate the information from the questionnaire. Through the interview, we read questions for each participant, reflected on the meaning of what she heard from them. For multiple-choice questions, the researcher put tick on the choice they made and took notes according to their main idea for open-ended questions.

The data collected from the interview was analyzed in two ways. The multiple choices were analyzed through descriptive statistics such as rank and frequency. The answers to the open-ended questions were quoted indirectly or summarized according to the research questions.

4 Results Description and Analysis

4.1 Results of Questionnaire

According the data analysis of questionnaire, we can draw the some results as following.

1. The Present Situation of College Students' Using Computer and Internet

Students spent their most time consulting materials (91.4%) and chatting on line (75.58%). 68.9% students received and sent E-mail. 64.5% students processed words. 90% students surfed on line. Only a small percent of students used BBS (54.3%)and Blog (8.5%).

Students had very convenient access to computers. The survey found that almost all the students could use computers if they wanted. Most students used computers in computer lab on campus, which suggested that this college had a good condition of hardware almost enough to meet students' demand. 55.2% students went to the net bar. Even 42.5% students had their own computers, and this percentage would increase with the decrease of the price of computer (see Table 1).

Table 1. Frequency, Percentage and Rank of the Present Situation Of Using Computer and the Internet

Questions	frequency	percent	rank
I often use:			
E-Mail	41	68.9	4
word processor	39	64.5	5
Consult materials on line	49	82	3
Surf the web	54	90	1
BBS Discussion	32	54.3	6
Blog	5	8.5	7
Chat on line	51	85.5	2
Access to Computers:			
I have my own computer at home	25	42.5	3
I use the computers in the net bar.	33	55.2	2
I only use the computers at school.	54	90.5	1
I have never used a computer.		0	4

52.3% students spent 1-5 hours per week on line; 35.2% students spent 5-10 hours on line, 9.6% students spent less than 1 hour on line, 2.9% students spent more than 10 hours on line.

26.5% students spent less than 5 hours per week on computer, 39.4% students spent 5-10 hours per week, 34.1% students spent more than 10 hours per week.

2. Students' Attitude toward Present MET curriculum Teaching and learning

(1) Students' Perception of the Present Teaching and learning

"I hope teachers can often change their teaching method" got the highest mean score 4.63, which implied that students felt that MET curriculum were dull or at least couldn't motivate them. "I'm satisfied with the present teaching method " and "I don't like attending MET curriculum because of its dullness " seems to be contrary, but this shows that students were careless about MET curriculum class, which may be because they had no right to choose what they wanted to learn and didn't know what they needed to learn.

Students still felt that the present teaching helped to improve their understanding and application of educational technology. The results mentioned above displayed that students seldom participated in class lecture activities and communication with others. But why did they agree that the present teaching helped to improve their knowledge or ability of using the MET? The only explanation is that the online courseware worked. Self-study in computer lab fostered students self control.

(2) Students' Perception of Teaching and Learning Materials

Teaching and learning material is one of the most important part for the blended learning practice in MET curriculum. Most students agreed that the content of the courseware was rich and interesting and the content of textbooks is interesting . Still students agreed that the use of the courseware in this curriculum made it more interesting. Students also agreed that they still learned MET besides textbooks. But time practicing MET because of the use of courseware students disagree that they spent and learning more MET because of courseware . All these showed that even interesting materials might fail to motivate students to study and meet the objective. So teaching model and instructional design of the curriculum is the key part to making the materials functional. (see Table 2)

Table 2. Mean, SD, Rank of Students' Perception on the Teaching and Learning Materials

Questions	Mean	Std. Deviation	Rank
The content of the courseware is rich and interesting.	3.75	.87	1
I'm interested in the content of the textbooks	3.42	.93	2
The use of the courseware in this curriculum made it more interesting	3.37	.94	3
I learn Met sometimes from other Met materials.	3.32	.92	4
I spent more time practicing Met because of the use of the courseware in this curriculum.	2.56	.93	5
I learned more Met because of using the courseware.	2.53	.88	6

3. The Tendency of Learning Style

As for the tendency of learning style, students were more likely to study by themselves than through cooperation with their classmates , but this also showed that they

could accept both way of learning. The result of the total of questions implied that learning styles of students were diversified. Even they didn't like to participate in class activities, but they could accept the concept of cooperative learning.

4. The Tendency of Communicating Style

In our teaching practice, students didn't like to ask teachers questions privately; nor did they like to ask teachers questions during the class . Even through BBS and E-mail they still didn't like to solve problems and communicate with teachers and classmates. All these demonstrated that students didn't like to communicate with teachers in any way. Even though they had the tendency to cooperate with classmates, they were willing to solve them themselves or just left them there when they met problems.

The lack of interaction and unwillingness to communicate with others in MET curriculum would lead to the low level of communicative competence. (see Table 3)

Table 3. Mean, SD, Rank of Communication between Teachers and Students and among Peers

Questions	Mean	Std. Deviation	Rank
I would like to ask teachers questions privately.	2.88	.90	1
I would like to ask teachers questions at class.	2.67	.86	2
I learn Met sometimes from other Met materials.	2.38	.82	3
I would like to communicate with teachers and classmates through e-mail or BBS.	2.20	0.78	4

4.2 Results of Interview

1. The Present Situation of Teachers' Adoption of Computers and Internet

From the results analysis of the interview, the five teachers all agreed that they had convenient access to computers and Internet. The things they often do on the computer and Internet were word processing, consulting teaching materials, editing PPT courseware, sending and receiving e-mail, participating the discussion on BBS, editing Blog and chatting. The frequency of doing things an computer or Internet was as follows (from most often to least often): word processing, consulting materials, sending e-mail, editing courseware by themselves, BBS, Blog, or chatting on line.

2. The Present Situation of College MET curriculum Teaching

This research question is divided into 4 sub-questions. The results of them are outlined as below.

(1) The Application of Technology in Teaching

All teachers adopted multimedia courseware in their college MET curriculum teaching(including the PPT document and other multimedia learning resources). All teachers chose MET curriculum materials on the Internet to complement the textbook. Four teachers conducted some teaching activities by E-mail. Three teachers communicated with students about MET curriculum study through BBS or E-mail. All of them instruction through web pages aided with the web based instruction platform (see Fig1).



Fig. 1. interface of the MET web based instruction platform

(2) The Way of Improving Students' Communicative Ability

Own to their students lack of communicative activity, the five teachers used to improve students communicative ability were presentation, debate, creating some situations for students to communicate with each other. All of them agreed that students were not active in taking part in these activities. They seldom took some other ways such as E-mail or chatting on line. The reasons were that they felt it took time to design activities and the present situation was not good enough to adopt these ways.

(3) The Choice of Teaching Materials

As a MET curriculum teacher, they have rich knowledge and media processing skills. The five teachers thought that the textbooks were not interesting. So they sometimes chose some materials outside textbook to complement their teaching. These materials were mainly from the Internet and other media styles. The standard to choose these materials was to be appropriate to MET level of students, to be related to the content of the text they learn, to increase the interest of class.

(4) The difficulties in the Adoption of Computers and Internet

Although they have more experienced, they also meet some difficulties in their using computer and the internet in their teaching. All the teachers thought that the hardware and software was not good enough to support their teaching and learning, the speed of net was not fast and teachers had not enough skills and experiences in integrating computers, the Internet and other forms information technology in teaching. Especially, teachers thought that it was not easy to control student's study since students often did some other things on the computer.

5 Conclusions

Through the survey of students and interview with teachers, both teachers and students spent their most time online in consulting materials, chatting, and sending e-mail. Both teachers and students seldom used BBS and Blog. But the big difference between teachers and students was on chatting online. Students almost spent their most time on it but teachers spent a little time on it.

All the teachers used multimedia courseware in their teaching. Students gave high evaluation on the courseware, but they didn't think their MET knowledge and skills was improved through the use of courseware. The researcher thinks that although the courseware can improve the interests of teaching and learning, the instructional value of the courseware may be poor. Some published courseware in fact are the copy of textbook decorated by some pictures and sound but lack of interaction and flexibility. So teaching and learning language shouldn't depend on courseware too much.

Teachers often adopted teaching methods such as text explanation and group discussion. Students gave positive evaluation on teaching method, but they still hoped that teachers could often change their teaching model. This shows that students have high demand on teaching. The diversified teaching methods not only avoid dullness but also meet the needs of students.

There are some discrepancies between students and teachers in learning styles. So teachers need further investigation into students' learning styles to ensure that all students are able to complete their curriculum successfully.

Own to the students didn't like any ways to communicate with teachers and students about MET study. Teachers need to designed some activities to encourage the interaction.

According to these results mentioned above, we can see that it is feasible to carry out BL in college MET curriculum teaching since both teachers and students have convenient access to computers and the Internet and basic skills to surf online. In addition, it is necessary to take the model of BL since students are not satisfied with courseware and the unchangeable teaching, especially students have the willingness to study by themselves.

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A Multimedia Instructional Environment for English Learning

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Abstract. The paper explores the effects on learning of English as a first foreign language by utilizing the multimedia equipments, including personal computer (PC), digital video recorder (DVR), projector, and dual integrated viewer (DIV), to present the recording/recorded learning activities as learning materials in a classroom environment. An experiment was applied to two groups of third-grade students in the elementary school in Taiwan. The singular and plural forms of English vocabularies were presented as the learning content. Learning environment of the conventional group was in a traditional classroom setting with whiteboard teaching. The second group was in a multimedia learning environment with projector to display the computer slides on the screen and an extra digital video recorder to capture the student's mouth shape. The result showed that the experiment group performed better than the conventional group on learning effects. Consequently, the finding supports the use of multimedia equipments in classroom learning environment.

Keywords: Information technology, multimedia learning, presentation and interaction.

1 Introduction

Language learning is a vivid and systematic activity and instructors have to plan their teaching in advance. On the basis of modern English pedagogy, the methods and techniques employed by the instructors play an irreplaceable and significant role in English teaching. With adequate teaching aids, the instructor can organize English teaching class lively and efficiently.

In traditional English teaching classroom, the instructor often applies more text-centered presentation on a whiteboard and the students read directly following the instructor. However, individuals learn a second language with different senses. For example, some learners are more visual-oriented and others are more audio-oriented [1]. According to dual coding theory (DCT) [2][3] and multimedia learning theory [4], which are built on the use of verbal and imagery representations in associative learning, learning from words and pictures leads to a general improvement in learning. These

verbal and imagery systems have been linked with the left and right hemispheres of the brain, respectively [5]. Tufte argued that the visual representation can communicate complex ideas more clearly and efficiently [6]. Van Someren, Boshuizen, de Jong, and Reimann suggested that the educational representations should be developed to utilize this multimodality approach to allow learners to learn by exploring and linking different modalities [7]. Also, some research literatures show supporting evidence that memory for some verbal information is enhanced when paired with a visual image, and which leads to deeper understanding [8][9][10][11].

Due to the impact of information technology on society and education, multimedia becomes an increasingly important part in English teaching. The academia pays much attention to use multimedia devices to effectively improve the instructor's teaching ability and the student's learning performance in the classroom English learning environment. Multimedia applications are able to provide both visual and auditory channels for learning. However, some studies do not entirely support the effect of the use of verbal and imagery representations in learning [12][13][14]. Churchill and Hedberg suggested that in the design of a learning object more emphasis must be put on the leverage of visualization and interactivity than text and audio [15].

Frequent interaction is crucial in learning processes. Classroom interaction is one of the most important educational activities [16]. Allwright considered interaction as 'the fundamental fact of classroom pedagogy' because 'everything that happens in the classroom happens through a process of live person-to-person interaction [17].' Observing the interactional events happen in a classroom makes it possible to understand how learning opportunities are created. Instructors need to move toward more meaningful interaction and ensure that classroom interaction is managed not just by the instructor, but by all participants. In a traditional classroom learning environment, the instructor normally employs question-answer drills method to improve the interaction and to provide learning feedback. Feedback is intended to acknowledge the progress that students have made toward achieving the learning outcomes of a unit. Providing a mark or a grade only, even with a brief comment is rarely helpful. Tufte argued that technology made interactivity possible to significantly expand the representational power of visual displays [6]. Hattie and Jaeger stated that positive feedback focused on the assignment has a positive effect on a learner in terms of attitude and achievement [18]. Timely, relevant, meaningful and encouraging feedback is most effective and can help a student better achieve learning goals [19][20]. Providing opportunities for practice and graduated feedback would enhance student engagement in the learning process and student success to create knowledge [21].

An effective multimedia presentation and interaction can enhance the learner's learning motivation, learning will, self-confidence and even learning performance when it is operated in coordination with the curricular and methodological innovation. Additionally, implementation of an effective teaching and learning process should be based on comely educational theories. In a teaching process, although what we interest is the added value of certain technologies will bring to the learning, great emphasis must be placed not only on the technical skills involved in teaching with technology, but also on the importance of the pedagogical concepts behind using those skills. Vermetten et al. mentioned that a power learning environment embedded with adequate

educational theories can improve the learning efficiency and validity [22]. Accordingly, an integrated model with feedback and interaction mechanism that is adjustable to meet the needs of individual instructors, researchers, and students is demanded urgently. In this study, the authors proposed a presentation and interaction (P & I) instructional model that integrated both of the information technology by utilizing the multimedia equipments, including personal computer (PC), digital video recorder (DVR), projector, and dual integrated viewer (DIV), and educational theories - Dual Coding Theory (DCT) and multimedia learning theory - to promote the presentation skills of the teacher and interactive behavior between the participants. We believe that this P & I instructional model would improve the classroom English teaching quality and learning performance. The sketch map of the model is shown in Fig. 1.

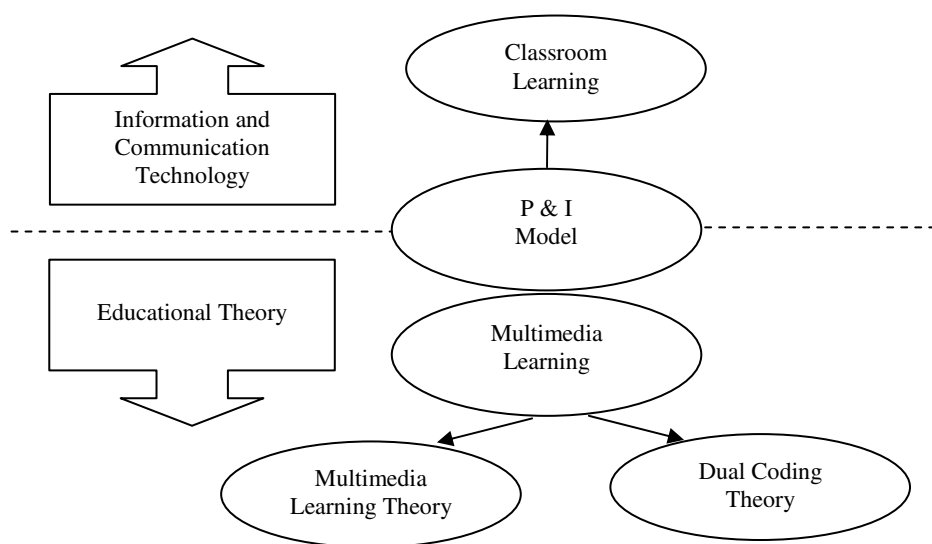


Fig. 1. The multimedia presentation and interaction model

This research, based on the dual coding theory and the multimedia learning theory, uses Microsoft PowerPoint software to generate presentation materials and considers using video technology as a means of collecting learner's mouth-shape to provide prompt feedback on English learning. We believe that the P & I instructional model environment proposed by this research can encourage better class preparation by students and thus improve the student's learning performance.

2 Literature Review

2.1 Multimedia Learning Theory

With the rapid growth of Internet and the advent of computer technology, it is an explosion in the availability of visual ways of presenting material, including on-screen

texts, words, pictures, animations, audio and video. In such a situation, learning from words and pictures was called multimedia learning [4]. There has been an increasing amount of multimedia research that is grounded in cognitive psychology includes the work of Richard Mayer [4][9]. Mayer grounded the majority of his multimedia work on an integration of Sweller's cognitive load theory, Pavio's dual-coding theory [2], and Baddeley's working memory model [23]. Mayer defined multimedia as the presentation of material using both words and pictures and thus focused on the auditory/verbal channel and visual/pictorial channel.

2.2 Digital Video in Learning

With recent advances in multimedia and communication technologies, digital video recorder has become a productive and powerful medium in education. It can be utilized to capture the teaching and learning process and also offer the off class learning. The adoption and success of this technology depends on learners' acceptance of this learning format.

Prior research has found that video is able to support the processing of linguistic information and facilitate language comprehension [24] as well as vocabulary acquisition [25]. Further studies reported positive effects of instructional video [26] on learning outcomes. Tschirner argued that digital video may be used for presentation and practice in classroom to provide foreign language instructors and learners with effective means to make language acquisition [27]. Zhang et al. reported that interactive video could enhance both learner engagement and learner satisfaction in e-learning [26]. In classroom English learning, words, phrases and sentences need to be perceived clearly and practiced productively. Video may be used to provide words, phrases, sentences within a concrete situation. Language learning does not occur as a result of the transmission of learning content and lecturing and recitation are not the most appropriate means of English learning. Davies and Pearse [28] suggested that successful English teaching should think mostly in terms of learner practice, not teacher explanations. The non-English native speakers need continuous and efficient practice to gradually build up their self-confidence and improve their performance. Most of the prior studies, regardless of the use of interactive or non-interactive video, reported higher levels of learner satisfaction than learning without video. However, most of those studies examined the influence on education by using the recorded video in a distance learning environment instead of using the live video in a classroom learning environment. In traditional English teaching classroom, most of the students can only observe the instructor's face, even if one student is assigned to answer the question. The instructor is often the center of classroom interaction. In order to avoid being the center of classroom interaction, the instructor should arrange an environment in that the students can look at each other directly, or at least the one who is replying to the instructor's request. This helps create more interaction among the students. Teaching quality can be observed from the attention and interest shown by the learners. Holding the learners' attention and active participation are essential in English language teaching, as in all other teaching [28]. The objectives of teaching should be reachable and apparent to the learners. For example, you may decide that it is useful to get the learners to

memorize some irregular plurals of nouns, and empower the learners with transferring ability as they encounter the problem of answering the plurals of other nouns. Therefore, the goal of teaching should emphasize in stimulating the learner's interest in English learning to achieve the quality-oriented education. At this stage, there are very limited guidelines suggesting effective design considerations for using live video in classroom learning environment. Hence, the effect of interactive live video on classroom learning is still not well understood.

2.3 Learning Feedback

Feedback is any response made in relation to students' work and is intended to acknowledge the progress that students have made toward achieving the learning effects. It can be given by a teacher, an external assessor or a student peer. It is usually spoken or written. Feedback is probably the best-tested principle in psychology. Good feedback is focused and constructive, points students to ways in which they can improve their learning and achievement, so that students have an opportunity to act on the feedback [29].

Benson, Mattson and Adler defined feedback as any procedure used to inform a learner of the degree of appropriateness or correctness of a response to an instructional stimulus [30]. Feedback comes in many forms. Clariana and Smith [31] suggested that higher ability students can gain additional messages and benefits from attentive and explicit feedback. With the assistance of computer-based instruction, teachers can offer greater variety of possible feedback strategies to optimize learner performance [32]. Hattie and Jaeger stated that positive feedback focused on the assignment had a positive effect on a learner in terms of attitude and achievement [18]. Timely, relevant, meaningful and encouraging feedback is most effective and can help a student better achieve learning goals [19][20]. Another research finding reports a direct and positive correlation between frequency of feedback and learning [33]. Providing opportunities for practice and graduated feedback would enhance student engagement in the learning process and student success to create knowledge [21].

Some examples of unhelpful feedback include unfocused comments, dismissive and sarcastic comments, comments that 'pass the buck', and comments sending mixed messages [34]. Feedback is essential to the learning process. Feedback needs to be timely: given early in a unit, or promptly after assessment tasks, so that students have sufficient opportunity to use the feedback for improving subsequent performance.

3 Method

3.1 Design of Learning Activity

In an English teaching process, the instructor usually requests the oral interaction activity and expects the other students can also learn and profit by the interaction. The aim of this study was to evaluate the effects on English learning by utilizing the multimedia equipments, including personal computer (PC), digital video recorder (DVR),

projector, and dual integrated viewer (DIV), to present the recording/recorded learning activities as learning materials in a classroom environment. Two phases of experiments were applied to two groups of third-grade students in an elementary school. The singular and plural forms of English vocabularies, which were extracted from the English learning area of General Guidelines of Grade 1-9 Curriculum of Elementary and Junior High School Education published by the Ministry of Education of Taiwan, were presented as the learning content in the first phase. In the second phase, one article selected from textbooks, which were appropriate for the third-grade curricula of Taiwanese students to read aloud, was used as the learning content.

Learning environment of the first group was in a conventional classroom setting with whiteboard. The experiment group was in a learning environment with projector to display the computer slides on the screen. Additional, an extra digital video recorder was used to capture the practitioner's mouth shape, and an integrated tool (DIV tool) was used to integrate the output from notebook and digital video recorder into the projector to show on the screen. With the integrated projection every student could observe the practitioner's mouth-shape while he was replying to the request from the instructor. Aside from the peer learning, the practitioner could be aware of what he answered and with what kind of attitude as he responded to the instructor and other classmates. This self observation behavior, one of the three steps of self regulation, will be beneficial for controlling the human behavior [35]. Also, with the prompt feedback given by the instructor, the practitioner would then be able to improve the abilities of mimicry, memorization and make more effective practice. Giving prompt feedback to

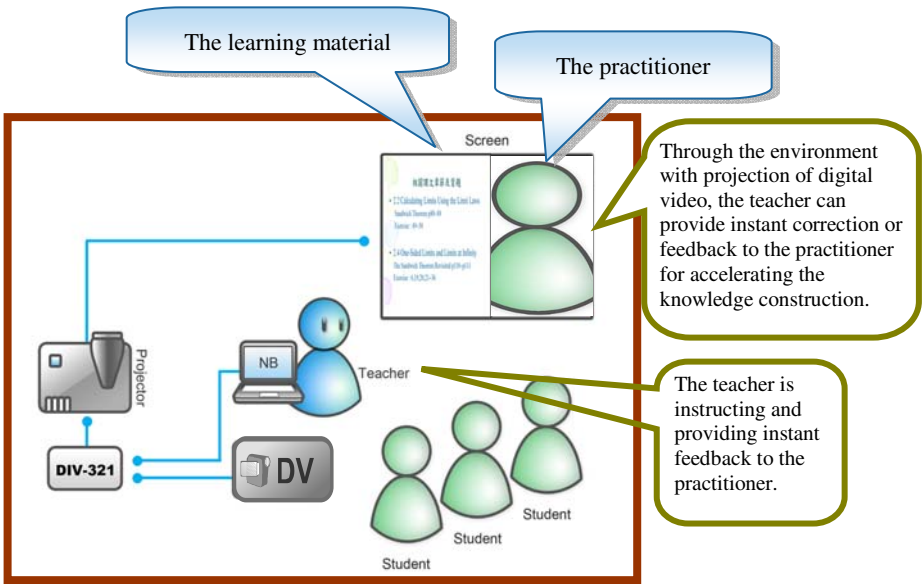


Fig. 2. The multimedia presentation and interaction instructional model environment



Fig. 3. A sample of dual-coding presentation-PowerPoint slides and recording video

student is one of the seven principles for good practice and is helpful in improving teaching and learning [36].

In order to make better use of the DVR, the teaching, learning, and interaction processes were also recorded and could hence offer a more complete reproduction of learning scenario for further review. Fig. 2 depicts the presentation and interactive teaching structure for c-Learning instruction feedback mechanism. Fig. 3 shows a sample of dual-coding presentation and interaction with PowerPoint slides and recording video.

As we mentioned above that the purpose of this study was to evaluate the effects on English learning by utilizing the multimedia equipments including a DVR in a classroom environment. However, most of the previous studies examined the influence on education by using the recorded video in a distance learning environment. Hence, the effect of interactive live video on classroom learning is still not well understood. In this study, we produced a sample lecture series and tried to discover whether the video technology would improve student's retention and transfer abilities. In the first phase, a hard copy of the English vocabularies was considered as textbook function for two weeks lectures and would be given to the two groups of students at the first lecture. The lecture material (handouts) was organized in the matrix style (Table 1) and would be given to the two groups during the lectures. After each lecture, students in the second and third groups would be offered a hard copy of the PowerPoint slides. In the second phase, a hard copy of reading aloud article was considered as textbook function for one week lecture and would be given to the two groups of students.

Table 1. A Sample of handout

	Singular		Plurals		Chinese
oo → ee [u] [i]	foot	[fʊt]	feet	[fi:t]	足
	goose	[gʊs]	geese	[gi:s]	鵞
	tooth	[tuθ]	teeth	[tiθ]	牙齒
an → en [æ][ə] [ɛ] [ə] [ɪ]	businessman	[ˈbiznɪsmən]	businessmen	[ˈbiznɪsmen]	商人
	fisherman	[ˈfɪʃəmən]	fishermen	[ˈfɪʃəmen]	漁夫
	gentleman	[ˈdʒentlmən]	gentlemen	[ˈdʒentlmən]	紳士
	man	[mæn]	men	[men]	成年男子
ouse → ice [aʊ] [aɪ]	mouse	[maʊs]	mice	[maɪs]	鼠

The focus of this study was to build a “referential connection” by using “mouth-shape” as image-based mnemonics to enhance the abilities of memorization, transfer and comprehension. Based on Wang and Thomas’s study, image-based mnemonics were superior for immediate recall than rote learning [37][40]. The instructor would encourage students to practice the pronunciation of these vocabularies and ask students to discuss and identify the differences of the mouth-shape between the instructor’s and the practitioner’s. In the second phase, the instructor would encourage students to read aloud the article and discuss the meaning of the content. We assume that through the peer learning most of the students will learn more efficiently thus the frequency of correction will be reduced.

3.2 Assessment

English is the first foreign language in Taiwan. Students at the third grade begin to learn English listening and speaking in elementary school. A total of 64 third-grade pupils consisted of 26 males and 38 females from a rural elementary school participated in the study. These pupils were recruited and randomly assigned to the two groups. Pupils range in age from 9 to 10 years (*Mdn* = 9.6). During this initial phase, the pupils had to complete a prior questionnaire that contained 10 questions of English vocabularies. Their performances on this prior knowledge questionnaire determined whether or not they could proceed to the following phases of the study. Thus, participants who obtained a score better than 5 points out of 10 in the pre-questionnaires were considered to possess too much prior knowledge and were consequently excluded from our analyses. A week after the three lectures, all participants were required to take examinations for two phases. The first test was to evaluate how many irregular plurals of nouns they could remember and transfer. In this paper, the learning effect of a learner was measured with 20 items. The process of test is that pupil points out which word in a list of words while he hears the sound of the target word. (e.g., sound “woman, women”, point and pronounce it women). The participants are asked to recognize 20-pairs printed words. The test is modified from the originally developed test [38]. Additionally, this

research uses questionnaire to survey whether the multimedia presentation and interactive teaching structure will have impact on student's learning attitude in behavior components [39]. This study focuses on the examination and analysis of student's learning concentration. The second test was to reckon how many percent of the article they could understand.

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4 Result

The use of multimedia equipments as a tool makes it possible to improve the subjects' performances in terms of the memorization of irregular plurals of nouns, the transfer of knowledge and the comprehension of articles, when compared with the traditional classroom learning environment. Our empirical study examined the influence of live digital video on learning outcome in the classroom learning environments. The result shows that the average score for the experiment group is 87.19 ($SD = 6.90$) and the conventional group is 82.56 ($SD = 11.88$). The result shows that the experiment group performed higher than the conventional group.

5 Conclusion

Cognition is such a powerful ability in human learning. Our goal is to study the process of memorization, explore the techniques to engage better understanding and applying quality, and integrate our discovery to design appropriate instructional strategies for the creation of a high quality learning environment. The presentation and interactive teaching method is already designed for English learning. The students are indeed impressed by the interactive features after study. Future research should investigate the potential of its use in the classroom. The differences between classes may have different results. We can observe the interaction in these classes and evaluate the method.

Acknowledgements

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Long Distance Learning for Under-Developing Countries Using Replicated XML Database System*

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Abstract. Education can improve the quality and production of the people in a country in a long run, which is especially important in under developed countries. Besides, there illiteracy rates in remote districts in People Republic of China are still high. Deficient transportation and communication are common in these areas, and it is therefore necessary to resolve these two critical issues. As education involves exchanging large amount of teaching materials, such as course materials, assignments, questions and answers, between educators and learners, XML is a preferable document format for these materials and XML database is therefore a preferable storage and retrieval facility. For remote districts, it is preferable to have regional offices that handle the teaching materials, and each regional office should be equipped with an XML database and the entire education framework is supported by XML databases installed in the university, the regional offices and student machines, and the document exchanges are to be implemented by replication. This paper addresses the issues related to supporting long distance learning by resolving the communication and transportation problem with a loosely connected XML database system with replication.

Keywords: Long distance education, e-learning framework, XML, replicated XML database.

1 Introduction

Many countries in the world are still under developed. Many people in those countries are still living in remote districts or villages where the transportation and communication systems are still under development. Therefore, for children and teenagers who want to further their studies, there are almost no choices. On the other hand, distance learning is a preferable learning approach for them, because students can acquire the knowledge at their own paces by studying the course materials, and it is not necessary for both the learners and teachers to travel.

If a university in such under developed country is dedicated to provide distance learning services to people who are living in remote districts, there are several possible arrangements, such as the followings:

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1. Individual students communicate with the university directly.
2. Students are living in villages that cannot communicate with the university directly, but several such villages are attached to a large village that has a regional office. Then, it can coordinate the distribution of the course materials and assignment submissions.

Regarding the communication approaches, there are several possibilities, such as,

1. Postal service whether all course related materials are handled in hardcopies. It is the last resort in case there are no suitable telephone line networks implemented in the country. If individual students can have a computer, such as a computer provided by the One Laptop Per Child (OLPC) project [1], a USB flash disk would be a preferable media for carrying the materials on the way via postal.
2. If there are telephone line networks, it is possible to transfer the course related materials electronically. Besides, there are two possible arrangements. If there are Internet Service Providers (ISPs) providing Internet services, individual students or regional offices can subscribe the services for generic Internet accesses. Otherwise, the university can implement a modem pool so that individual students and regional offices can dial up to the modem pool for solely communication with the university.

You can see that there are several possible scenarios that may occur. These scenarios suggest that there are two key issues to addresses:

1. Document formats – there are various course materials, such as lecture notes, journal papers, quizzes and examinations from a university and the questions and assignments submitted by students. As such, it is necessary to standardize the document format so that a software application can handle them properly.
2. Synchronization – the course materials must be replicated into individual students' computers or at least to the regional office so that students can synchronize their computers with the server located at the regional office.

This paper will propose a solution that addresses the above two issues so that universities can provide distance learning service in those under developed countries.

2 Proposed Solution

To handle the first issue, course materials in softcopies are mostly in Portable Document Format (PDF), Microsoft Office suite formats (such as Word, Excel and PowerPoint). These formats are proprietary and need special software to read them. On the other hand, XML is standard and open format, and there are XML standards (or schemas) for various document formats, such as OpenDocument [2] and DocBook [3]. For other documents to be transmitted, such as questions and answers, discussion messages and so on, it is necessary to propose a new set of XML vocabularies for them.

Regarding the second issue, synchronization, every computer involved in the system embeds an XML database. As such, it is necessary to implement an automatic synchronization mechanism for XML database, so that changes in one of the databases will propagate to the other XML database as well. There are several types of computer involved, which are,

1. Student computer – a desktop or laptop/notebook computer, or even a low-end OLPC machine, which is used by students for their own learning purposes.
2. Regional office computer – a computer that resides at a regional office that serves the students who are accessible to the office.
3. University central computer – the computer that consolidates all changes from individual computers and regional office computers.

For all computers involves, it is possible to deploy an XML database to each of them, which is for maintaining the documents and messages for the related students. For example, the XML database hosted on student computer is maintaining the messages/documents for the student only, the regional office computer is responsible for maintaining all messages/documents for all students that are entertained by that regional office. For the XML data hosted in the university, it maintains the data for all students. With such arrangement, the XML databases can be considered to be a replicated XML database system, and the synchronization of the XML databases are illustrated in Figure 1.

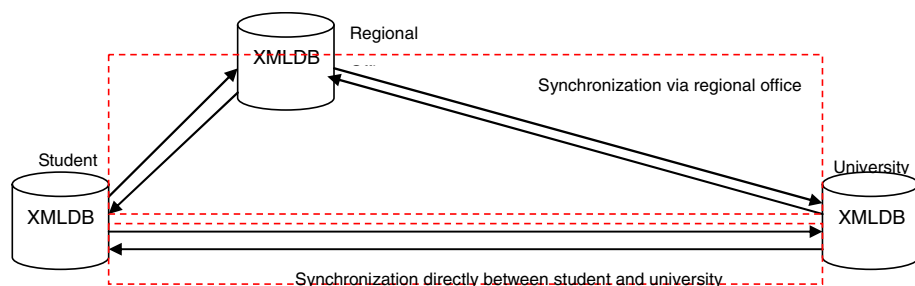


Fig. 1. Data synchronization among XML databases

The machine that a student uses is equipped with a software application that makes use of the XML database for reading course related materials and assignments submissions. After submission, the student can perform an **export changes** that exports an XML document for the changes by the student. Such XML document for the changes can be stored in a USB flash drive or a CD (preferably a rewritable CD). There are two possible approaches to synchronize the changes to the university.

Direct synchronization

The storage medium that stores the XML document for the changes are sent to the university via postal, and a university staff can retrieve the changes from the XML document to be updated to the university XML database. On the other way round, the changes in the university XML database are exported as an XML document that is stored on the same medium to be sent back to the student via postal.

Synchronization via a regional office

If the postal costs at the remote districts are not affordable by individual students, the students can go to a regional office of the university, which is equipped with a machine that can retrieve the changes of individual students from their storage media,

and consolidate an XML document for the changes of all students. Such consolidated XML document is sent to the university for synchronization, such as by postal or narrowband, if any. On return, the university exports all changes for all students that are served by such regional office by either postal or narrowband connection. Afterwards, individual students can synchronize their own computers by getting the changes from the regional office with a portable storage medium, such as a USB flash disk. Then, connecting the student computer with the USB flash disk, the changes are synchronized to the XML database hosted on the student computer.

While designing the system, the following factors are considered:

1. Availability of communications – For remote districts, the transportation system is inconvenient and it is most probably no direct telephone lines to the outside world, not to mention Internet connection. Therefore, the transmissions of changes must be designed to work with the baseline communication or transportation services, such as postal. Therefore, the updates of the changes must be feasible with an off-line approach.
2. Cost of communications and transportation - Students may not be affordable for the postal cost, as there may be frequent communications with the university. Therefore, a regional office set up by the university or one student among all students who live nearby can serve other students by playing the role of the message exchange hub. The changes by all students are extracted and consolidated and the XML document for the changes involve all students entertained. Then, the XML document for all changes are sent to the university via postal or by a narrowband Internet connection with the Internet or direct modem-to-modem connection with the university modem pool through a telephone number would be adopted.
3. Openness of the document – Among all existing document formats, XML is currently a most common used format that can serve various purposes. Then, all the messages and documents can be consolidated in a single format for transmission purposes, whereas it is converted into a desired format that suits the manipulation of the data. For example, XML data for an assignment questions can be transformed by a pre-defined XSLT or CSS for display purposes.
4. The use of XML database – In case all messages and changes are stored in XML format, use an XML database can maintain all these data and the students can have a single point of reference for their studies. Besides, the XML database serves as the single point of reference so that a student can always search all course materials in the XML database.
5. Synchronization approach – The changes by any involved person do not change any previous XML data. For example, submitting an assignment create new XML data for the answers that are to be transmitted to the university, disregarding the means used. On return, when the assignment marks, comments are prepared by a teaching staff, they are new XML data to be returned to the student and append to the students' XML database. Therefore, all changes are creation operation, and there are therefore no dependencies among the operations, and the synchronization can be implemented as replications.

Based on the above considerations in mind, the document hierarchy and the system architecture are proposed in the following sections.

3 Document Hierarchy

As the single native XML database is playing the repositories for the entire studies of the students, it is necessary to classify the document into well-defined levels for facilitating the document synchronization from the university to students. Without loss of generality, all materials can be classified into the following levels,

1. University level
2. Department level
3. Curriculum level
4. Course level
5. Tutorial group level
6. Student level

The relationships among these levels are illustrated in Figure 2.

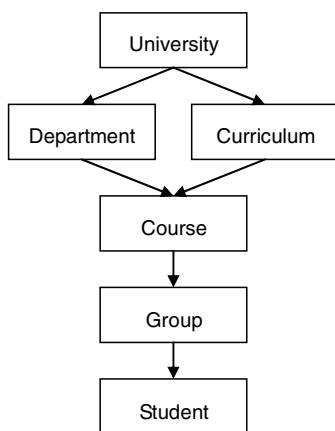


Fig. 2. The relationships among the different levels

The interpretation of the different levels is that a university contains of several departments and provides several curriculums. A course is provided by a department that can be involved in various curriculums. Then, for each course, there may be more than one group and each group contains many students. Each actual level is dedicated to a particular person. For example, an instance of a student level is assigned to a student, and an instance of the course level is assigned to the responsible lecturer. The handling of materials of different levels is as follow.

- If a material/document is defined to be university level, it is applicable to all departments/curriculums, and hence all courses and all groups and all students. In other words, that material or document needs to be replicated to every student of the university.
- If a material/document is defined to be department level for a particular department (or curriculum level for particular curriculum), it is applicable to all courses of the department (or curriculum) and then all groups and all students of the course.

- If a material/document is defined to be course level, it is applicable to all groups and hence all students. In other words, the material/document will be replicated to all students who take the course.
- If a material/document is defined to be group level, it will be replicated to all students in the group.
- If a material/document is defined to be student level for particular student, it will be replicated to the specified student only.

On the reverse direction, the student can place a document to a particular level, so that when the document is synchronized, it would be replicated to that level to be handled by the corresponding staff.

4 Document Structure

There are several document types involved in the system, which are,

1. Course reading/reference materials,
2. Questions regarding the course contents raised by the student
3. Answer to the questions raised by the student
4. Assignment question script,
5. Assignment answers, and
6. Examination questions
7. Examination answers

For document oriented type, such as (1), (4), (5), (6), (7), the open document format, such as OpenDocument format and hence the freeware OpenOffice [4] can be used. For (2) and (3), the XML schema can be defined according to the design of the university, and is implemented by the student front-end software.

For the design of the XML database, the schema is illustrated by the following DTD diagram.

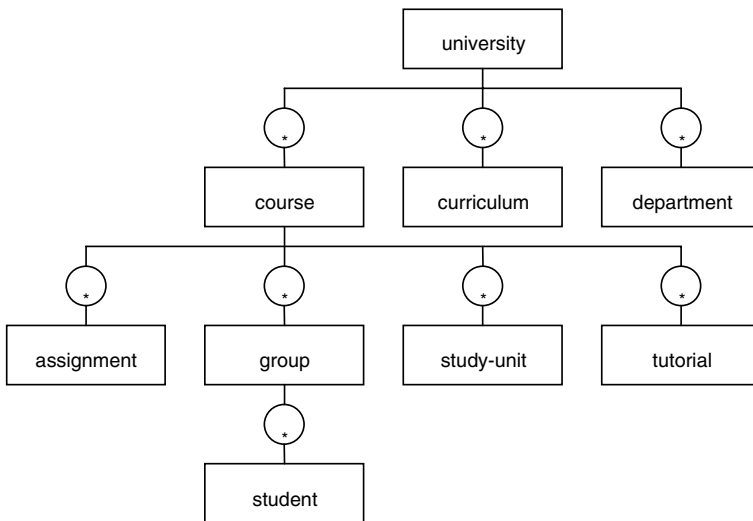


Fig. 3. DTD graph for the XML database schema

```
<!--ELEMENT university (course*, curriculum*, department*)-->
<!--ELEMENT course (assignment*, group*, study-unit*,
tutorial*)-->
<!--ELEMENT group (student*)-->
<!--ELEMENT assignment ANY-->
<!--ELEMENT student ANY-->
<!--ELEMENT study-unit ANY-->
<!--ELEMENT tutorial ANY-->
<!--ELEMENT curriculum ANY-->
<!--ELEMENT department ANY-->
```

Fig. 4. The DTD for the XML database schema

Figure 3 shows the schema of the XML database to be used by all XML database and Figure 4 shows the corresponding Document Type Definition (DTD). The DTD for some of the XML elements in the schema are ANY for illustration purposes only, as it relaxes the restrictions of the sub-trees to be added. For actual implementation, university can define their validation DTD with a particular XML namespace accordingly

The only difference in all XML database instances is the data to be stored. For the university XML database, it stores the documents all courses, all curriculums, all departments, all courses and so on. For regional office machines, the XML databases store the portions of the data for those students that synchronize their XML database by such regional office. For individual student, the XML database only stores the documents that are related to his/her curriculums and courses only. Under the elements assignment, study-unit and tutorial, the child elements can be any other XML elements, which are mostly defined by other XML applications, such as OpenDocument, and are identified by their own XML namespaces. All operations with all XML database instances involved in the e-learning supporting system are adding new XML documents (as sub-trees to appropriate elements in the schema), and it is therefore no conflicts of updates as for relational databases.

5 System Architecture

To ease the operation of the e-Learning system, all user interfaces are implemented as web applications, so that the users can operate the system without formal training. As web browsers are pre-installed by almost all operating system, the software to be

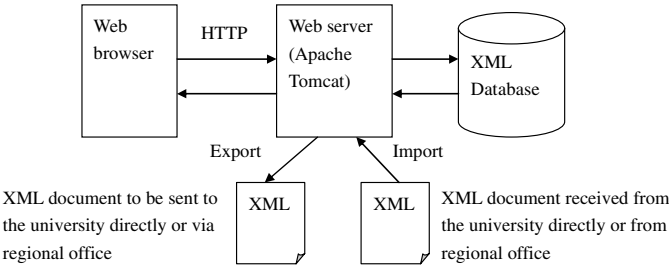


Fig. 5. System architecture of the software implemented by the student computer

installed to the student computer is the web server with the XML database server, such as Apache Tomcat [5] with Apache Xindice [6] or eXist [7] respectively and the complete system architecture for student computer is illustrated in Figure 5.

The student computer entitles a student to review all course materials, and requests and submissions to the university are firstly stored in the local XML database. Upon request, an XML document for the changes is exported since last export operation, and the exported XML document is to be transmitted to the regional office (and then the university) or the university directly.

The following diagram illustrates the architecture of the regional office computer. The computer is responsible for consolidating the requests and changes from various students as a single request/update XML document, which is then transmitted to the university. On return, an XML document for the feedbacks and changes from the university to all students that are served by that regional office is returned to the regional office, from which the changes are dispatched as individual XML documents to be obtained by individual students.

The following diagram illustrates the system architecture of the computer hosted in the university. It solely accepts changes from all regional offices and students. After processing, XML files for changes and feedbacks for regional offices and students are generated and dispatched.

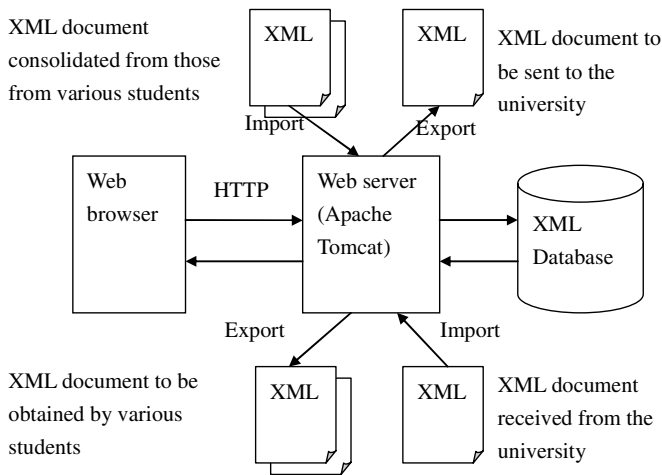


Fig. 6. System architecture of the software implemented by the regional office computers

Figure 7 illustrates that the e-learning supporting system hosted by the university is operated with a web browser, and it takes XML documents collected from various channels, including online Internet connections and offline synchronization XML documents for import purpose. Periodically or on-demand, the system will generate outgoing synchronization XML documents to be distributed to students for new materials according to various document levels, and the regional office of the students or the students individually.

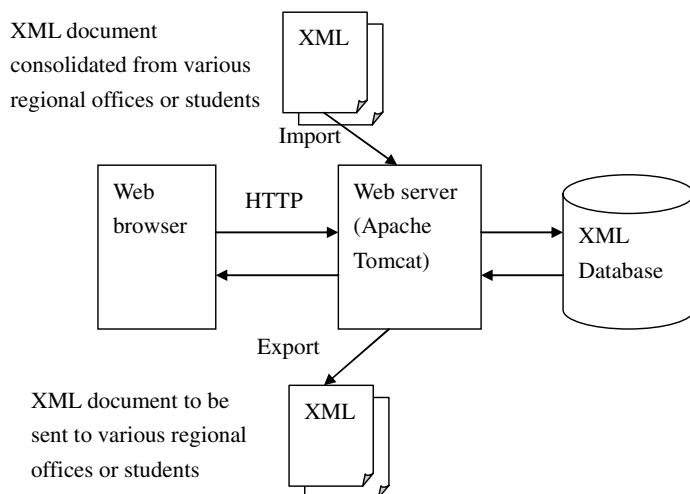


Fig. 7. System architecture of the software implemented by the university computer

6 Algorithm of XML Database Synchronization

The entire e-learning supporting system with XML database is implemented with XML databases hosted on various machines, and the synchronization is realized by replication.

For student machine, whenever there is a new import XML document, contents of the import XML document are decomposed into various sub-trees according to the document levels, and these sub-trees are added as the children of the appropriate elements in the XML database hosted on the student machine. For every new document the student creates, such as a question regarding an assignment, the document is also marked with a particular level, such as the course CS1234 level. Then, the next time when the student machine generates an export XML document for replication, the question is exported for the course level CS1234 that will be eventually replicated to the university central XML databases under the element for course level CS1234. The sample XML document will look like the one shown in Figure 8.

```

<?xml version="1.0"?>
<university xmlns:cityu="http://www.cityu.edu.hk/CS#">
  <course id="CS1234">
    <assignment id="TMA1">
      <cityu:question studentId="S07001234" cityu:questionId="TMA1:001">
        What can be done with XML databases?
      </cityu:question>
    </assignment>
  </course>
</university>
  
```

Fig. 8. A sample XML document for replication by an individual student

```

<?xml version="1.0"?>
<university xmlns:cityu="http://www.cityu.edu.hk/CS#">
  <course id="CS1234">
    <assignment id="TMA1">
      <cityu:question studentId="S07001234" cityu:questionId="TMA1:001">
        What can be done with XML databases?
      </cityu:question>
      <cityu:question studentId="S07002345" cityu:questionId="TMA1:001">
        What is the core difference between XMLDB and RDB?
      </cityu:question>
    </assignment>
  </course>
</university>

```

Fig. 9. A sample XML document for replication by a regional office after consolidation

The sole responsibility of the regional office is just to consolidate changes by individual students by merging their export XML documents, and dispatch replication XML document obtained from the university into individual replication XML document to be processed by the corresponding students. For example, the sample XML document for replication as shown in Figure 9 is the one consolidated after two students synchronized their replication XML document with the regional office.

The e-learning supporting system at the university merges all import replication XML documents and inserts them to the XML database as the children of suitable elements. On return, the changes in the host XML database will be exported into regional office based or individual student based replication XML document. For example, a sample XML document returned to the regional office is shown in Figure 10 and the XML document “decomposed by the regional office to be replicated to the student is shown in Figure 11.

```

<?xml version="1.0"?>
<university xmlns:cityu="http://www.cityu.edu.hk/CS#">
  <course id="CS1234">
    <assignment id="TMA1">
      <cityu:answer studentId="S07001234" cityu:questionId="TMA1:001">
        XML database can store and retrieve XML data effectively.
      </cityu:answer>
      <cityu:answer studentId="S07002345" cityu:questionId="TMA1:001">
        Data in RDB are in network model, whereas data in XMLDB are in
        hierarchical model.
      </cityu:answer>
    </assignment>
  </course>
</university>

```

Fig. 10. XML document returned to regional office

As illustrated by the sequence of XML documents being exchanged, the XML databases of the students and the university central XML database can be synchronized systematically.


```

<?xml version="1.0"?>
<university xmlns:cityu="http://www.cityu.edu.hk/CS#">
  <course id="CS1234">
    <assignment id="TMA1">
      <cityu:answer studentId="S07001234" cityu:questionId="TMA1:001">
        XML database can store and retrieve XML data effectively.
      </cityu:answer>
    </assignment>
  </course>
</university>

```

Fig. 11. XML document returned to individual student

7 Conclusion

For e-learning, using XML as the standard document format would simplify the handling of various course related materials. As such, an XML database can be used to play the role as a document repository for the entire study of a student. For Internet accessibility well-established countries, the student XML database can be synchronized with the central XML database hosted by an education organization, such as a university, in a timely approach. For under developing countries where Internet accessibility is still unaffordable for most students, off-line synchronization, which in particular replication, can be adopted so that synchronizations can be achieved in batches. This paper proposes the classifications of materials into different levels and synchronizing by replications with and without an intermediate synchronization agent, such as regional office or dedicated students. With open-source XML database products, low-cost laptop computer (such as those provided by OLPC) and affordable rewriteable storage media (such as flash storage and CD-rewritable), distance (or long-distance) learning in developed and under developing countries can be facilitated.

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A Modern Tool for Viewing the Learning Resources

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Abstract. The paper presents a topic map graphical view successfully used in medical education. The technological development and the Internet contributed to the development of e-learning resources, repositories and digital libraries for medical domain. Because many of them are structured as databases, the paper proposes also an original algorithm for automated mapping of a relational database to a topic map. This process assumes topic generation corresponding to the database, tables, records and columns. It assumes also association building corresponding to relationships between tables, database and tables, tables and records, tables and columns. Topic maps include as basic elements topics and associations between them. At the basic level, topics represent in fact the learning objects stored in the database, and the associations represent the semantic relationships between them. The learners can use the topic map as a navigation tool. They can navigate through topic map depending on their interest subject, they can learn about the semantic context, in which a collection and its single items are embedded. The students in medical domain consider the proposed topic map graphical view very intuitive, especially because it allows the graphical visualization of the associations between topics that are in fact learning objects.

Keywords: Medical e-learning, learning object, semantic relationships, topic maps, relational database.

1 Introduction

Nowadays, more and more people receive education and update their knowledge through e-learning. The specialists consider that e-learning has become a very important means of learning, taking advantage of rapid development of knowledge society and the accelerating of knowledge updates [1, 2].

In diverse medical education contexts, e-learning appears to be a completion of the traditional instructor-led methods such as lectures.

Although medical learning cannot replace direct transfer of knowledge performed during hospital practice hours, the e-learning solution can offer significant advantages which were highlighted in medical literature: increased accessibility to information, better updating solutions, personalized training, better distribution, standardization of content, better efficiency in achieving knowledge and aptitudes [15].

It can be said that hybrid learning represents the best solution in the medical domain. E-learning can be used by medical educators to improve the efficiency and effectiveness of traditional face-to face activities. The e-learning platforms give the possibility of permanent online access from any location, reducing time and cost.

Medical hybrid learning plays an essential role in medical personnel shaping and developing, and an online system facilitates their access in order to increase the accumulated knowledge, simplifying also this process.

The accomplished studies, including those focusing on medical domain, indicated that the students substantially appreciate the e-learning method, due to the facilities offered (easy access to materials, navigation, interactivity, friendly interfaces), but they don't consider it as a replacement of the traditional learning which has other advantages [15].

The technological development and the Internet contributed to the development of e-learning resources. Repositories and digital libraries for access to e-learning materials were established (MedEdPortal, Association of American Medical Colleges, End of Life/Palliative Resource Center, The Health Education Assets Library, Multimedia Educational Resource for Learning and Online Teaching, International Virtual Medical School) [15]. Usually, the e-learning systems use a database that stores the learning content and also information about users.

The e-learning systems must have powerful and intuitive tools for viewing the learning resources, for browsing the lessons or topics and relationships between them, and also for searching the relevant information. An important feature of an e-learning system is the presentation way of the semantic relationships between topics using an appropriate navigational structure.

This aim can be achieved using a modern concept - topic map. Topic Maps (TM) are an emerging Semantic Web technology that can be used as a means to organize and retrieve information in e-learning repositories in a more efficient and meaningful way [9, 10].

The paper presents two important aspects:

The original algorithm for automated representation of a relational database with a topic map. This aspect is favorable in e-learning domain because a lot of e-learning systems use a relational database. This process will be illustrated on a database used in TESYS e-learning system, successfully used in the medical domain [8].

A topic map graphical view that allows learner navigation for studying the topics and associations that represent in fact the relationships between topics in database. Associations provide the context information necessary to better understand a topic. Associations simulate the way human think and such are essential for knowledge modeling. This tool allows also the learning resources filtering by establishing the search criteria in topic map.

The paper has the following organization: section 2 presents related work, section 3 presents a fragment of an e-learning relational database used then in section 4 for explains the topic map building algorithm. Section 5 presents the graphical view for topic map navigation, section 6 the experimental results and section 7 the conclusions.

2 Related Work

Many e-learning systems use a database for storing the learning content and also information about users. Two of the most familiar e-learning platforms will be mentioned. So, the Moodle database has around 200 tables. These tables are grouped around the system modules. For example, the Forum module uses 8 tables that are connected at the core tables. The same is true for each activity module. Once you take out the tables for each activity module in this way, and similarly take out the tables belonging to the enrolment plugins, question types, etc., you are left with about 50 core tables. The information about Courses and their organization into categories are stored in the following tables: `course`, `course_categories`, `course_display`, `course_meta`, `course_request`. The information about Activities and their arrangement within courses are stored in the next tables: `modules`, `course_allowed_modules`, `course_modules` and `course_sections`. The database structure is defined, edited and upgraded using the XMLDB system [3]. Also, the Blackboard Learning System uses a relational database for storing necessary data [14].

Topic maps represent a new technology for the structuring and retrieval of information, based on principles used in traditional indexes and thesauri, with inspiration from semantic networks. Topic maps work with topics, the relationships between topics, and links to resources about those topics. Because topic maps are independent of the resources they describe, they enable their use in many different situations. As a result, the topic maps can be used in information access on the Web, in reference book publishing, or in the integration of corporate information repositories [7, 9, 10].

There are some available TM authoring tools, but they are useful to experts in knowledge representation, not to end users (Ontopia Knowledge Suite [12], Mondeca Intelligent Topic Manager [13]). Also, there are few specialized education-oriented TM tools that can be used to facilitate the creation, maintenance, search, and visualization of Topic Maps-based learning resources.

We can mention papers that present interesting and modern modalities of using topic maps in e-learning. For example, TM4L is an e-learning environment providing editing and browsing support for developing and using topic maps-based digital course libraries. The TM4L functionality is enhanced by an interactive graphical user interface that combines a hierarchical layout with an animated view, coupled with context sensitive features [4, 5].

Another author proposed topic map ontology, focusing on both students and teachers as active producers of learning resources. Topic maps customize the interface, and the interface should also provide possibilities for online students to share learning resources like “on campus” students do [6].

In [16] the authors present original ways of using topic maps in medical e-learning. The topic map is mainly used for visualizing a thesaurus containing medical terms. The topic map is built and populated in an original manner, mapping an xml file that can be downloaded free, to an xtm file that contains the structure of the topic map. Only a part of the MeSH thesaurus was used, namely the part that includes the medical diagnosis’s names. The paper presents also how to use the topic map for semantic querying of a multimedia database with medical information and images.

3 TESSYS Database Structure

In figure 1 there is a part of the relational database used by the e-learning system called TESSYS, successfully used in the medical domain [8]. This database will be used later to explain better the topic map automated building and also its graphical view.

The table named *Courses* stores data about electronic courses, each course being equivalent to a unit of curriculum or an academic subject in traditional learning. Usually, a course contains many chapters, and each chapter a number of topics. Each topic represents one unit of knowledge, being the smallest component. The topic can be a piece of text, a video clip, a picture or a voiced text.

In this database structure the relationships between topics studied at the same course or different courses are important. If a topic uses some knowledge that is presented in other topics, these topics must be linked. As a result, on *Topics* table a m:m recursive relationship is defined. This special relationship is implemented with *Topic_connection* table.

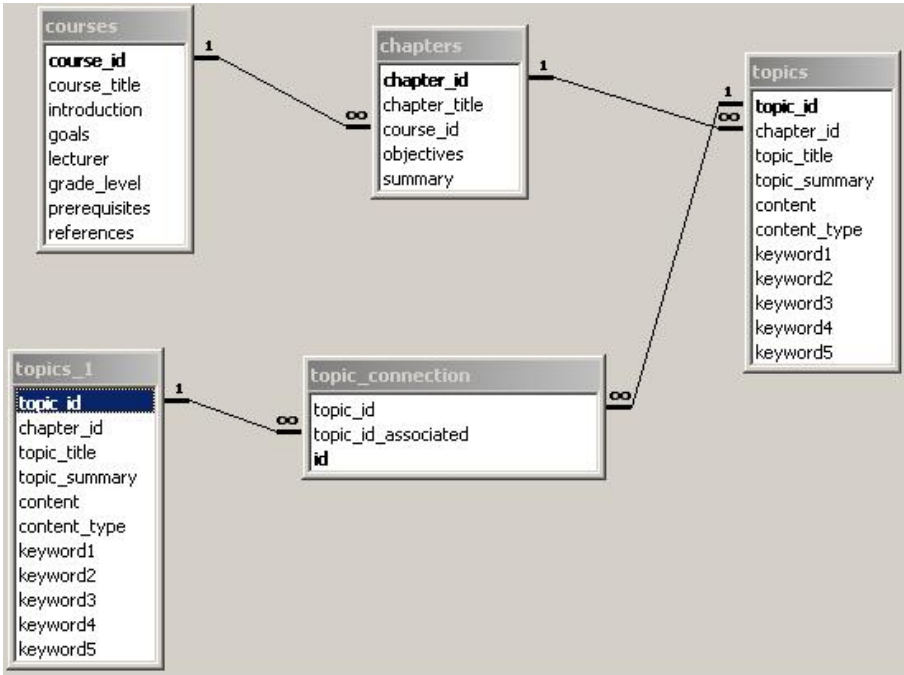


Fig. 1. TESSYS database structure

4 Building the Topic Map Starting from a Relational Database

The basic concepts of the topic map paradigm are [7, 9, 10]:

- Topics that represent subjects and carry names
- Occurrences of a topic that point to relevant resources

- Associations that connect related topics
- Topic classes, occurrence classes and association classes that help to distinguish different kind of topics, occurrences and associations, respectively

Manual topic map population may require lots of resources: time, money and humans. As a result it is considered the problem of the self-populating the topic maps. The available resources that can act as a source of input to auto-population are identified: ontology, relational or object-oriented database, metadata about resources, index glossary, thesaurus, data dictionary, document structures and link structures or unstructured documents.

The solution adopted in this paper was to use the relational database for the design and self- population of topic maps.

A relational database consists of tables, columns, rows, keys and foreign keys. The transformation will probably not map all tables into the topic map, but selected ones. The obvious mapping is [9]:

Table -> topic class
 Row -> topic instance of corresponding class
 Column -> name or occurrence
 Key -> topic id
 Foreign key -> association

The topic map generation process is a general one. It can be used for any relational database. The result is a topic map that offers an intuitive view of the content from the learner's point of view. Topic map content is stored in an xml file that respects xtm syntax [11].

Initially, the topic map generation process builds a topic types array: "database", "table", "row", "column", "relationship", "part", "whole", "primary", "foreign" that will be used as basic types for types and associations.

From database meta-data the algorithm needs the following:

- The array with table names
- The relationships between tables

Topic map generation process has the following steps:

1. Topic generation for database and tables

The algorithm produces a topic that is an instance of the topic *database*. This topic has an id that contains the database name.

Example: For *ELearning* database it will be generated the topic with the id "*ELearning*", being an instance of the topic *database*.

```
<topic id="ELearning">
  <instanceOf>
    topicRef xlink:href="#database " />
  </instanceOf>
  <baseName><baseNameString>ELearning
    </baseNameString></baseName>
</topic>
```

In the same way, the algorithm creates a topic for each table in the database. The topic id is given by table's name, because this is unique in the database. For the database in figure 1, it is generated such a topic for tables: *courses*, *chapters*, *topics*, *topics1*, *topic_connection*.

Example: For the table *courses* it is generated the topic with id "*courses*" that is an instance of the topic *table*.

2. Topic generation for table columns and records

The algorithm will generate a topic for each column in a table. The topic id is given by the next syntax: *table name. column name*. This is our choice because each topic must have a unique id.

Example: For the column *course_title* in table *courses* the generated topic has the id "*courses.course_title*". This topic is an instance of the topic *column*.

```
<topic id="courses. course_title">
  <instanceOf>
    <topicRef xlink:href="#column" />
  </instanceOf>
  <baseName>
    <baseNameString>course_title</baseNameString>
  </baseName>
</topic>
```

The method generates a topic for each table record. Topic unique id has the next syntax: *table name. Row. Primary key value*. The record content is considered as topic occurrence.

Example: The record with primary key value 3 in table *chapter* will be represented by a topic with the id "*chapters.Row.3*" that is an instance of topic *row*. One of the columns in table *chapters* is *chapter_title*. For this column content it is created an occurrence that is an instance of topic *chapters.chapter_title* and having the text value "*Therapy in the digestive tract*".

```
<topic id="chapters.Row.3">
  <instanceOf>
    <topicRef xlink:href="#row" />
  </instanceOf>
  <baseName>
    <baseNameString> chapters.Row.3 ></baseNameString>
  </baseName>
  <occurrence>
    <instanceOf>
      <topicRef xlink:href="#chapters.chapter_title" />
    </instanceOf>
    <resourceData>Therapy in the digestive tract
    </resourceData>
  </occurrence>
</topic>
```

3. Associations generation process

3.1 associations corresponding to relationships between tables

For each relationship in the database is generated an association of type “*relationship*”. The association identification is generated intuitively using the tables’ names, the primary key and the foreign key. This development mode takes into consideration to offer information about the database structure for facilitating the learning process.

Example: For the relationship 1: m between tables *courses* and *chapters* it is generated an association with the next id: “*courses.course_id-chapters.course_id*”. This association is an instance of the topic *relationship*. In this association, the table *courses* contains the primary key and plays the role “*primary*” and the table *chapters* containing the foreign key plays the role “*foreign*”.

```
<association id="courses.course_id-chapters.course_id">
  <instanceOf>
    <topicRef xlink:href="#relationship" />
  </instanceOf>
  <member>
    <roleSpec>
      <topicRef xlink:href="#primary" />
    </roleSpec>
    <topicRef xlink:href="# courses " />
  </member>
  <member>
    <roleSpec>
      <topicRef xlink:href="#foreign" />
    </roleSpec>
    <topicRef xlink:href="# chapters" />
  </member>
</association>
```

3.2 associations between database and tables

The association between database and its tables is of type “*part-whole*”. The topic representing the database plays the role “*whole*” and every topic representing a table plays the role “*part*”.

Example: The association between the topic representing the database *ELearning* and topics representing the tables (*courses*, *chapters*, *topics*, *topics1*, *topic_connection*) has the id “*Database:ELearning.Tables*”, being an instance of the topic *part-whole*.

3.3 associations between table and records

The fact that a table contains records is represented by an association of type “*part-whole*” between table and its records.

Example: For the table *courses* is generated an association with the next id: “*Table:courses.Rows*”, that is an instance of the topic *part-whole*. In this association the topic representing the table *courses* plays the role “*whole*” and every topic representing a record plays the role “*part*”.

3.4 associations between records involved in a 1:m relationship

This association is of type “*related-to*”. In order to be generated, for every value of the primary key, the records that contain the same value in the foreign key column must be found. As a result, this association is established between the topics already generated for every these record.

Example: Tables *courses* and *chapters* are involved in a 1:m relationship. The course entitled “Digestive tract” contains 3 chapters stored in the table *chapters*. This fact is represented by an association of type “*related-to*” between the topic representing the corresponding record in the table *courses* and the topics representing connected records from the table *chapters*. Every topic plays the role “*related*”.

5 Topic Map Graphical View

Based on the algorithm presented in section 4, using the meta-data and data extracted from relational database it was generated an xtm file that represents the topic map. Topic map content is explored using a graphical interface with multiple views.

The viewing interface for topic maps is organized in two windows: the left window displays a list of all topics, topic types, associations, association types, occurrence types and member types. As a topic type we have: *column*, *database*, *row*, *table*, etc.

In topic map there are 3 association types: “*part-whole*” (defined between the topics that represent database and tables or between topics representing a table and its records), “*relationship*” (defined between the topics representing tables implied in a 1:m relationship), and “*related-to*” (defined between the topics representing the table records bound with a 1:m relationship).

Each topic type involved in an association plays a certain role: *part* (a topic representing a table or a record plays this role), *whole* (a topic representing a database or a table plays this role), *primary* (a topic representing a table with a primary key), *foreign* (a topic representing a table with a foreign key), *related* (a topic that represents a table record implied in a 1:m relationship).

The learner can select an item from the list displayed in the left window and he will see in the right window the item’s graphical representation. Topic map viewing tool intends to offer learner many information about the selected item. Unlike TM4L, our viewing tool displays for each topic involved in an association its occurrence content also. Example: for the topic that represents a record in *Courses* table, the learner will see information like: *lecturer*, *grade_level*, *introduction*, etc. Topic content can be visualized separately by selecting it in the left window.

Another original element in this graphical window is that the learner can see directly the record content involved in 1:m relationship implemented in topic map by “*related-to*” association. Beside these associations viewing that offer the topic better understanding, the learner can go directly to study the associated topic.

In figure 2 there are presented details of an association of type “*related-to*” defined between topics representing records in the table *topics*. Between these records there is a semantic relationship. Every topic in this association plays the role “*related*”. In order to offer details, for every topic it is presented the occurrence content: *content*, *content_type*, *topic_title*, *keyword1*, *keyword2*, *keyword3*, etc. In figure 3 it is presented an association of type “*part-whole*”.

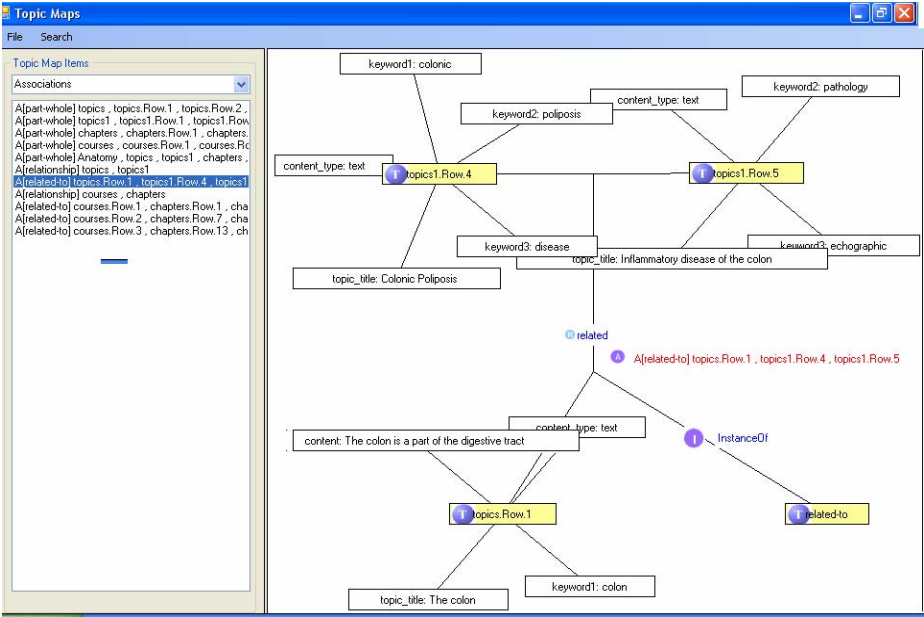


Fig. 2. An association of type “related-to”

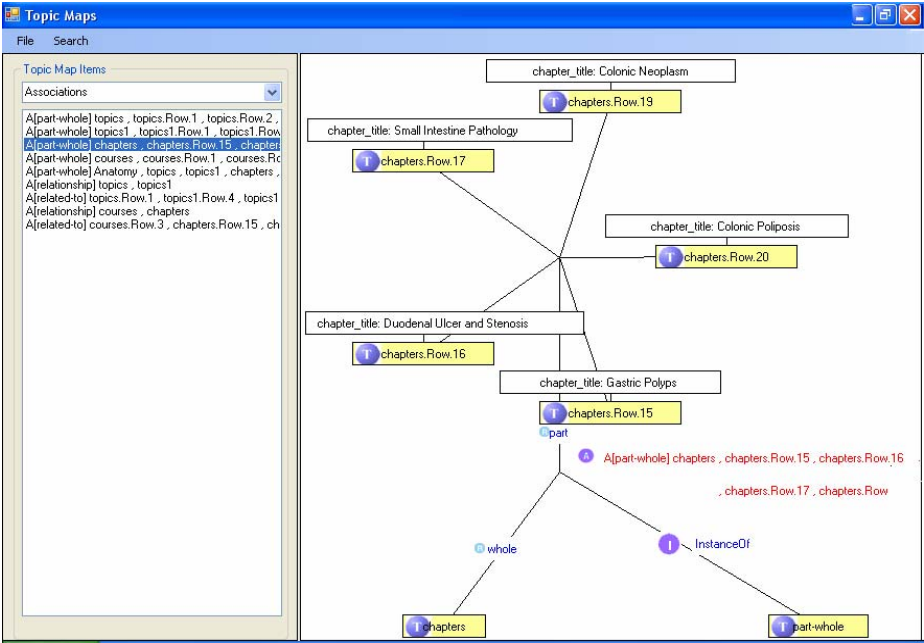


Fig. 3. An association of type “part-whole”

The users can use the topic map as a navigation tool. They can navigate through topic map depending on their interest subject, having in this way big advantages. They don't have to be familiar with the logic of the database, they will learn about the semantic context, in which a collection and its single items are embedded and they may find useful items that they would not have expected to find them in the beginning.

At this moment, the graphical tool allows only a simple search based on topic types. The learner can specify a topic type and the application will display a list with all the topics of the selected type. Selecting an item in this list, the graphical window will display automatically its details.

6 Experimental Results

A number of 60 students in the medical domain participated to the following experiment: they were asked to study the discipline "Digestive Tract" using TESYS system, an on-line e-learning platform that uses a tree structure for displaying the learning content: the learner chooses the course, then a chapter, and finally a lesson. The existing relationships between learning objects are implemented as hyperlinks. The student can also use some search criteria. After that they had to study the same discipline using the topic map created with this software tool.

The students emphasized the fact that using topic maps in the e-learning field presents positive aspects: they are easy to use, the student can easy to pick a subject and see the relationships between subjects.

The students consider also that viewing a large number of subjects in topic map can be a negative aspect. In this case, the student can feel "lost" in the middle of a large amount of information.

The final conclusion was that 75% from them considered that topic map is a much more intuitive alternative, especially because allows the graphical visualization of the associations between topics which are in fact lessons. 25% from the students considered that both alternatives are efficient.

7 Conclusion

The paper presents two important aspects:

1. The algorithm for topic map automated building starting from a relational database. The existing topic maps software doesn't allow this thing. This aspect is useful because there are many e-learning systems that store the educational content in a database.
2. A topic map graphical view with important facilities for learner: topic map navigation useful in studying topics that represent in fact learning objects and associations between them. This window allows learner to filter the information based on his interest.

The new software tool was accepted by the teachers from Gastroenterology department of the Medicine and Pharmacy University and appreciated as useful and original. During the year 2008, 60 students used this new graphical modality for

consulting TESYS e-learning database. Many of them considered it a better solution against the traditional one.

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Building a Semantic Resource Space for Online Learning Community*

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Abstract. By incorporating Semantic Web technologies, this paper describes the design of a semantic resource space with semantic link networking on learning resources, aiding the development of communities of knowledge. With an integrated, scalable and easy-to-use interface, the semantic resource space serves as an entry point for learners to conveniently author, access, reuse and aggregate resources via diverse intelligent facilities, such as semantic search, relational navigation, recommendation, multi-view filter, etc. A platform has been developed and deployed within an academic setting to better support resource management and utilization for cooperative research.

Keywords: Semantic Resource Space, Semantic Link Network, Relational Navigation, Comparison-search.

1 Introduction

As the amount of information on the Web is increasingly continuously, users spend a great deal of time on the Web searching and browsing for information to “amplify” their intelligence [1]. They try to gather enough information about a topic to be able to answer a question or complete a task, but the acquired knowledge is often disordered, disconnected, and not effectively integrated to address their learning needs. Thus, the wealth of resources presents a great challenge: how to provide a coherent, structured, shareable collection of resources to cater for users’ specific needs. Some systems have been proposed intending to effectively support resources accessing and exploitation [3], [4], [13]. But the substantial impediment to the destination is the fact that the resources are disordered, isolated, and heterogeneous, and there is no common overarching context for the available resources. Additionally, finding the precise information is very difficult because of the lack of semantic description of learning resources. Thus, navigation through a large set of independent resources often leads to users’ being lost.

Proponents of collaborative learning claim that learners in cooperative teams achieve higher levels of performance and retain information longer than learners who

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work individually [12]. CSCL, first noted in the early 1990s, is the development of collaboration by means of technology to augment education and research. CSCL promotes peer interaction and facilitates the sharing and distribution of knowledge and expertise amongst a group of learners [7]. Currently, Wikis have become popular tools for collaboration on the web because of its collaborative features, such as collaborative editing, versioning, discussion about the content. Many online communities employ wikis to exchange knowledge. The primary goals of wikis are to organize the collected knowledge and to share this information. But in spite of its utility, a Wiki is essentially a collection of Web sites connected via hyperlinks, the meaning of its content is not machine-understood and machine-processable, so finding and comparing information from different pages is challenging and time-consuming. Additionally, the rigid, text-based content of classical wikis can only be used by reading pages in a browser or similar application [5].

The Semantic Web is an extension of the current web in which information is well-defined and linked in a way for more effective discovery, automation, integration, and reuse across various applications. By combining properties of Wiki (like ease of use, collaboration, linking) with Semantic Web technology (like structured content, knowledge models in form of ontologies, reasoning), semantic wikis emerged aiming to address the existing issues in wikis. Recently, many researchers are developing semantic wikis for different purposes, such as platypus [10], Semantic MediaWiki [6], SemWiki [11], WikSAR [2], IkeWiki [9]). In order to better support online learning community collaborate to share, exchange and utilize knowledge, this paper, based on the semantic wiki technologies, proposes a semantic resource space with semantic link networking on learning resources, enabling flexible and easily learning content authoring, accessing, reusing and aggregating.

2 The Framework for Designing a Semantic Resource Space

Figure 1 illustrates the framework of a semantic resource space (SR-Space). As the figure shows, the semantic resource space comprises three layers. The bottom layer serves as the underlying learning repositories. The middle layer consists of modules about processing and exchanging of structural information, which is accomplished by Semantic Web technologies. The top layer provides various application services for decentralized learners.

The bottom layer is comprised of knowledge base, content database and semantic template. Knowledge base consists of ontology and semantic link networks. The former is an explicit specification of a conceptualization with respect to the specific application domains, and the latter represents various semantic relationships between information objects. Content database deposits multimedia learning materials authored or uploaded by learners. In addition to including predefined parts of text into pages, semantic template comprises placeholders that are instantiated with user-supplied text when the template is included into a page. By simply adding typed links or attributes to the template text, the semantic template also allows the encapsulation of semantic annotation.

In the middle layer, parser is responsible for converting the text written by the user into information objects. It parses the text for semantic annotations, layout directives, and links. Inline query enables editors to add dynamically created lists or tables to a

page, thus making up-to-date query results available to readers who are not even aware of semantic queries. Compared to manually edited listings, inline queries are more accurate, easier to create, and easier to maintain. Render takes charge of filling the page dynamically based on semantic templates, which determines the display layout delivered to learners. Reasoner is responsible for executing reasoning based on inference rules.

Regarding the top layer, several distinctive functionalities are provided. With the assistance of Ontology & Content authoring module, expert or administrator can construct and modify the domain ontology, and learners can input and edit information objects along with properties via templates. Semantic linking allows learners to annotate links between information objects via a special type of markup, while Comment empowers learners to evaluate information objects with certain grading and remark. The processing of this markup is performed by the components of Parsing and Rendering. Other functionalities are detailed in the section 4.

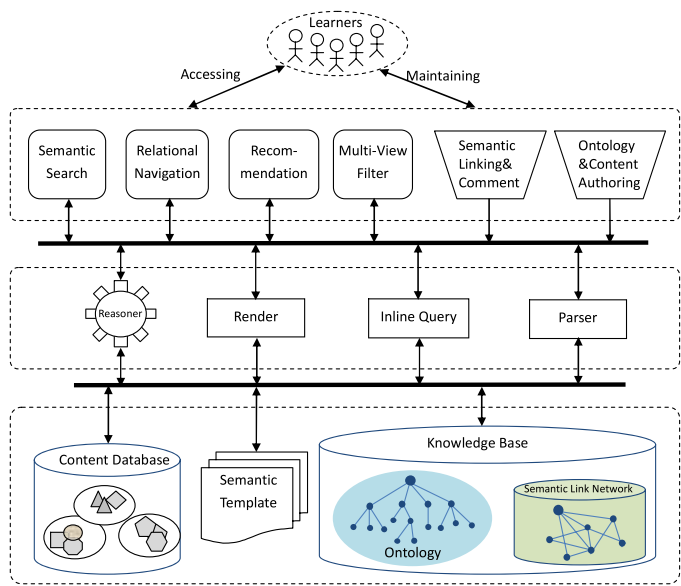


Fig. 1. The framework for designing a SR-Space

3 Learning Resource Modeling with Semantic Link Network

The kernel to modeling learning resources is to encapsulate one or more learning materials with property metadata description. Herein, we define the information objects (IO) as the basic building blocks, which refers to any multimedia objects (e.g. a block of text, PDF documents, images, web pages, a segment of audios) as well as any real world objects such as people, places, organizations and events. Metadata differs in different application scenarios, which is initially defined by experts and then co-edited by learners. Figures 2 shows the schematic view of an information object in

pedagogical setting, where *title* specifies the unique information object about a specific subject as well as *type* that specify the ontology concept to which the information object belongs. The content description indicates what the information object is about. It encapsulates the general information about the information object, such as the *introduction*, *linkAddress*, and *mediaType* (e.g. text, image, video, audio, animation, etc). The structural description indicates the information object's relationship with other information objects. The context description expresses the pedagogical information of an information object, such as the *instructionObjective* (e.g. comprehension, application, analysis, synthesis, and evaluation), *difficultyLevel* (e.g. low, moderate, high), *knowledgeType* (e.g. definition, example, elaboration, operation, procedure, process, etc.), *pedagogicalRole* (e.g. exercise, simulation, questionnaire, diagram, figure, graph, index, slide, table, narrative text, exam, experiment, problem statement, lecture).

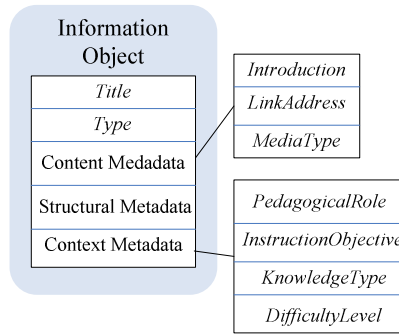


Fig. 2. Schematic view of an information object

A semantic link network (SLN) is a model to intuitively represent the semantic relationships between document fragments or documents [15]. Accordingly, we adopt SLN to represent the binary relationships between information objects, which is denoted as $IO_i \xrightarrow{\alpha} IO_j$, where α is a certain type of semantic relationship while IO_i and IO_j are information objects. Some usual relationships are listed in the following.

- 1) *Sequential*, denoted as $IO_i \xrightarrow{seq} IO_j$, which defines that IO_i is the prerequisite to IO_j . A single message may have multiple prerequisite messages, and can also be a prerequisite to multiple messages.
- 2) *Part-of*, denoted as $IO_i \xrightarrow{par} IO_j$, which defines that IO_j is semantically a part of IO_i .
- 3) *Similar-to*, denoted as $IO_i \xrightarrow{sim} IO_j$, which defines that IO_j is similar to IO_i . The *similar-to* link is intransitive.
- 4) *Reference*, denoted as $IO_i \xrightarrow{ref} IO_j$, which means that IO_j is related to IO_i , e.g. IO_j can be an annotation of IO_i .
- 5) *Cause-effect*, denoted as $IO_i \xrightarrow{ce} IO_j$, which means that IO_i is the cause of IO_j , and the IO_j is the effect of IO_i .

- 6) *HasSupplement*, denoted as $IO_i \text{---} sup \rightarrow IO_j$, which means that IO_j serves as the supplementary or additional content to IO_i .
- 7) *Contrast*, denoted as $IO_i \text{---} con \rightarrow IO_j$, which means that IO_j is in contrast to IO_i . Unlike the similar-to link, this contrast link emphasizes the differences between IO_i and IO_j in a context.
- 8) *Corequisite*, denoted as $IO_i \text{---} cor \rightarrow IO_j$, which means that IO_i and IO_j should be learned in parallel. The corequisite relationship is symmetric.

The reasoning rules can be used for chaining the semantic relationships and obtaining the reasoning result from the chaining. A simple case of the reasoning is that all the semantic relationships have the same type, which is called single-type reasoning. According to the transitive characteristic of the semantic relationships, we have the following reasoning rule: $IO_1 \text{---} \alpha \rightarrow IO_2, IO_2 \text{---} \alpha \rightarrow IO_3, IO_{n-1} \text{---} \alpha \rightarrow IO_n \Rightarrow IO_1 \text{---} \alpha \rightarrow IO_n$, where $\alpha \in \{ce, ref, par, seq, sup, cor\}$. More heuristic rules suitable for connecting different types of semantic links are listed in [14].

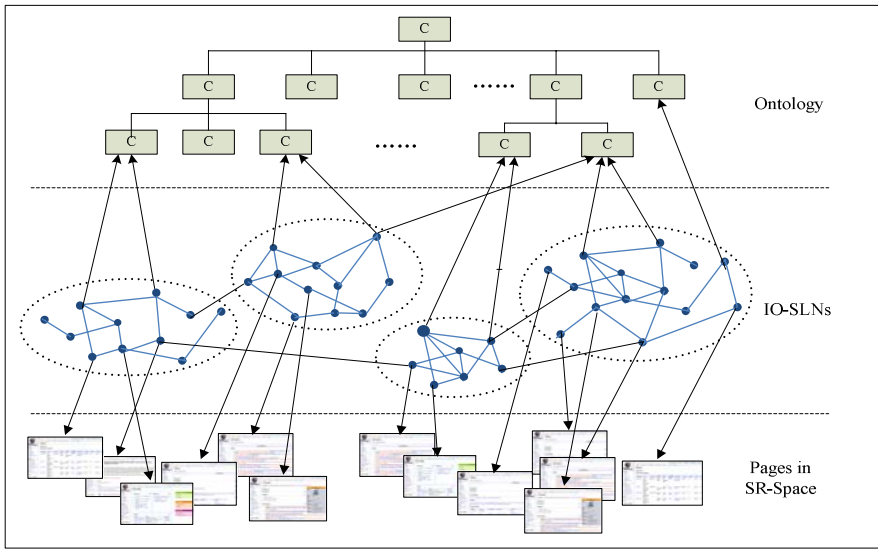


Fig. 3. Conceptual model of semantic resource organization

Figure 3 illustrates the conceptual model of learning resource organization in SR-Space. Ontology describes the category-tree in an application domain, and an information object in semantic link networks can belong to one or more categories in the ontology. The information objects belonging to the same category constitute an IO-SLNs, and the lines within one IO-SLNs or across different IO-SLNs express the relationship between information objects. Moreover, an information object corresponds to a page that embodies the information object's properties and related information (e.g. semantic relationship with other information objects, comments).

4 Supportive Functionalities in SR-Space

4.1 Semantic Search

In contrast to the traditional search engines, queries within semantic search lead to the focused search and quick location of the precise information. With certain semantic denotation, the query results can be profoundly-repacked with the inward semantic schema of the matching information object, including basic information and semantic relationships with other information objects. With the advantage of semantic inference with logic foundation, more implicit information can be extracted, and the search results can be more comprehensive and rational (see [8] for more details).

Particularly, a comparison-search mode is designed for learners to find relationships between two information objects, e.g. the connections between different places or the commonalities of people. For the given keywords, firstly identify the matching information objects in content database, then their corresponding properties description are analyzed to find the potential connecting terms, and finally the search results are displayed in two columns within one page where the top potential connecting terms are properly highlighted so that the relationships between the two information objects can be easily identified.

4.2 Relational Navigation

Started from an information object, the enhanced navigation gives easy access to relevant information. Whereas the usual learning environments only allow learners to follow a hyperlink, the relational navigation offers additional information on the relation the semantic link describes. Such information can be used to offer additional or more sophisticated navigation. This function changes the way content is presented based on semantic links and enables the content aggregation from different pages. This can include enriching pages by displaying of semantically related pages in a separate link box, displaying of information that can be derived from the underlying knowledge base, or even rendering its content of a page in a different manner that is more suitable for the context (e.g. multimedia content vs. text content).

4.3 Recommendation

To facilitate active learning, this function is to proactively recommend related information a learner may be interested in. The interests can be any identity, such as people, concept, or conference, etc. Learner can input his interests via personal profile template. After a learner's interests are identified, he will be informed of newly-added related information by email or display in his personalized page when he login. For example, if a learner is interested in the researcher Gerry Stahl, any newly added information about Gerry Stahl (e.g. papers wrote by Gerry Stahl) will be recommended to the learner. Furthermore, related information can be organized and displayed in a multi-mode to cater for the different needs of learners.

- *Date-view*, which allows the learners to browse the information in sequence of date.
- *Popularity-view*, which enables the learners to browse the information that draw a lot of attention from others by ranking the information according to the number of clicking.
- *Evaluation-view*, which allows the learners to browse the information in sequence of evaluation-score computed based on grading offered by learners.

4.4 Multi-view Filter

Multi-view filter offers faceted browsing to learners with advanced text search and filtering functionalities. With this function, property values of information objects that occur more often can be grouped. Learners can select the values they would like to see by checking them, and then query results that do not hold the selected values will vanish. The rendered view can be interactive maps, timelines, and other visualizations. In case one would like to have more than one view, multiple values can be limited by a comma, and thus one can switch between them by using a panel.

5 Implementation

Semantic MediaWiki [5] is as an extension of the popular wiki engine MediaWiki with many enhanced knowledge management features. It renders semantic annotations in both text and RDF/XML, as well as supports semantic query so that users can query and display semantic content from other pages on any wiki page. Furthermore, to enable external reuse, formal descriptions for one or more articles can be obtained via a web interface in OWL/RDF format.

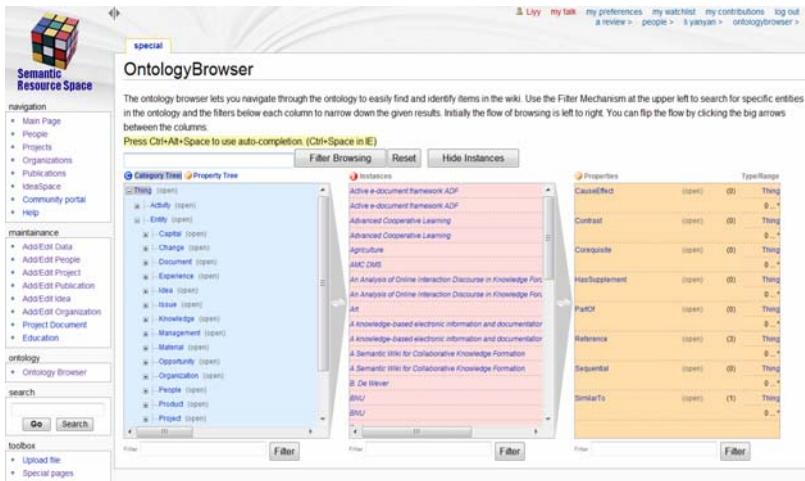


Fig. 4. The interface for defining domain ontology

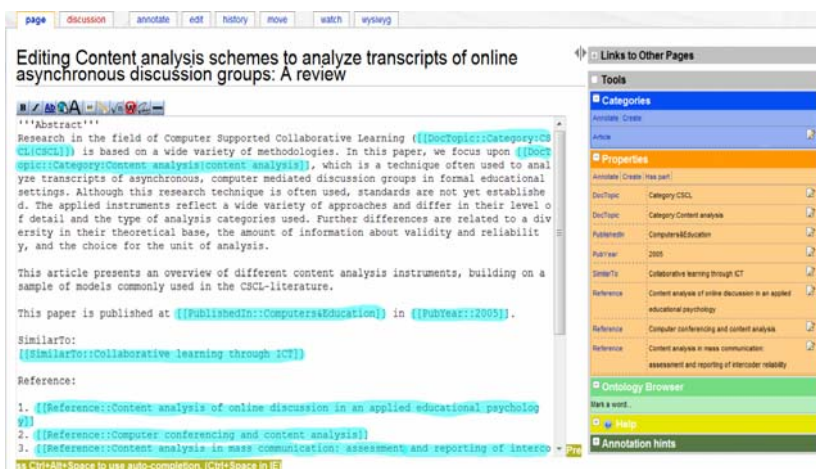


Fig. 5. The interface for editing the semantic annotation

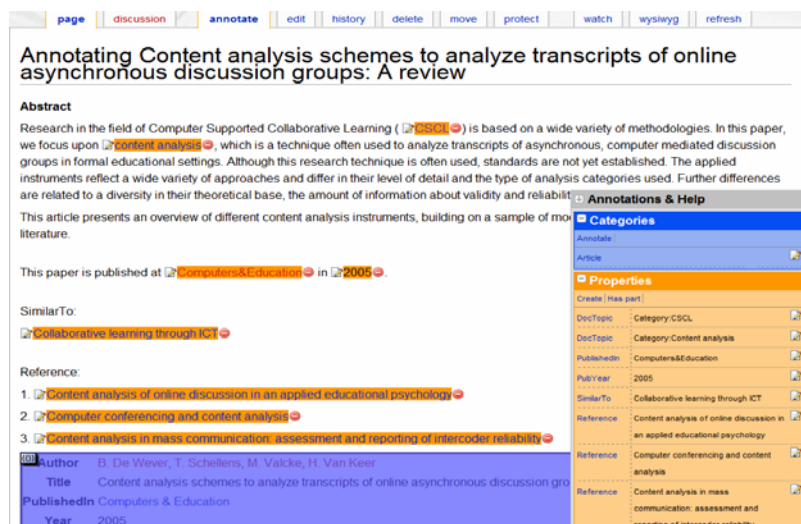


Fig. 6. The interface of annotation view

Based on Semantic MediaWiki, we have built a platform to support collaborative research for online learning community. Figure 4 to figure 9 are the snapshots of the interface. Figure 4 shows the interface for defining domain ontology. The three colored parts from left to right displays the tree-structure categories, entities and corresponding properties, individually. Figure 5 illustrates the editing page for adding semantic annotation to any object. As shown in the figure, the texts marked with blue are the annotation scripts added by the learner. Alternatively, learners can click the right floating panel to add semantic annotation, which is more easily and intuitively for the general users to operate. Figure 6 is the interface of semantic annotation view, which allows learners to follow extensive learning by simple clicking the annotated

object. Figure 7 illustrates the comparison-search results for the query searching for two persons as “David W. Johnson” and “Edythe Holubec”. Their basic information, teaching courses, books and involved activities are listed with the highlighted connecting terms that indicate their commonalities. Figure 8 illustrates the relational navigation view for the concept “CSCL”. As CSCL related information (e.g. people, journal, event, and publication) are organized and displayed in such a clear way, learners can easily learn about overview of CSCL and click any object to get more focused information. Figure 9 is the personalized page in which the newly added information relevant to the learner’s interests is recommended.

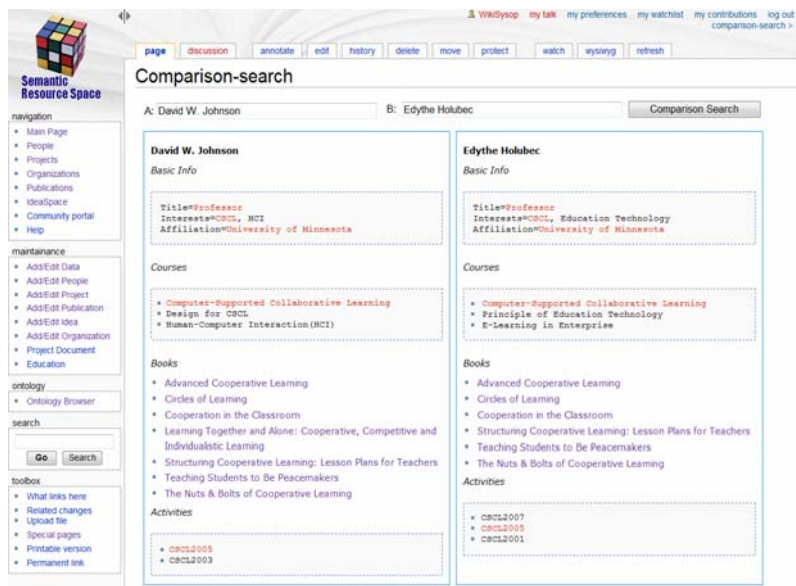


Fig. 7. Comparison-search results with highlighted terms

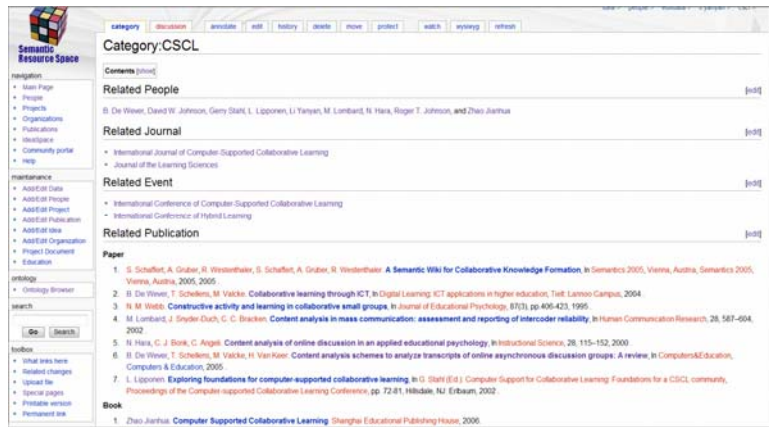


Fig. 8. Relational navigation view for extended learning

Semantic Resource Space

navigation

- Main Page
- People
- Projects
- Organizations
- Publications
- Ideaspace
- Community portal
- Help

maintenance

- Add/Edit Data
- Add/Edit People
- Add/Edit Project
- Add/Edit Publication
- Add/Edit Idea
- Add/Edit Organization
- Project Document
- Education

ontology

- Ontology Browser

search

Go Search

toolbox

- What links here
- Recent changes
- Upload file
- Special pages
- Printable version
- Permanent link

Li Yanyan

Li Yanyan is a teacher and researcher in BNU. Her research focuses on E-Learning, CSCL and Semantic Web.

Contents [show]

Education [edit]

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- Semantic Grid (973)
- Semantic Link for E-Learning
- Web Knowledge Discovery

Publications [edit]

1. **Li Yanyan, Huang Ronghui: An Analysis of Online Interaction Discourse in Knowledge Forum**, In Proceedings of 2008 International Conference on Computer Science and Software Engineering, Dec. 2008
2. **H. Zhuge, Li Yanyan: Learning with Active E-Course in Knowledge Grid Environment**, In *Concurrency and Computation: Practice and Experience*, 18(3), pp. 333-356, 2006
3. **Li Yanyan, Dong Mingkai, Huang Ronghui: Special Interest Groups Discovery and Semantic Navigation Support within Online Discussion Forums**, In Proceedings of the International Joint Conference on Neural Networks (IJCNN 2008), pp. 3904-3911, 2008
4. **Li Yanyan, Huang Ronghui: Topic-Centered Adaptive Curriculum for E-Learning**, In *Adaptive Hypermedia*, Dublin, Ireland, Lecture Notes in Computer Science, LNCS 4018, pp. 350-353, 2006

Recommend [edit]

Book

- Gerry Stahl
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Paper

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Fig. 9. Personalized page with recommended information

6 Conclusions

This paper presents a semantic resource space for online learning community, effectively supporting decentralized learners to easily access, utilize learning resources, and collaboratively build the evolved learning repository. Its kernel idea is to organize the learning resources in a semantic link network rather than in a discrete and incoherent structure, empowering semantic-based reasoning and resource retrieval. The SR-Space prototype has been implemented and deployed for collaborative research community, which shows the functionalities and effectiveness of SR-Space.

Ongoing work is to complete more functionalities of SR-Space, to apply it in the practical learning settings and improve it according to the feedback from learners.

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Multi-document Summarization for E-Learning*

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Abstract. As a large amount of learning materials available in e-learning, automatic summarization has been utilized in digital library for e-learning. Multi-document summarization extracts information from multiple texts documents. It improves the effectiveness of retrieval and accessibility of learning materials in e-learning. Related study has shown that hierarchical summarization is a promising technique. Hierarchical summarization has been extended to summarization of multiple documents. This paper investigates the impact of organization of documents on hierarchical summarization. Automatic document clustering technique is developed for organization of learning materials. A multi-document hierarchical summarization system is developed based on these techniques. The system provides an essential tool for e-learning.

1 Introduction

In e-learning activities, a large amount of static and dynamic content will be created. It is a great challenge to improve the effectiveness of retrieval and accessibility of learning materials. Scientists are investigating how language technology can be utilized for e-learning [12]. Techniques have been developed to automatically extract the keyword from learning object [3][7], and use ontology in facilitating e-learning.

Given a huge number data for e-learning, automatic summarization can effectively extract the most important information from the source document. It has the great potential to be used in e-learning. Many automatic summarization models have been proposed previously [1][4][6]. Research of automatic summarization has been extended to multi-document summarization [9][10][16][17]. Multi-document summarization system provides an overview of a topic based on a set of related documents.

It has been shown that the document structure is important in both automatic summarization [19][22] and human abstraction [2]. Hierarchical summarization model was proposed based on the hierarchical structure of documents [22][25]. Experiment results have shown that hierarchical summarization model is a promising summarization technique.

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In e-learning, a collection of related documents are returned for a query. However, there is not a trivial way to organize a large collection of documents into a hierarchical tree structure. Three hierarchical structures were proposed to organize a collection of documents into a tree structure [21]. This paper investigates the impact of different hierarchical structures on the summarization technique. Experiments have been conducted to study how the extraction of information is affected by the hierarchical structures.

The results show that the hierarchical summarization of multiple documents outperforms other multi-document summarization without using the hierarchical structure. Moreover, the hierarchical summarization by event topics extracts a set of sentences significantly different from hierarchical summarization of other hierarchical structures and performs the best when the summary is highly-compressed. It is shown that the hierarchical summarization system can extract the critical information effectively among a large collection of documents.

We have designed and implemented a hierarchical document clustering system. The learning materials are automatically organized into a hierarchical structure based on the similarities among documents. Consequently, a multi-document hierarchical summarization system is developed. The system provides a critical tool for e-learning. It helps the learner to study a large number of learning material within a short period.

2 Hierarchical Summarization Model

The information overloading problem can be solved by the application of automatic summarization. A number of automatic summarization techniques have been developed [1][4][6]. The hierarchical summarization model was proposed to summarize a large document based on the hierarchical structure and salient features of the document [25]. Experimental results have shown that the hierarchical summarization model is a promising summarization technique.

Traditional automatic text summarization is the selection of sentences from the source document based on their significances to the document [1][6]. The selection of sentences is conducted based on the salient features of the document. The thematic, location, and heading are the most widely used summarization features.

- The thematic feature is first identified by Luhn [6]. Edmundson proposed to assign the thematic weight to keyword based on term frequency, and the sentence thematic score as the sum of thematic weight of constituent keywords [1]. Nowadays, the *tfidf* (Term Frequency, Inverse Document Frequency) method is the most widely used method to calculate the thematic weight of keywords [16].
- It is believed that the topic sentences tend to occur at the beginning or the end of documents or paragraphs [1]. Edmondson proposed to assign positive weights to sentences as location score according to their ordinal position in the document.
- The heading feature is proposed based on the hypothesis that the author conceives the heading as circumscribing the subject matter of the document. When the author partitions the document into major sections, he summarizes them by choosing appropriate headings [1]. A heading glossary is a list of words, consisting of all the words in headings, with weights. The heading score of sentence is calculated by the sum of heading weight of its constituent words.

Typical summarization systems select a combination of summarization features [1][6], the sentence significance score is calculated as sum of feature scores. The sentences with sentence significance score higher than a threshold value are selected as summary.

A large document has a hierarchical structure with several levels, chapters, sections, subsections, paragraphs, sentences, and terms. Related studies have shown that the hierarchical structure of document is very useful for human abstraction process [2], and automatic summarization [19]. Hierarchical summarization model was proposed to generate summary based on the hierarchical structure and salient features of the document [25].

The original document is partitioned into range blocks according to its document structure. The document is then transformed into a hierarchical tree structure, where each range block is represented by a node in the tree. The summarization system calculates the number of sentences to be extracted according to the compression ratio. The number of sentences is assigned to the root of tree as the quota of sentences. The system calculates the significance score of each node by summing up the sentence scores of all sentences under the nodes. The quota of sentences is allocated to child-nodes by propagation, i.e., the quota of parent node is shared by its child-nodes directly proportional to their significance score. The quota is then iteratively allocated to child-nodes of child-nodes until the quota allocated is less than a threshold value and the node can be transformed to some key sentences by traditional summarization methods.

3 Hierarchical Summarization for Multiple Documents

Multi-document summarization techniques have been developed for flat-structured documents. However, a collection of related documents may exhibit a much more complicated structure. As it was shown that the document structure is important in summarization, three hierarchical structures were proposed to organize a collection of news stories [21].

Multi-document summarization systems have been developed in the past [9][10][16][17]. Typically, the summarization systems consider a collection of documents as a set of individual documents with flat-structure. Given a set of documents, some summarization systems extract concepts and their relationships, and then integrate the extracted information as a summary [16][17]. Alternatively, some systems segment the documents into some small text units. They compute the similarities among the text units [9]. Then, the text units are extracted based on their similarity measurement to generate summaries. However, a collection of related documents exhibit a more complicated structure. At the initial step, we investigate the summarization of a collection of news stories related to an incident. Each news story is associated with a time stamp. Moreover, the news stories can be classified into event topics [22]. Current summarization system cannot capture the above information. As a result, a multi-document summarization system for structured document is required.

In order to have a better understanding of news stories related to an incident, two incidents have been analyzed. Related news stories have been collected from the CNN.com. The first incident is the “Madrid Train Bombing” in Spain on March 11th, 2004. The second incident is the “Beslan School Hostage Crisis” in a Russian town on

September 1st, 2004. In the figure of distribution of news stories against time, obvious peaks can be identified at the beginning (Figure 1). The peaks correspond to the burst of the incidents. Then, the number of news stories decreases as time goes by. As shown in the Figure 1, the “Madrid Train Bombing” has a more long-term impact. Therefore, there are more news stories and last for a longer period.

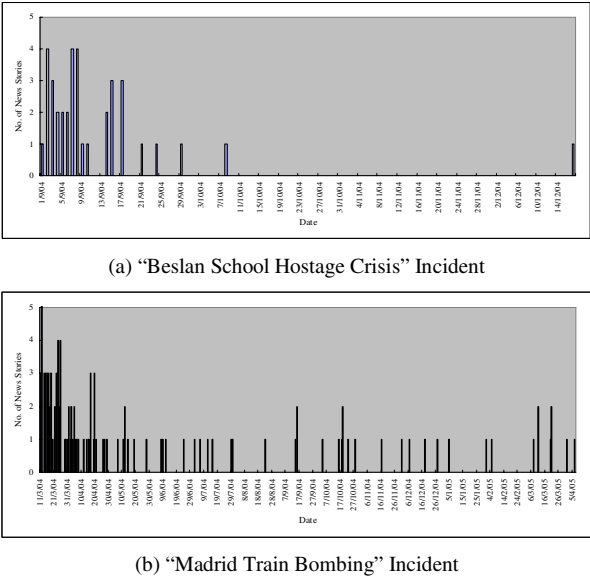
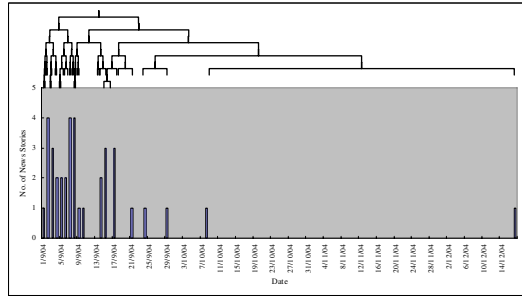


Fig. 1. Distribution of News Stories vs. Time

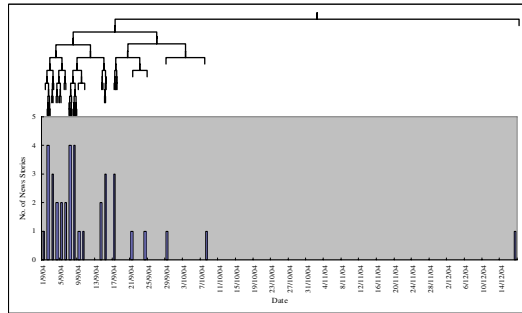
There is a large collection of news stories related to an incident. It is difficult for a human to view all the information without a structure. When a human professional writes a document about an incident, he partitions the information into chapters and then sections. As human is the best summarizer, a high quality summarization system should work similarly as human [2]. Therefore, the collection of news stories must be organized into a hierarchical structure before applying the summarization techniques. In Figure 1, a large number of news stories spread out over an interval of time. By intuition, we propose to organize the news stories by number of documents as well as by time interval. It is also believed that a set of news stories may contain several event topics [22], which are very important during information extraction. As a result, three hierarchical structures are proposed to organize a collection of news stories.

- Results of hierarchical summarization of large documents showed that a good summary must have a wide coverage of information and extract information distributively [25]. Moreover, when an author writes a document, he distributes the information into units. Combining these observations together, we propose to organize the news stories into a hierarchical tree by number of documents (Figure 1a). The news stories are sorted by chronological order and then organized as balanced hierarchical tree, such that each node at the same level contains approximately the

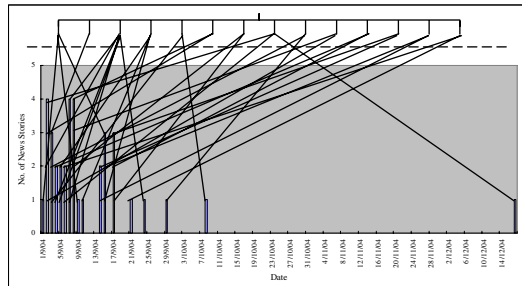
same number of news stories. Because the information contents are evenly distributed into the tree structure, hierarchical summarization will extract information distributively. To simplify our discussion, we focus on binary tree in this section. The figures in this paper show the news tree up to news stories level only. Tree structure exists within the news story.



(a) Hieratical Structure by Number of Documents



(b) Hieratical Structure by Time Interval



(c) Hieratical Structure by Event Topics

Fig. 2. Hierarchical Structure of “Beslan School Hostage Crisis” Incident by Event Topics

- Temporal text mining discovers temporal pattern inside the text information [11]. Similar technique has been used in multi-document summarization [10], summarization of news stories are generated for fixed number of days, then an overall summary is generated. Therefore, we propose the hierarchical structure by time interval (Figure 2b). The news stories are organized into a hierarchical structure such

that each child node represents an equal and non-overlapping interval. Unlike the hierarchical structure by number of documents, the hierarchical structure by time interval is an unbalanced tree structure. Therefore, the information is not evenly distributed into node blocks.

- It is believed that a collection of news stories may contain several event topics, the detection of event topics is very important in information retrieval [22]. Recent research in automatic summarization proposes to classify the documents into document set before summarization [15]. Therefore, we propose the hierarchical structure by event topics (Figure 2c). Because the accuracy of event topic detection affects the performance of the summarization directly, the news stories are clustered into event topics by qualified human professionals in our experiment. Each event topic is represented as a child node under the root node. The news stories under the event topics are then the child nodes of events. The hierarchical structure by event topic is not a balanced tree.

Hierarchical summarization is applied to summarize the news stories with different hierarchical structures. The system generates a summary for each range block, and then the summaries of range blocks are concatenated as an overall summary for the collection of news stories. When the number of news stories inside a range block is too large, iterative partition of range block into sub-range blocks is required and the hierarchical summarization technique will be applied to summarize the range blocks. The hierarchical summarization for multiple documents is very similar to the hierarchical summarization of a large document [22][25], only some minor modifications are required to demonstrate the characteristic of the news stories.

- Firstly, there is no heading for the internal nodes in the tree. As a result, the heading feature considers only the headings of news stories and the theme of the incident.
- Traditional summarization assumes that the importance of a sentence is indicated by its location. The news stories inside a node are considered as equally significant regardless its location inside the node. Therefore, the location feature is not considered during hierarchical summarization of the tree structure. However, if the range block is small enough, for example, selection of sentences within a news story, the location feature will be considered.

4 Impact of Hierarchical Structure on Summarization

A collection of related documents can be organized into hierarchical tree structures by different classification. They have a different distribution of information contents among the nodes inside the tree. It may have a significant impact on the summarization technique. In this section, we will investigate the impact of hierarchical structure on the accuracy of automatic text summarization.

The comparison of summarization system is very difficult, because different research uses different data sets and different ground-rules. The TIPSTER Text Summarization Evaluation (SUMMAC) is the first large scale, developer-independent evaluation of automatic summarization systems [8]. The SUMMAC has identified two categories of methods for evaluating text summarization.

Intrinsic evaluation is the most straight forward method to measure the quality of system summaries. It judges the quality of summaries by direct analyses in terms of some set of norms. One of the most common approaches is to match a system summary against an ideal summary. We have conducted intrinsic evaluation for hierarchical summarization of multiple documents. The system summaries are compared with human abstracts to measure the quality of summaries by gold standard [4]. The detailed results are reported in [21][22].

As we would like to investigate the impact of document structure on summarization for e-learning, we measure the quality of summary by extrinsic evaluation which judges the quality of the summarization based on how it affects the completion of some other tasks.

4.1 Experimental Setting

Among the extrinsic evaluations, the question-answering task is to find the “informativeness” of a summary, namely, the degree to which it contains answers found in the source document to a set of topic-related questions [8]. The question-answering task has been proved as a promising method for automated evaluation of summarization [8]. The quality of summaries will be measured by question-answering task in our study.

Given a collection of news stories, human professionals are requested to prepare a set of topic-related questions and the answer keys using a common set of guidelines [26]. These questions cover some essential information that is provided in any of the news stories. We have conducted experiments on the previous two incidents. The recall of the summarization is defined as the percentage of answers that can be found in the system summaries [8].

In most literatures, the compression ratio for summarization is chosen as 25% because it has been shown that extraction of 20% sentences can be as informative as the full text of the source document [14]. However, it is believed that the highly-compressed abstracting is more useful [19]. Therefore, we have conducted the experiments from 5% to 25% for each interval of 5%. In the question-answering task, the set of questions and their answer keys can be used for evaluation at different compression ratios. Therefore, it is feasible to conduct experiments with different settings without increase in the workload on the human professionals.

In our previous discussion, the number of children (degree) of a tree is limited to two for hierarchical tree by number of documents and by time interval. However, there may be a large number of children in the hierarchical tree by event topics. The number of children nodes will significantly affect the distribution of information. In order to have a fair comparison, we have conducted the experiment to summarize hierarchical tree with different number of child nodes for these two hierarchical structures.

4.2 Evaluation of Summarization

We have conducted experiments from 5% to 25% for each interval of 5% (Figure 3). We have compared the recall of summarization of hierarchical trees with different degrees by t-test. All hypotheses are rejected at 75% significance levels. It shows that there is no significant difference between different degrees. As a result, we take the mean of recalls of one hierarchical structure with different degrees as the overall recall of the hierarchical structure (Figure 4).

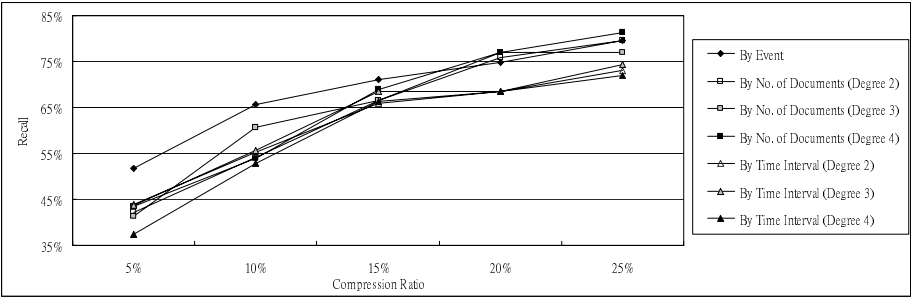


Fig. 3. Recall of Summaries in the Q&A Task for All Hierarchical Structures

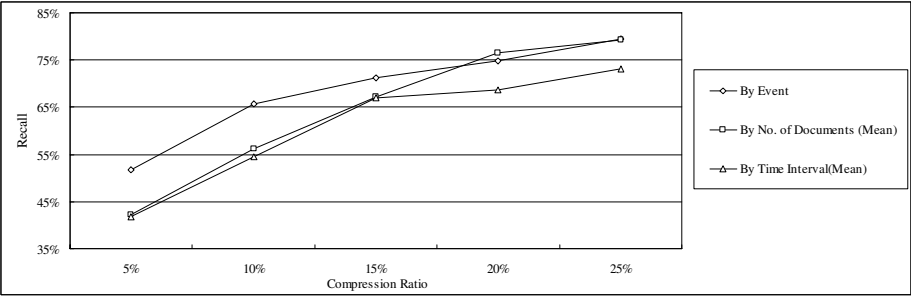


Fig. 4. Average Recall of Summaries in Q&A Task for Three Hierarchical Structures

The experimental results have shown that the degree of a hierarchical tree will not affect the accuracy of hierarchical summarization. It could be explained by the fact that the hierarchical summarization calculates the significance score of a node by measuring the amount of information contents inside the node, and the quotas are assigned to the nodes directly proportional to their significance score. Therefore, the summarization process is not affected by the degree of a hierarchical tree.

We have compared the recalls of summarization using different hierarchical structures at different compression ratios. By t-test analysis, we find that there is no major difference between the hierarchical summarization by number of documents and by time interval. However, we find that hierarchical summarization by event topics outperforms hierarchical summarization by number of documents and by time interval at 90% significance level, when the document is highly compressed, i.e., 5% and 10% compression ratio. However, as compression ratio increases, the recall increases and the difference diminishes. When the compression ratio is 15%, hierarchical summarization by event topics outperforms hierarchical summarization by number of documents, but there is no difference between hierarchical summarization by event topics and hierarchical summarization by time interval. When the compression ratio further increases, there is no significant difference identified among three hierarchical structures.

Because extraction of 20% sentences can be as informative as the full text of the source document [14], when the compression ratio is higher than 20%, most of the summarization systems can produce a summary as informative as the full text. Therefore, there is no significant advantage for hierarchical summarization by event topics

over the other two. However, highly-compressed summarization is much more useful [19]. Hierarchical summarization by event topics outperforms the other two structures, when the summary is highly compressed. Therefore, it provides a useful information extraction tool. In this study, the documents are clustered into event topics by human professionals. Further study will be conducted to investigate how the summarization is affected by clustering techniques in the future.

Finally, in the question-answering task of the SUMMAC, it is found that the summarization systems achieve the peak value of recall when the compression ratio is 35% to 40% [8]. Most of the system recorded a recall about 60% [8]. Our system achieves a recall of 60% when the compression ratio is 10%, and a recall of 70% when the compression ratio is 20%. Hierarchical summarization of news stories organized in tree structure outperforms the participants in the SUMMAC. The results in the question-answering task show that our system is a promising system for multi-document summarization. It can extract the information from the source document effectively and produce an informative summary.

5 Multi-document Summarization with Automatic Hierarchical Clustering

Experimental results show that the hierarchical summarization of multiple documents organized in a hierarchical structure outperforms significantly the automatic summarization of multiple documents without using hierarchical structure. It is also shown that hierarchical summarizations by event topics outperform the other two hierarchical structures when the summary is highly-compressed. As there is a large volume of learning material for e-learning, a fully-automated system is more desired.

We have designed and implemented an automatic hierarchical clustering system for text documents. The system will organize a collection of documents into a hierarchical tree based on their similarity measurements. This technique together with the hierarchical summarization provides a complete solution for automatic multi-document summarization.

5.1 Hierarchical Clustering for Text Document

Clustering is a well-known problem in data mining. It partitions a collection of objects into clusters, such that those objects within each cluster are more closely related to one another than objects assigned to different clusters. There are two major methods of clustering. The k -mean clustering partitions the objects into k disjoint clusters. In hierarchical clustering, objects are organized a hierarchical tree [5]. Hierarchical clustering is subdivided into agglomerative methods and divisive methods. The agglomerative methods apply bottom-up approach to combine objects into groups recursively. The divisive methods apply top-down approach to separate objects into groups recursively.

Hierarchical clustering may be represented by a two dimensional diagram known as dendrogram which illustrates the fusions or divisions made at each successive stage of analysis (Fig. 5).

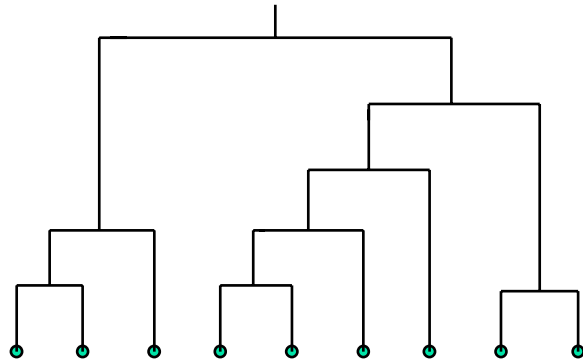


Fig. 5. An Example of Dendrogram in Hierarchical clustering

The central of cluster analysis is the notion of degree of similarity between the individual objects being clustered. Traditionally, the document clustering algorithms measure document similarity by presence of common keywords among documents. The traditional approaches compare documents by string matching only. However, they do not consider the semantic meaning of keywords.

Event detection technique has been developed [24]. We have implemented the event detection technique. We cluster a set of documents into document groups as events. As some events may be more closed related than others, we measure the distance among events. A hierarchical structure for a set of incident-related documents is constructed accordingly by using the hierarchical clustering technique.

5.2 Evaluation of Multi-document Summarization with Automatic Hierarchical Clustering

In last section, we measure the performance of automatic summarization with different hierarchical structures. For the multi-document summarization with automatic hierarchical clustering, we have repeated the same experiment with same set of document. The recalls of summarization at different compression ratio are shown in Fig. 6.

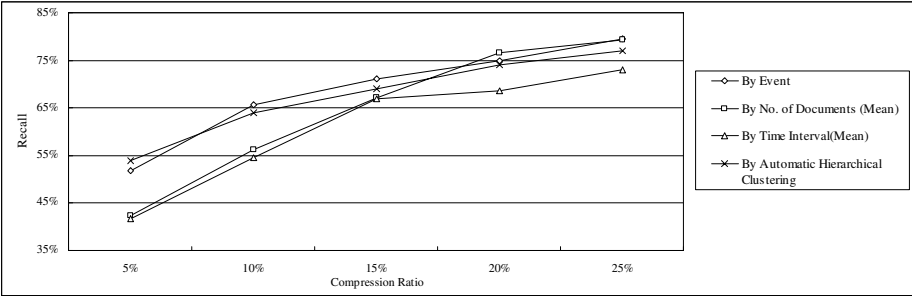


Fig. 6. Recall of Summaries in the Q&A Task

As shown in the Fig. 6, the hierarchical summarization with automatic clustering has outstanding performance. When the compression ratio is high, the hierarchical summarization with automatic clustering outperforms the other techniques. As the compression ratio, hierarchical summarization by automatic clustering can still get a similar recall as hierarchical summarization by event topics.

Because there is a large amount of learning material available, a highly-compressed summarization is more desired. On the other hand, the hierarchical summarization with automatic clustering performs the best when the compression ratio is high. Summing up the above, hierarchical summarization with automatic clustering provides an indispensable tool for effective learning.

6 Conclusion

Automatic summarization of multiple documents is very useful to extract most important information from a large collection of text documents. Three hierarchical structures have been proposed for organization of documents. Experimental results show that the hierarchical summarization of multiple documents organized in a hierarchical structure outperforms significantly the automatic summarization of multiple documents without using hierarchical structure. It is also shown that hierarchical summarizations by human detection of event topics outperform the other two hierarchical structures when the summary is highly-compressed. Hierarchical clustering with machine detection of event topic has been implemented. It is integrated with hierarchical summarization to provide an automatic multi-document summarization for e-learning. It has been shown that hierarchical summarization with automatic clustering has a good performance when the summary is highly-compressed. This novel technique can extract essential information from a large number of documents effectively. It provides a useful tool for e-learning.

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From an Online Training Course to a “Virtual” Teacher Training Academy—Design and Implementation of Peking University Asynchronous Online Teacher Training Program

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Abstract. Online Training has become the major model for a large scale in-service teacher training in China. What kinds of Online Course can meet K-12 teachers demands, and engage them in online learning activities? It is a big challenge for the designer of online teacher training course. The online teacher training course introduced in this paper refers to an asynchronous online course mode prevailing in America, was designed elaborately in content, learning activities, evaluation, and course management system and feedback policy, and achieved well-pleasing training performances. With this course is advocated, a teacher training academy has been built in Internet.

Keywords: Online course, teacher training, Online classroom, Procedural evaluation, educational technology competence construction plan.

1 Introduction

In order to catch up with the development of quality-oriented education and the reform of the basic education, and to integrate ICT into K-12 curriculum, the Ministry of Education of China(MOE) has launched and implemented the Educational Technology Competence Construction Plan for K-12 Teachers throughout the country, with an aim to fully enhance the education technology application competence of K-12 Teachers, to integrate ICT into K-12 curriculum. In December 2004, the Ministry of Education promulgated Educational Technology Competence Construction Plan for K-12 Teachers and developed two sets of training materials.

In 2005, the Teacher-training Bureau of MOE empowered Peking University and the East China Normal University to develop the online training course of Educational Technology Competence Construction for K-12 Teachers on the basis of the two sets of training materials. During May – September 2006, refers to the asynchronous online course mode of SUNY Learning Network, School of Education(GSE) of Peking University designed the online course content, activities and structure (the author is the chief designer) at first, and then completed the development of online courseware, course platforms, online learning activities and procedural evaluation, and the Learners’ Manual and Teachers’ Manual, cooperated with the School of Distance Learning, Peking University.

In accordance with the schedule of the Project Office of Educational Technology Competence Construction Plan of K-12 Teachers, during November 2006- January 2007, Peking University trained nearly 200 K-12 teachers from Shenzhen of Guangdong, Shenyang of Liaoning and Urumqi of Sinkiang, the pilot online training achieved satisfactory achievements. In February 2007, this online training course passed the expert review organized by the Teacher-training Bureau of MOE, and was recommended to the whole country. May 2007, the Project Office of Educational Technology Competence Construction Plan of K-12 Teachers signed the GSE of Peking University to train 172 national-level backbone teachers from nine provinces in hybrid model.

From 2007 to 2009, over 120,000 K-12 Teachers enrolled this online training course in the School of Distance Learning of Peking University and Guangzhou Distance Education Center. By the end of 2008, the School of Distance Learning of Peking University has trained more than 60,000 teachers from multiple provinces and autonomous regions such as Guangdong, Guangxi, Sichuan, Sinkiang and Inner Mongolia. Guangzhou Distance Education Center has trained at least 60,000 teachers. In 2009, nearly 90,000 K-12 teachers have applied to enroll this online training course in the School of Distance Learning of Peking University.

The quality of this online training course has also been affirmed by the k-12 teachers. In November 2007, the MOE held a distance training conference for K-12 Teachers in Guangzhou. According to the conference presentation submitted by Peking University, 48% of the trained K-12 teachers are of the opinion that, in terms of effect, the online training is better than the ordinary lecturing training; 47% of them think that it equals to the ordinary lecturing training; only 3% of them do not think that it is superior to the ordinary lecturing training.

Furthermore, the feedbacks from Shenzhen Audio-visual Education Office, Sinkiang Audio-visual Education Office and Guangzhou Bureau of Education, the postings on the online chat-room, including a poem composed especially for this online training course by a Shenzhen Math teacher, also demonstrate that this highly interactive and asynchronous network course mode which is widely adopted in America online learning, has successfully “landed” in China, and was recognized as a successful online teacher training mode. By imitating the training mode of this online course, Guangzhou Distance Education Center and the School of Distance Learning of Peking University have developed more online training courses, for example, “head teacher training course”, and attain satisfying achievement.

Based on the online training course, tied by the course management system, the School of Distance Learning of Peking University and Guangzhou Distance Education Center have established a team of online training supervisors and online tutors spread all over the country, and formed a pyramid “virtual” network teacher training academy, as shown in Fig. 1.

Taking the School of Distance Learning of Peking University as an example, there are about 10 supervisors in the pyramid structure; 400 “online tutors” team from all over the country. The recruitment, management and teaching performance monitor of online tutors were implemented totally online. More than 60,000 learners come from eastern developed regions including Guangdong, Jiangsu and Shandong as well as western regions including Sinkiang and Guangxi.

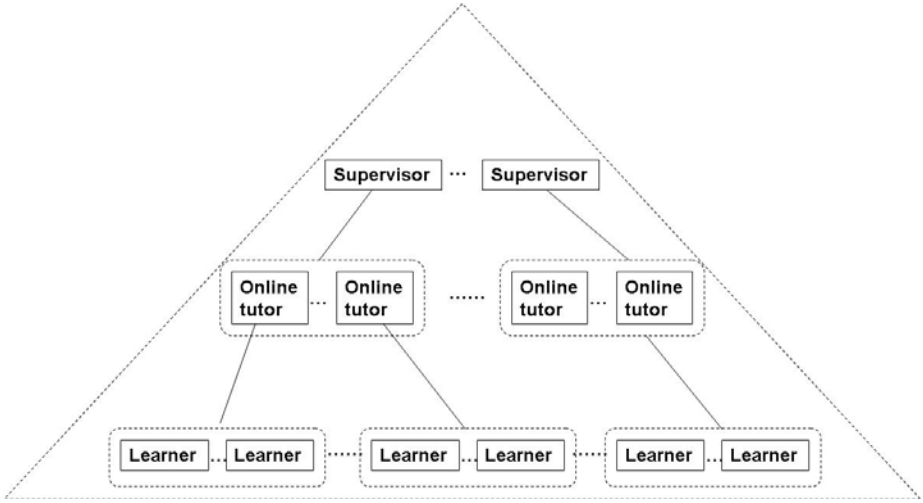


Fig. 1. Pyramid virtual network teacher training academy

From an online training course to a “virtual” teacher training academy, the Ministry of Education and the Project Office makes every effort to improve the event. Meanwhile, features of this online training course also make their unique contributions to the progress of the project.

2 The Fundamentals of This Online Teacher Training Course

Two fundamentals run through the stage of the online course design. The first is integrating teachers’ on-hand experiences into the online course as a unique training resource, thus solving the issue of separation between theory and practice in teacher training. The second is highlighting the human-to-human communication in the online course, learn the advantages of the asynchronous online learning mode of SUNY Learning Network, and solve the problem of emphasizing the multimedia presentation of the content and neglecting human-to-human dynamic communication in China’s online learning practice.

2.1 Integrating Teachers’ On-Hand Experiences into the Online Course as a Unique Training Resource

Teacher training falls into the category of adult learning. The teacher’s knowledge and experience form the basis of teacher professional development. Meanwhile, the existing knowledge and experience can be a filter, a large quantity of training contents will be filtered out by an experienced teacher. This makes the designing of teacher training course to be a tough task, and leads to the lower satisfaction of teacher training course.

Teaching is a creative labor. Any expert, no matter how advanced he is, is unable to stay with students day by day, and to deal with various unexpected events as k-12 teachers. The teacher' on-hand experience is a unique training resource. The key of a successful teacher training course is to integrate the teacher' on-hand experiences into the training course as a unique learning resource, and to link the theory and the practice to promote the development of teacher.

2.2 Highlighting Human-to-Human Dynamic Communication

Dr. Thomas Hulsmann, a German expert of distance education, classifies the application of ICT in distance education into two types: Type I(information) application, focusing on the human-to-content interaction. Type C(communication) application, focusing on continual communication between teachers and students. I+C gives prominence to the feature of modern information technology (ICT, Information Communication Technology), and also embodies the largest difference between the web-based distance education and radio&TV-based distance education.

In accordance with Thomas Hulsmann classification, online education represented by the courseware of three-part-separated screen and hyperlink courseware adopted currently by 68 network education pilot colleges in China is much closer to Type I application. The asynchronous online course adopted by SUNY Learning Network, using textbooks as major teaching materials (no courseware is developed), relied on the continual online learning activities, is representative Type C application. In online education practice of China, Type C online course is rare. The Online training course of the Educational Technology Competence Construction Plan developed by Peking University has performed a profound exploration in this field.

3 Design of Online Teacher Training Course

Continual communication between teachers and students is not only a task at the stage of online course implementation, but also a central task throughout the course design and implementation. The continual communication between teachers and students shall be put into practice in all stages, including courseware content designing, online learning activities designing and procedural evaluation plan, function development of the course management system and implementing process.

3.1 Expression of Courseware Content: Creating a Pleasant Reading Atmosphere by Using Cases and Stories

The contents were introduced in a dialog style, and equipped with proper cases and stories to create a desirable reading atmosphere, to facilitate the communication between learners and contents.

Stories and cases are able to make abstract texts more specific and vivid. See the examples below.

What is Opportunity Cost?

Case I: the opportunity cost means proceeds brought about by other business lost for the purpose of engaging one business.

Case II: Should Jordan trim the lawn by himself?

Michael Jordan, the best NBA player, can also do other things quite well. For example, he is able to trim his lawn within 1 hour. Just within 1 hour, he may also earn ten thousand US dollars by filming a sports shoe advertisement. In comparison with him, Jennifer, a little girl from his neighbor, can trim Jordan's lawn within 4 hours. Within such four hours, she may work for Macdonald's at revenue of \$20. In lawn trimming, the opportunity cost for Jordan is \$10,000, while the opportunity cost for Jennifer is \$20. In this case, should Jordan trim the lawn by himself?

The first type is completely expressed in the form of definition, so it is obscure and uninteresting. The second type, introducing “opportunity cost” in the form of stories, is both vivid and interesting, and enables readers to make judgment by using “opportunity cost” automatically when they confront a choice. It is obvious to see which expression mode is more suitable for a learner of the distance course.

The courseware of Peking University Online training course of Educational Technology Competence Construction Plan of K-12 Teachers provides large quantities of stories and cases related to the concepts of educational technology, enhances the reading pleasure and the reading enthusiasm of trainee.

3.2 Empirical Rules of Online Activities Design: Conciseness and Consistency

The Empirical rules SUNY Learning Network told us: (1) the teaching process must be simple and concise; (2) teaching activities shall be kept consistent. The two empirical rules are aimed to: focus the learners' attention on the learning task instead of on the technical platforms and teaching means.

To implement the two rules, Peking University Online training course of Educational Technology Competence Construction of K-12 Teachers has elaborately chosen three kinds of online learning activities: reading quiz, threaded-discussion and assignment. The learning activities are identical roughly in 8 modules, and thus consistency is maintained.

The roles of the three learning activities respectively are: (1) the quizzes can facilitate independent learning (reading) really happen, and help the learners to pass the National Educational Technology Competence Examination hosted by MOE. (2) the threaded-discussions intends to promote the communication among learners(K-12 teachers), and guide learners to share their teaching experience and teaching stories. (3) the assignments can effectively link the theory and experience, and transfer knowledge into practice, and in addition, the 5 assignments cover major operative skills in National Educational Technology Competence Examination.

3.3 Procedural Evaluation: Effective Learning Process Management Measures of Online Learning

Procedural evaluation is the most important teaching management measure in asynchronous online learning. Without a reasonable evaluation scheme, even a better content can not make online learning really happen. In this online course of Educational Technology Competence Construction, the designer distribute the total 100 scores to 21 learning activities of 8 modules, as shown in Fig. 1. The score of each online learning activity will be accumulated to form the final grade of the trainee.

Table 1. Scheme for procedural evaluation

	Reading quiz	Discussion	Assignment	Total scores of modules
Module 1	1.2	1.8		3
Module 2	2.8	5.6	5.6	14
Module 3	2.8	5.6	5.6	14
Module 4	3.6	5.4		9
Module 5	4	6	10	20
Module 6	4	6	10	20
Module 7	2.8	5.6	5.6	14
Module 8		3	3	6
Total scores	100			

In table 1, the quiz is graded by the system automatically; discussion and assignment are graded by the online tutor.

This procedural evaluation of asynchronous online learning takes into account both learning quantity and quality. Firstly, distributing the 100 scores to 21 learning activities indicates that every learner should take part in the 21 learning activities to communicate with content, peers and teachers. Secondly, the Rating Scale of each online learning activity, either graded by system automatically or by online tutors, puts a clear criterion for the communication quality.

To sum up, the procedural evaluation scheme puts forward a clear requirement for both communication quantity and the communication quality, to ensure the learners to engage the online learning activities.

3.4 Designing of the “Online Classroom”

With regard to the design of a course management system, the following two aspects shall be taken into account:

3.4.1 A Course Management System(CMS) Is Just Like a Web-Based Campus, Its Core Unit Is the “Online Classroom”. The Functions of CMS Have to Support Diverse “Classroom” Teaching and Learning Events to Make Online Teaching and Learning Work

Taking this course as an example, the CMS shall support the content (courseware) presentation; support teaching activities including quiz, discussion and assignment; and support the procedural evaluation scheme(system automatic scoring and tutor scoring).

The CMS supported this online course was developed based on Moodle. The team designed the online course activities and evaluation scheme at first; Secondly, tested several open source CMS systems and two off-the-shelf online learning platform, and found Moodle supported the three activities and most features of procedural evaluation. Finally, we chose Moodle as the platform, and added two evaluation features to support this online training program.

3.4.2 The Interface of the CMS Shall Conform to the Learner’s Habit and Create a Comfortable Feeling for the Learner

The “comfortable feeling” is a new topic of the web-based interface design, and also a factor which is considered rarely in China online education practice. Currently, in 68 network education colleges of China, the interface of learning platform system are typically “technical function-centered”, arranged in accordance with technical function modules, for instance, learning resources, BBS, lecture video, and so on. To complete a learning task, a learner has to enter into and from different function modules frequently, many online learners fall out because of failure to find out the locations for handing in their assignment and posting.

<i>Module 1: Orientation</i> Date: from 22nd to 24th Background of this Program:  Lecture: Introduction of this Online Course Learning Activity:  Ice-breaker 1: Affirm your information  Ice-breaker 2: Syllabus  Ice-breaker 3: Introduce myself Reading and Test:  Reading 1: What is Educational Technology  Reading 2: Definition of ET  Quiz
<i>Module 2: Analyze Learner and State Objectives</i> Date: from 25th to 27th Reading and quiz  Reading 1: Fundamentals of Learning  Reading 2: Instructional Design  Reading 3: State Objectives  Reading 4: Analyze Learners  Quiz Discussion:  What is the right stuff for our kids? Assignment:  Learners Analysis and State Objectives

Fig. 2. Network Course Interface

Usually, learners have used to the “potential rule” of physical classroom teaching and learning: fixed learning space; the schedule of meeting every week or every day. The learners’ habit were shaped by the “potential rules” of physical classroom. When “learning” moves from “physical classroom” to “online classroom”, the learners still hold their habits.

In consideration of learners’ habit, when we design the online training course, we highlight two features in interface design: (1) All learning events(learning resources, learning activities, teacher’s message, so on) are arranged in the course homepage (relatively stationary online learning space); (2) All learning activities are arranged according to time cue, learners expend little effort making sense what the learning events are, and use most of their mental effort to engage into online learning events, for example, reading, quiz, discussion and assignment, and achieve the learning objectives. See Fig. 2.

The course homepage creates an “online classroom” conforming to learners’ learning habits, and the interface items of the course homepage may correspond to the physics classroom. For example,

- Course homepage, as a virtual space on the network corresponding to a physical classroom.
- “Reading materials” corresponds to the text and “blackboard” in the classroom, responsible for contents presentation.
- “Quiz” corresponds to quiz and examination in a physical classroom.
- “Threaded Discussion” corresponds to the group study and discussions in a physical classroom.
- “Assignment” corresponds to homework assigned by teachers. The difference between a physical classroom and online classroom lies in that the comments and scores given by online tutors are recorded in the CMS, and the students’ grades were calculated automatically.

The “online classroom” and time cue can greatly reduce the disorientation caused by learners’ frequent entry into and going out of each module, have learners to focus on reading, discussion and assignment effectively, and thus increase teaching quality and finish rate. This is a major reason that the online training course of Educational Technology Competence Construction Plan has been widely popularized without establishment of an out-campus “learning center”.

3.5 Management of Teaching Process: Training Manual

To ensure the completion of the teaching tasks designed previously, the project group has developed the Learners’ Manual and Trainers’ Manual, and clearly specified tasks to be completed by online learners, and the feedbacks to be provided by online tutors.

To summarize, this online training course is composed of the following elements:

Online course = content (courseware) + learning events (activity + evaluation) + CMS features + two manuals.

4 Implementation of Online Teacher Training Course: Feedbacks

The designed size of class is about 50, and each class is facilitated by two online tutors. Three pilot training classes were implemented in this size and 1:25 ratio. However, when this online training course was promoted to more and more Provinces, for lack of qualified tutors and the limited expense, the size of class actually ranges from 60 to 120, and the training attainment goes down as compared with the three pilot classes, but overall satisfaction is still better than general lecturing training.

In the course of training, the major tasks of tutors and trainees are to complete each task as required in the Learners’ Manual and Trainers’ Manual. Communications between tutors and learners and between learners are mainly carried out through four types of feedbacks: regular feedback, evaluation feedback, teaching feedback and group feedback.

4.1 Regular Feedback: 24-h Feedback and 3 Times Summary

As prescribed in the Trainers’ Manual, a tutor shall response to the learners within 24 hours (including discussion and assignment). The Manual also suggests tutors should respond to learners in a certain period of time every day on a regular basis.

Apart from the 24-h feedback, the Trainers’ Manual also asks tutor to post 3 teaching summaries in course homepage to comment the performances of online learners, and give explanations in texts in light of common problems. The three postings just like “lecture” in words, and guide the learners to go through the online training, and achieve the training objectives.

In addition, tutors can also post messages in the “notice area” and “module area” on the course homepage if they need. Usually, tutors can post messages to prompt the deadline of quiz and assignment, or to recommend an excellent posting of a learner to be a new learning resource. With such feedbacks, tutors can deliver their effort to engage learners in online learning.

4.2 Evaluation Feedback: Help Learners to Voice Their Point Based on “Evidences”, Avoiding “Labeling”

In this asynchronous online training course, a trainee is expected to import their teaching stories and on-hand experience into the online course to be a particular training resource. This design concept is challenged at the beginning of pilot training class.

The discussion topic of Module 2 is: what is the right stuff for our kids? In order to help learners to consider this issue and frame their posting, we provided two cases of historical classes in the discussion scaffold: (1) A historical class for American children; (2) Teaching design of peasant wars in late Ming Dynasty and Qing Army going through Shanhai Pass. The scaffold requires the trainees to figure out their posting based on the two cases.

In the first pilot online training class, we find that a large number of trainees like to use label-type discussion sentences, such as “America is....., China is”, “America pursues....., China pursues.....”, affixing different labels of “constructionism” vs “behaviorism”, “quality-oriented education” vs “examination-oriented education”, and “situated learning” vs “learn by rote” to the two cases.

The label-type discussion has bothered the trainees(K-12 teachers) to express their points based on their experience and reflection. In order to correct this status of “labeling” and encourage the trainees integrating theory with their practice and state

their point based on “evidence”, tutors scored and commented every posting to explain why the posting was scored high or low. By using evaluation feedback, tutors encouraged trainees to contribute their teaching stories to the online course, and share their on-hand experience each other, and come into an explanation about “what is the right stuff for our kids” themselves.

4.3 Teaching Feedback: “Lecturing” in Word

The discussion topic of Module 4 is “Search and recommend fine websites”. When designing the topic, we intend that “everyone helps each other”, namely, each person shall contribute “good” websites visited by him/her frequently so that every learner attending the online training course can set up his/her own website list of teaching materials and resources.

When carrying out the first pilot class in Heping Teachers' Continuing Education College, Shenyang, the tutor found that although the Internet is no boundary, the habit of trainees in browsing websites is characterized by some territoriality. Therefore, on the “notice area” of course homepage, the tutor posted a “lecturing” posting:

Heping Education Website Ranks Third

A few days ago, researchers surveyed the influential power of basic education websites in China. The survey was carried out within a discussion board of an online teacher training course. Firstly, K-12 teachers were asked to post the influential education websites; secondly, they were required to reply the posting to vote the website recommended. Finally, researchers calculated the score for each website with the formula: website score = number of posting * 2 + number of replies * 1.

The result shows CERSP ranks first, and Heping Education Website shares the third place with Suzhou Middle School Website at the score of 8.

How can we judge the ranking?

As a teacher from Heping District attending the training, you are sure to say that the survey cannot represent the situation throughout the country because it is conducted in Heping online teacher training course. Certainly, the survey bears an obvious problem of “sample bias”.

Apart from sample bias, factors influencing survey results may be: orientation of survey index, unreasonable data analysis methods, etc. Therefore, when viewing various rankings(for example, universities ranking, millionaire ranking, and so on) on newspapers and websites, you have be sure to understand what analytical process is used to get the result, and whether the sample can reflect the whole feature of the survey object.

In the era of information explosion, teachers and students must learn to decode the mass media critically, it is an important element of “media literacy”.

This “lecturing” posting impressed the media literacy with a story, and guided learners to access mass media in a critical manner, thus enriched the contents of the online training course.

4.4 Group Feedback in Distance Teaching: Cooperation between Trainees and between Tutors and Trainees

The discussion topic of Module 7 is “How to effectively use performance evaluation”, the teacher Zhang from Shenzhen designed a winter vacation homework for a science class, with an aim to judge the learning results of students by using performance evaluation.

Due to the openness of learning materials and learning results, this homework design is more difficult than ordinary class design. On the basis of teacher Zhang’s posting, trainees of his group give him advices, and tutors and experts¹ also participate. Finally, they help teacher Zhang to design a scheme for winter vacation events, which is described below:

Let the Vacation a Little Different

During the vacation, in terms of one finding or invention in the history of science or the history of development of human society, put forward some questions interesting to you, and design a learning plan, which includes:

- (1) Which aspects of the finding or invention do you want to explore?
- (2) In what ways do you plan to investigate the information? For example, collect non-fiction books, search internet, consult experts, and so on.
- (3) How to sort the information, and analyze to form your view points.
- (4) How will you report your finding to your classmates when the term begins? For example, designing a pamphlet, fabricating a PowerPoint, writing a composition about scientific findings and so on.

To provide students a starting point, a sample was provided:

Problems Interesting to Me

I have been interested in the question – Why could Bell invent a telephone. How did the idea come about? How is one invention realized and popularized after the idea is brought about? My subject plan is designed like this:

Subject: Why was the telephone invented by Bell?

My questions:

- (1) Why could Bell think of inventing a telephone? Why did other people have no such idea?
- (2) Introduce the process of Bell invented the telephone, the hardness and the memorable moments.
- (3) Depict the process of diffusion of telephone.
- (4) What role did telephone play in the social development?

I decide to search after relevant materials through the Internet, libraries and bookstores, and finally report my finding to my classmates with a PowerPoint presentation.

¹ Experts, here means the designer of this online course, she participated the pilot class from beginning to end.

To sum up, the “regular feedback”, “evaluation feedback”, “teaching feedback” and “group feedback” in the training process increase vigor of the course, add many “generative” teaching resources to the course, enhance the attraction of the online training course, build the learners’ belonging to the online class, and improve the quality and satisfaction of online training.

5 Conclusion

As the training size becomes larger, online training academy confronts new problems. The feedbacks from the School of Distance Learning of Peking University and Guangzhou Distance Education Center show the two problems to be solved urgently: (1) optimize the learning flows and management flows in accordance with learners, instructors, course management and managers, and redesign the function of CMS, and provide convenience for the further promotion of the online teacher training program; (2) strength the selection & recruitment, training and management of online tutors, and minimize the attenuation of training quality.

This “Virtual” Teacher Training Academy starting from an online course also provides a great deal of referenced experience in project management and training operation for the development of Chinese modern distance education project, and is an uncommon case of “effective practice” in the project of ICT in education of China. From now on, we will follow up and research on the teacher online training project to summarize experience, solve new issues emerging in the development, and promote the completely reformation of Chinese K-12 teachers in-service education, and provide valuable experience for further development of Chinese online education.

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The “E”-Vangelist’s Plan of Action – Exemplars of the UK Universities’ Strategies for Blended Learning

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Abstract. There have been national studies concentrating on institutional e-learning or blended learning practices in both the UK and US. Using comparative case study methods, this research adds to the growing number of studies by exploring two institutional policies and strategies for blended learning. The findings are reflected in four dimensions (1) a single strategy for blended learning promotes an institutional-wide adoption without confusion; (2) such an institutional strategy ought to be clear, simple and driven by research and support from an inter-disciplinary centre; (3) Disciplinary and individual-tailored support and external funded projects are necessary for further motivation; and (4) it is recommended to provide recognition for innovative teaching excellence and research excellence for blended learning directly from the top management.

Keywords: Hybrid Learning, Blended learning, Technology enhanced learning, Institutional Policy, Higher Education.

1 Introduction

A key part of the UK government’s mission is to use technology to bring education in life (Blair, 2006). As educators in the UK with a national commitment to technology enhanced learning and teaching, Loveless (2006) states that we live and work in interesting time, in which the cultural and political contexts of education raise challenges to many practice and beliefs. Carr-Chellma (2005) states that e-learning “democratise education and breaking down the elitist walls of the ivory tower” (p.1). Buzzwords such as e-learning, blended learning, technology enhanced learning, digital academe and digital literacy have become commonly used in the educational world. In particular, one of the most contested buzzwords is “blended learning” due to its provocative nature of highlighting face-to-face (f2f) instruction mediated by technology that fits into the common culture of higher education. “The emerging technologies in higher education have fostered the interest in blended learning” (Chew, 2008). These technological innovations impact on learning and teaching experience in higher educational institutions (HEIs). Many universities have spent much effort and resources in attempting to respond to such changes related to the digital culture.

There have been national studies concentrating on institutional e-learning or blended learning practices in both the UK and US (JISC, 2005; Allen, Seaman and Garrett, 2007; Arabasz and Baker, 2003). Most of them focused on the study of environments or perspectives for e-learning or blended learning. They were all quantitative studies with a large sample size – country-wide HEIs. This research adds to the growing number of studies by exploring the institutional policies and strategies for blended learning qualitatively. Fewer sample size (two HEIs) were investigated to provide an in-depth and qualitative case study exploration.

2 Research Method and Selected UK Higher Educational Institutions

Case studies methods (Yin, 1989; 2003) with Stake’s (1995, p.163) four forms of case study analysis and representation were used in this research: (1) direct interpretation from a single case and draw meaning from it; (2) category aggregation which seeks a collection of cases from the data and hoping that issue-relevant meanings will emerge; (3) pattern matching for cross case synthesis and (4) naturalistic generalisations from analysed data that others can learn from the case(s) or to apply to a population of cases.

Two case studies were selected due to their exemplar experience in blended learning policy and strategies. In the UK, HEIs are legally independent and are prevalent in the four nations - England, Wales, Scotland and Northern Ireland. The British education system is decentralised and is supported by central government, a number of local

Table 1. The British HE Education: Government and Funding Bodies (Hero, 2006; WDE, 2007; DIUS, 2008)

	<i>England</i>	<i>Wales</i>	<i>Scotland</i>	<i>Northern Ireland</i>
Government	Department for Innovation, Universities and Skills (DIUS) - which have replaced the Department of Education and Skills (DfES) in June 2007.	Welsh Assembly Government	Scottish Executive Education Department Enterprise Transport and Lifelong Learning Department (ETLLD)	UK Government Northern Ireland Higher Education Council (NIHEC) (Advisory Role)
HE Funding Body	Higher Education Funding Council for England (HEFCE)	Higher Education Funding Council for Wales (HEFCW)	Scottish Higher Education Funding Council (SHEFC)	Department for Employment and Learning (DEL)

government departments, sponsored agencies, churches and other organisations (WDE, 2007). Overall policy and funding for education is determined by the several major government departments as shown in Table 1. In England, Wales and Northern Ireland, HEIs are independent, self-governing bodies and established by Royal Charter. However, they are broadly similar in terms of the management and accreditation (QAA, 2008). The education system in Scotland has, however, always been completely separated with its own laws and practice (Eurydice, 2007a; 2007b). Overall, differences across the UK are particularly marked in the school systems, not at the university level. The policy and strategy is less varied at the HE levels (WDE, 2007).

Two universities in England and Wales were visited for a direct observation of their blended learning practices and facilities. The observations were captured during the interviews and transcription. Again, field notes were made in the process of each sites' visit to refresh the memory in the later analysis. Offline and online documentation, published journals, country reports and official statistics, websites and all sorts of written documentation were gathered. The comparative facts and figures for the case studies are listed as follows:

Table 2. Summary of Some Key Facts (UoL, 2008; UoG, 2007; 2008)

	<i>Case Study 1</i>	<i>Case Study 2</i>
<i>Founded</i>	1913	1921
<i>Gain University Status</i>	1992	1957
<i>Background</i>	Vocational college to university	Civic university
<i>Nature of the University</i>	New University, teaching-led	Old university, research-led
<i>Number of Students (2007)</i>	21,000	19,002
<i>Number of Academic Staff (2007)</i>	1,244	1,186
<i>Total Number of Staff (2007)</i>	2,520	3,355

3 Overall Policies and Strategies

3.1 Case Study I: The University A

The University A making a commitment to the adoption of blended learning across the institution and its delivery partners:

“The University is committed to the delivery of a first class learning environment incorporating the highest standard of e-learning, tutor facilitation and use of cutting edge learning facilities” ~ Vice Chancellor (UoG, 2005)

Given this vision, a three-year project (2005-2007) based on the Jones' Continuum (2006) to embed blended learning across the University's provision is being carried

out. Using the Continuum, academics align their modules to one of these points. In addition to this, the clear model embedding across the university has raised the awareness of the academics as well as students on blended learning (Chew, et al., 2008). Following the three-year project, University A has implemented a five-year institutional Learning, Teaching and Assessment Strategy, including the innovation in technology enhanced learning, teaching and assessment aspects (UoG LTA, 2009). The Learning, Teaching and Assessment Strategy is vested in the Centre for Excellence in Learning and Teaching (CELT) which acts as a centralised support unit that is proficient in developing and supporting pedagogy and the development and technology to enhance learning practice. It consists of (1) the technology enhanced learning team of educational experts and (2) its centralised IT department - the e-support team as summarised in the following table:

Table 3. The University’s A Centralised Support Team related to Blended Learning (Jones, 2007)

Technology Enhanced Learning Team	Comprises of pedagogical advisors, technology enhanced learning research staff and staff involved in providing advice and policy on teaching, learning and assessment. This team is committed to ensuring that blended learning will be not being driven by technology but by the needs of the University, its staff and students.
Learning and Corporate Support Services (LCSS) - eST Team	The LCSS-eST team (ISeLS) offers: ▪ <i>Customer Support Services</i>: One-stop-shop for all ICT and e-learning support. ▪ <i>Facilitation & Publishing</i>: Practical advice for utilising technology to enhance learning within pedagogically proven frameworks. ▪ <i>Multimedia Development</i>: Experienced in providing a range of graphical, audio, video and animated e-learning solutions, technical knowledge of software tools, development capability for games, quizzes, interactive simulations and case-studies. ▪ <i>Systems Development, Training and Support</i>: Develop maintain and support the Blackboard and bespoke virtual learning environment (VLE) systems.
	The LRC LCSS-eST offers - <i>eResources Management</i>: to help staff integrate into their teaching — in the classroom or online — the most appropriate existing learning resources from the Learning Resource Centre’s collections and beyond, to create a resource-rich and easy to use learning environment for students. Advice is provided on the availability of learning resources in different formats, and on the options for linking to external resources from Blackboard. Guidance is offered on the copyright implications of using content and permissions can be obtained on your behalf if required.

Other than the major institutional policy and establishment of teams, the following table summarises the major changes and practice across the university and how they have been implemented and highlights blended learning innovations across the institution.

Table 4. Strategies in the University A (Jones et al., 2009, p.16)

At the university level	(1) Full financial support from the management to: ▪ Personnel in CELT. ▪ The initiative of CELT innovation project grant to the academics.
	(2) HEFCW Technology Enhanced Learning Strategy Funding allows CLET to provide support for online assessment with QMP, Turnitin and learning and teaching with Social Software (with desired target).
	(3) CELT website: provide all necessary and prominent resources to blended learning practitioners and academics.
	(4) Blended learning team and GORaU: actively involving in blended learning research and projects both internally and externally.
	(5) Monthly blended learning seminars: provide practical case-studies and up-to-date educational methods and experience.
	(6) Learning zone: a blog acts as an impetus for blended learning discussion. (CELT Learning Zone, 2008)
	(7) Blended Learning Benchmarking and Evaluation project: the creation of new post such as Research Fellow and Research Assistant.
	(8) Blended Learning bid/proposal initiated by academics, supported by CELT and LCSS-eST Team.
	(9) Leading edge developments such as interactive workbooks, computer-aided assessment, reusable learning objects, simulations and game-based learning (e.g. <i>GlamStart</i>), hand held electronic voting and the use of weblogs and wiki as part of critical reflection.
	(10) Will introduce Template for Blackboard across all faculties in the academic year of 2008/2009.
	(11) The establishment of the Excellence in Learning, Teaching & Assessment Awards acts as a direct link between excellence in learning and teaching with academic recognition – a formal incentives or rewards system across the University to motivate the blended learning practise to be widely embedded.
At Faculty Level	(12) The creation of new post: the Head of Learning and Teaching in each faculty.
	(13) The creation of new role: the Blended Learning Champions in each faculty.
	(14) The creation of new role: Blackboard administrator.
	(15) The creation of templates for Blackboard across all faculties.

3.2 Case Study II: The University B

The University B has implemented an e-learning strategy in 2005 that is supported by a centralised department, Beyond Distance Research Alliance (2008). The University is the major provider of post graduate distance learning in the UK. Therefore, the e-learning strategy is aimed for a better market focus and position:

“The strategy will promote the building of pedagogical innovation, increase the deployment of learning technologies and enable research into e-learning in a way that directly addresses business opportunities and imperatives. It provides for equivalent and enhanced learning and support experiences for all students. It offers a framework that not only develops and extends the range of services and approaches already in place but also looks to deepen understanding and deployment of learning technologies in the University.” (UoL Strategy, 2005)

The E-learning and Pedagogical Innovation Strategic Framework for the University B is used to realise such e-learning strategy:

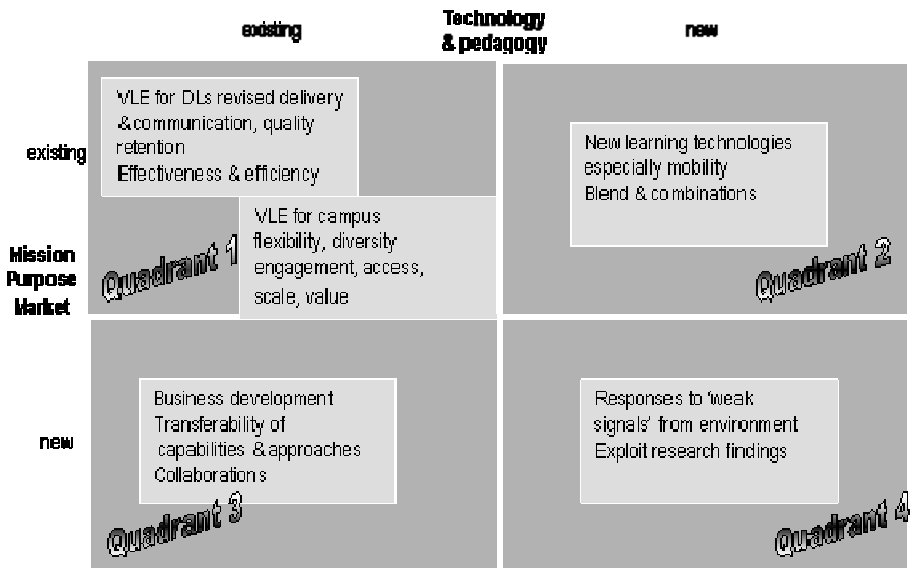


Fig. 1. The University B’s E-learning & Pedagogical Innovation Strategic Framework

The four quadrants in Figure 1 were illustrated in a creative and colourful representation, namely Media Zoo (2008) as shown in Figure 2. The four quadrants, *Pet’s Corner* (Quadrant 1), *Breeding Area* (Quadrant 2), *Safari Park* (Quadrant 3) and *Exotics House* (Quadrant 4) represent four different research and activities related to e-learning as follows:



Fig. 2. The E-learning & Pedagogical Innovation Strategic Framework (Media Zoo, 2008)

Table 5. The Four Quadrants in the Media Zoo

Quadrant 1 - <i>Pet's corner</i>	Quadrant 2 - <i>Breeding Area</i>
• Represents the mature and 'steady' technologies that are available for the University's academics to adopt. E.g. VLE such as Blackboard. • Major project: ADELIE (ADELIE, 2008) - to provide practical and disciplinary tailored technology enhanced learning workshop (Carpe Diem) at least once a month which is built into a staff development programme.	• Represents many new technologies available that have not been specifically developed for learning in a large cohort, but are prevalent among entertainment and business communication. • Major project: Informal Mobile Podcasting and Learning Adaptation project (IMPALA) – to investigate the model of f2f learning with podcasting in different context to enrich its validity.
Quadrant 3 - <i>Safari Park</i>	Quadrant 4 - <i>Exotics House</i>
• Represents the use of expertise and technologies that the University B has developed and applied them in new markets, new missions, and new levels and disciplines of learning and teaching through global alliance such as UN-Gaid (2008). Safari Park is the e-learning strategy implementation to research, to introduce and to enhance its collaboration and education to the world.	• Represents the most challenging, risky and potentially rewarding area of the zoo. Research on new technology in new environment is required at this quadrant. For example how second life can be embedded in higher education is the focus at the moment: Second Environment Advance Learning (SEAL, 2008).

Quadrants 1, 2 and 3 represent the deployment of the University B's existing core capabilities and capacity through incremental innovation. Quadrants 1 and 2 suggest deployment of the University's key strengths in teaching excellence but with

adjustments to new technologies. Quadrant 3 suggests deploying the understanding of technologies already in place to promote business development, solve problems and increase quality of all kinds. Quadrant 4 represents a more radical view of change using peripheral technologies, new products, new markets and missions (Salmon, 2005, p. 211).

4 Cross-Case Reflection

Table 6 summarises the cross-case comparison for the blended learning strategies and practices in the above two case studies.

Table 6. Cross Case Comparison – The Strategy

	Case Study I	Case Study II
<i>Blended Learning model / e-Learning Strategy</i>	Jones’ Continuum of blended learning (embedded in the University’s Learning, Teaching and Assessment Strategy)	Salmon’s 4 quadrants in the Media Zoo (separated from the institutional learning and teaching strategy for traditional f2f setting)
<i>VLE</i>	Blackboard	
<i>Centralised support unit</i>	A multi-disciplinary centralised support unit, CELT.	A multi-disciplinary centralised research unit, Beyond Distance Research Alliance
<i>Technologies that enhanced learning and teaching experience</i>	VLE, PowerPoint, blog, discussion board , online assessment tool (QMP), Flash, handheld voting system, SPSS.	VLE, digital library, web 2.0, video conference , email, podcasting, tablet PC, video and online journal.
<i>Highlight of good practice</i>	- Blended learning project bids proposed by academics. - Monthly CELT seminars and yearly road show. - The introduction of four Excellence Learning and teaching Awards for academic staff related to blended learning.	- Emphasise on funded research projects and make them exemplars. - 'Carpe Diem': disciplinary and pedagogy tailored workshop in group.

The University B Learning and Teaching Strategy (UoL, 2007a) is eleven pages in length but only mentions this e-learning strategy once:

“...the development and dissemination of good practice to ensure the promotion of high quality face-to-face, blended and distance learning, consistent with both this Strategy and the E-learning Strategy” (p.10)

Interestingly the case study II has two independent learning and teaching strategies, one for traditional settings and the other one for the “e” environment. Salmon (2005) states that, the University B “is typical of the traditional campus-based university keen to capitalise on the benefits of e-learning...” (p. 210). By separating the learning

and teaching strategies for traditional settings and for e-learning, it appears that the University may have a certain level of reserve to the benefits and investment of e-learning by not completely integrating e-learning into the institutional-wide learning and teaching strategy. On the other hand, the University A has only one Learning, Teaching and Assessment Strategy that has adopted blended learning as the key agent for change. There are reasons of why policymakers of the HEIs separated/combined the learning and teaching strategy for f2f setting and e-learning. Two separate strategies appear that e-learning is a separate entity from traditional f2f instruction; whereas one strategy leads to the impression of both approaches are equally important and working towards the same direction. Blended learning is part of learning and teaching practice and we would argue that it ought to be embedded in one institutional strategy.

Reflection 1: One blended learning strategy and one VLE per institution is essential to prevent confusion for academics and students. It is also to provide institutional-wide commitment towards the same practice and direction.

The University B has, in general, a clear, creative and research-led e-learning strategy (UoL, 2005) that recognises disciplinary differences and potential opportunities (e.g. through the *Pet's corner*); whereas the University A has a more practical and easy-to-understand Jones' model (2006) for an institutional adoption. However, it has less research elements in the model when one compares it with the University B's strategy. Comparatively, the University B's 4 quadrants of Media Zoo appear to be more interesting and have more of a research focus than Jones's Continuum. On the other hand, the boundary of each quadrant can be confusing. There is neither a clear line nor standard to differentiate "existing" technology" and "new technology". For example, is it new technology in the science and research lab? Or new technology used in the commercial world? Or technology that is new to the HE context? Moreover, quadrant categorisation may be stereotypic and market-technological-driven; whereas the University A's Continuum of Blended Learning provides a clearer and simpler model for wider adoption. It shows a different way of doing things in two UK HEIs – one focuses on the research on technology enhanced learning and the other one emphasises on institutional adoption of blended learning. We would argue that both aspects are equally important in an institutional strategy. Both universities have established an inter-disciplinary centralised research and support unit to provide a balanced pedagogical and technological advice.

Reflection 2: Institutional strategy and practice should highlight research on technology enhanced learning to inform institutional adoption or vice versa. It ought to be a clear and simple, but flexible for an institutional-wide adoption supported by inter-disciplinary support unit.

Unsurprisingly a funded research project can effectively become the motivation for blended learning projects and provide an exemplar for peers. An interesting exemplar in University B is the "Carpe Diem" and external funded research projects - they have positively empowered academics to embed blended learning in a disciplinary tailored manner. University B has successfully won a few external research funded bids

related to learning innovation. This inevitably highlights the external recognition as well as the motivation to the centralised team and to the academics. Comparatively, University A lacks funded and collaborative research. According to the highlight of good practice in both case studies:

Reflection 3: There is no blanket approach for blended learning strategy – disciplinary or individual tailored support; institutional policy or individual interest and initiatives; external funded research or internal project are necessary for further motivation.

University A has recently introduced an Excellent Awards related to blended learning – to complement a missing link between teaching innovations and academic recognition. There is a formal reward system across the faculties which would directly motivate the blended learning practise to be widely embedded.

Reflection 4: It is a good practice to recognise **teaching excellence** as well as research excellence by promoting blended learning.

5 Conclusion

HEIs today are disrupted by the digital culture. The research presents two exemplars in the UK that have implemented institutional adoption for blended learning. The main lessons reflected from the above two case studies are summarised as follow: (1) One blended learning strategy across the university is essential to prevent confusion for academics and students. It is crucial to provide **one single institutional-wide commitment** towards the same practice and direction; (2) An institutional strategy and policy should highlight research on technology enhanced learning, practicality and simplicity for understanding to inform institutional adoption or vice versa. **It ought to be a clear and simple, but flexible approach for institutional-wide adoption underpinned by research** support from a inter-disciplinary centre; (3) There is no blanket approach for blended learning strategy – disciplinary or individual tailored support; institutional policy or individual interest and initiatives; external funded research or internal project are necessary for further motivation; (4) It is a good practice to practically recognise **teaching excellence** as well as **research excellence** from the top management to promote blended learning.

We are certainly not arguing that the above principles are the only critical successful factors to an institutional policy for blended learning. We would assert that they are valuable experiences derived from two universities that have disrupted and made effort to the institutional changes. Such practice could inform other institutions who are practising blended learning in order to bring the agenda forward. Otherwise blended learning research may merely be perceived as nothing more than an ICT support unit without an institutional and educational commitment - this would “water down” blended learning to being technological-focused, a mere alternative platform other than f2f classroom and similar to the role of estates and facilities in a university, i.e. an instrumental and operational unit. It is recommended to put the above principles in place for the design and implementation for an institutional policy to

promote technology enhanced learning and teaching. Future works such as the evaluation of the impacts of these principles and the terminology to be used in the context (e.g. e-learning, blended learning, hybrid learning or technology enhanced learning) are recommended.

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An Assessment of the 5i Design Framework for Hybrid Learning

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Abstract. This paper assesses a 5i design framework for hybrid learning by using a quantitative methodology in studying two courses for which a hybrid course structure had been designed incorporating the five “i” elements in the framework, namely initiative, interaction, independence, incentive and improvement. Reliability tests, exploratory factor analysis and confirmatory factor analysis were used to analyze the data collected. The results show that the 5i design framework has a high level of reliability and validity. The study confirms the significance of this design framework in that the use of the five “i” elements is shown to be a critical and useful approach for teachers and course designers when designing a hybrid course structure. The results show that the effectiveness of both teaching and learning could be enhanced if the five “i” elements are incorporated when designing activities for students and when monitoring how the students participate, interact and are motivated when learning independently and how aware they are of their improved performance.

Keywords: Initiative, interaction, independence, incentive, improvement, hybrid learning, course design, reliability and validity.

1 Introduction

Hybrid learning has become a popular topic of research because of its importance in enhancing students’ learning interests (Naqvi, 2006). The hybrid learning approach seeks to find a balance between the deficiencies and merits of traditional classroom learning and online learning modes. However, neither of these learning environments exists in isolation and there is a need for balance and harmony between them (Kurnrow, 2007) since otherwise the students could become confused. A course using the hybrid approach should be carefully designed in order to enhance the pedagogical learning, the students’ access to knowledge, the social interaction between student and teacher, and between the students themselves, as well as personal agency and review of the learning progress (Kurnrow, 2007). Wong (2008) proposed a 5i framework for the use of course designers and instructors to provide them with the necessary elements when designing course contents and activities using a hybrid approach. The purpose of this study is to assess the validity and reliability of the 5i design framework by means of an empirical study of comments made by students after completing a course that had been constructed following a hybrid approach in line with the framework.

2 Course Design

The 5i design framework (Wong, 2008) consists of five elements; these are initiative, interaction, independence, incentive and improvement. The approach used in the framework takes into account the affective and normative needs of students in order to maximize the effectiveness of their learning in a carefully designed hybrid course. The comments by the students in Wong's (2008) qualitative study show that they found the five "i" elements to be critical in their perceptions of the experience of studying in a course that followed a hybrid approach. The comments of individual students gave the author of the present study valuable information concerning the design, structure and approach of a hybrid course. Overall, the comments from the Wong's (2008) study show that the effectiveness of the students' learning in a hybrid course will depend on the approach adopted by the teachers and instructors when designing the course structure.

The comments of students from two hybrid courses were studied for the present study. The first course was on "Principles of Sales and Merchandising" run by the Associate of Hospitality Management (AHM). In the AHM course 14 students were enrolled, and they had to go to the WebTL online learning platform provided by the college to collect their assignment. WebTL is a private area in the college system which would be more conducive for this work than an individual reflection site such as a web blog (Tabor, 2007) because it is more closely controlled and is isolated from interactions from the public. There were four versions of questions for different students and each question had its own scenario. No common or model answers existed for the questions, so students needed to search for appropriate information from the Internet to prepare their answers. The questions required students to simulate a conversation with a client (teacher), the purpose of which was to enhance the interest and initiative of the students. This assignment was used as an element in the course assessment and the teacher had to emphasize that the assessment would depend more on the improvements shown by the students in their way of talking to the client rather than the conversation itself. Each student needed to provide his/her own responses but they could also view the other students' conversations with the teacher for reference purposes. This approach was adopted to achieve the maximum independence and interaction by the student. The teacher played the role of the client but at the same time provided comments to the student about the conversation. This helped to make the students more aware of their improvement and gave them an even greater incentive to improve their responses to the client.

The second course studied was "Database Systems" for the Higher Diploma in Computing Studies (HDCS) programme. Two rounds of online activities were included in this course, in which 12 students were enrolled. The first was an assignment about drawing system modelling diagrams. There were three versions of questions for different students. Similar to the AHM course, the questions selected for posting on the online environment had no single answers. Students needed to search for appropriate information from the Internet, textbooks or teaching materials to answer the questions. The second activity was an online test using similar types of questions, but the test had to be completed within three hours. Similar to the case

described above, the course contents were designed to reflect the five “i” elements of the design framework that is under study.

The five “i” elements were also taken up during the traditional classroom learning for the two courses. The answers from the students and other suggested answers were discussed in the class so the students would have to take the initiative of attending the classes if they wanted to know how their performance compared with that of the others. Students could defend their answers in class and comments on the students’ online learning progress were also discussed in class, thus contributing to the aim of greater interaction, incentive and performance improvement. The teacher acted as a facilitator and an observer of the students’ self-learning and self-regulation during the learning process.

3 Measurement of the Responses to the 5i Framework

The following descriptions outline the process and basis of the formulation of the statements that the students were asked to rate in a questionnaire distributed at the end of the courses for the preparation of this study.

3.1 Initiative

The purpose of this element is to design a course content that would encourage students to take the initiative of attending both the classroom mode of learning and the online environment. The contents of the lectures should motivate the students to attend the classroom frequently and the activities in WebTL should motivate the students to use the online environment frequently as well (Bates & Watson, 2008). The contents of the two courses used both direct instruction and guided discovery (Clark, 2000 cited in Bates & Watson, 2008) to promote the students’ initiative. The students were asked to rate the following statements about the level of their motivation when they had completed one of the hybrid courses.

1. The contents in the lectures motivated you to attend the classroom lectures frequently.
2. The contents in the WebTL motivated you to use the online environment frequently.
3. You could find appropriate knowledge online to answer the questions in the assignment.
4. The questions posted on the WebTL required you to find the answers yourself.

3.2 Interaction

Wong (2008) comments that a hybrid course needs two types of interaction since the students’ feedback can improve not only their learning progress but also the evaluation of the course design (Timpson, 2009). The delivery of the two courses is designed in such a way that interactions between the teacher and the students, and

between the students themselves are available in both the traditional classroom mode and in the online environment. The design of the courses also fulfilled the three interactions identified by LaPointe & Reisetter (2008). The students could interact with their teachers, their peers and also the course itself by actively reading the teaching materials and sourcing relevant information from the Internet. Since students are more confident and more assertive when stating their views online than they are in a face-to-face environment (Chen, Bennett & Maton, 2008), the teacher needs to help students by building up a learning community in the classroom (Chen, Bennett & Maton, 2008) so the students would be more active in discussion in the classroom mode. In addition, the course contents and activities in the classroom and online should be cross-referenced to achieve an interaction between these two modes of learning. The students were asked to rate the following statements about whether interaction helped their learning.

1. The Lecturer provided sufficient communication with you by WebTL to help you to find the correct answer.
2. The communication through WebTL fitted your learning pace.
3. Discussion of your online work in the classroom motivated you to attend the classroom sessions.
4. Providing comments on your work through the WebTL motivated you to use the WebTL environment more.

3.3 Independence

Independent learning is important for students in the online environment and is essential at the tertiary education level for which the students need a high level of self-learning and self-regulation. The activities in the two courses were designed to develop the students' capability in self-regulation and control of learning (Negas, Wilcox & Emerson, 2007). The students were asked to rate the following statements with respect to their independence in learning.

1. You could complete the questions in WebTL according to your own working schedule.
2. You could work on the questions in WebTL more independently than in the classroom.
3. You could plan your working schedule when the assignments are posted on WebTL.
4. You could find the appropriate knowledge from the Internet or the WebTL yourself to answer the questions.

3.4 Incentive

In order to motivate the students to attend both of the learning environments and complete the work in both the classroom and online, an assessment of the work in both locations is required and cross-referencing of the work and the marks in class

and online was used. The teacher informed the students that the assessment was not only based on the final answers given by the students but was also based on the students' learning process in the course of completing the work (Keller, 2008). So the students would be less anxious and have more confidence about completing their work online, under their personal control and in line with their own ability and effort. This enhances the incentive of students to attend online learning voluntarily. In addition, the online activities are arranged in the form of a discussion forum, a format that has been implemented in the WebTL. Since participation in discussion forums is one of the most popular activities on the Internet, students will be more familiar with and more interested in participating in such activities during the course (Bates & Watson, 2008) and thus the students will have a higher sense of involvement and commitment to the course activities (Tabor, 2007). The students were asked to rate the following statements concerning their incentive to participate in the activities.

1. The materials in the classroom and the WebTL are cross-referenced.
2. The communication with the Lecturer in the classroom motivated you to answer the assignment questions.
3. The communication with the Lecturer in WebTL motivated you to answer the assignment questions.

3.5 Improvement

The final "i" in Wong's (2008) framework considers whether there is an improvement in the students' learning and whether the students are conscious of any improvement they are making if the course is conducted in a hybrid mode (Teeley, 2007). The two courses were designed in such a way that students would have similar work in both the classroom and online. They could compare whether they had achieved an improvement in their marks on the assignments and tests completed in the traditional way and in the online mode. The teacher also encourages students to explain their work online and motivates them to ask questions. The teacher has found that some students that used to be quiet in class are more active speakers in the classroom after frequent interactions with the teacher in the online environment. The immediacy of the teacher's responses both in the classroom and online reduces the social and psychological distance between them and will have a positive effect on the student's satisfaction and produce an improvement in learning (Ni & Aust, 2008). The students were asked to rate the following statements about whether they recognized an improvement after attending the hybrid course.

1. Assessment of your work in WebTL improved your learning progress.
2. Having both classroom discussions and communication in WebTL during the assignment made you learn better than under the form used previously.
3. You were more active in answering questions in WebTL than in the classroom.
4. The online communication experience in WebTL encouraged you to actively answer questions in the classroom also.

4 Methodology

This study uses quantitative methodology to collect data from two classes of students. Questionnaires were distributed to the students at the last lecture in the classroom. The advantage of this approach is that it ensures a higher response rate because the number of students involved is limited and it is a faster and more direct method for collecting data from students for analysis. There were 14 students in the course “Principles of Sales and Merchandising” of the Associate of Hospitality Management (AHM) and 12 students in the course “Database Systems” for the Higher Diploma in Computing Studies (HDCS).

A five-point Likert scale was employed with “5” indicating “Strongly Agree”, “4” “Agree”, “3” “Neutral”, “2” “Disagree” and “1” “Strongly Disagree”. A five-point scale was used instead of the more usual seven-point scale because of the small sample size, since a narrow scale will have less diversification of results and a more concise outcome from the statistical analysis.

5 Results

5.1 Independence T-Test

The mean values of the two samples with respect to the responses to the questionnaire are shown in Table 1.

Table 1. Mean Values of responses to each statement in the questionnaire

Questions	AHM (n=14)	HDCS (n=11)	Overall
INT1	3.50	3.18	3.36
INT2	3.79	3.27	3.56
INT3	4.21	3.64	3.96
INT4	3.86	3.73	3.80
INTER1	3.86	3.64	3.76
INTER2	3.86	3.55	3.72
INTER3	3.64	3.27	3.48
INTER4	3.79	3.36	3.60
IND1	3.57	3.64	3.60
IND2	3.71	3.27	3.52
IND3	3.50	3.45	3.48
IND4	3.92	3.73	3.84
INC1	3.79	3.82	3.80
INC2	3.71	3.64	3.68
INC3	3.64	3.73	3.68
IMP1	3.79	3.82	3.80
IMP2	3.71	3.82	3.76
IMP3	3.64	3.45	3.56
IMP4	3.71	3.36	3.56

An Independence t-test was used to test whether the mean values of the responses from AHM and HDCS are similar or different. The results are shown in Table 2.

Table 2. Results of Independence t-test (with equal variances assumed)

Questions	AHM (n=14)	HDCS (n=11)	Sig. Value (p)	Result
INT1	3.50	3.18	0.439	Not significant
INT2	3.79	3.27	0.073	Not significant
INT3	4.21	3.64	0.068	Not significant
INT4	3.86	3.73	0.588	Not significant
INTER1	3.86	3.64	0.420	Not significant
INTER2	3.86	3.55	0.214	Not significant
INTER3	3.64	3.27	0.164	Not significant
INTER4	3.79	3.36	0.106	Not significant
IND1	3.57	3.64	0.825	Not significant
IND2	3.71	3.27	0.127	Not significant
IND3	3.50	3.45	0.867	Not significant
IND4	3.92	3.73	0.378	Not significant
INC1	3.79	3.82	0.892	Not significant
INC2	3.71	3.64	0.694	Not significant
INC3	3.64	3.73	0.746	Not significant
IMP1	3.79	3.82	0.912	Not significant
IMP2	3.71	3.82	0.706	Not significant
IMP3	3.64	3.45	0.523	Not significant
IMP4	3.71	3.36	0.139	Not significant

All p values for the statements are greater than 0.05, which means that the t-test is not significant. The mean values of the two groups are not significantly different. In the light of this result, the responses from both groups of students were used together for further statistical analysis.

5.2 Reliability Test

A reliability test was conducted on the construct of the 5i framework. The results are shown in Table 3.

These results show that some items in each construct do not have an item-loading value greater than 0.5 but most of them have a value only slightly lower than 0.5 and may be considered as acceptable. Some items need to be taken out from their corresponding construct because the Cronbach's alpha value is higher if they are absent. These items are INT4 in initiative, IND1 in independence, INC1 in incentive, IMP1 and IMP4 in improvement.

Table 3. Reliability Test of the Construct of the 5i Framework

Construct	Items	Item-loading	Cronbach's alpha	Cronbach's alpha if item deleted
Initiative	INT1	0.480	0.574	0.390
	INT2	0.475		0.416
	INT3	0.376		0.487
	INT4	0.128		0.639
Interaction	INTER1	0.608	0.833	0.814
	INTER2	0.759		0.747
	INTER3	0.627		0.805
	INTER4	0.662		0.789
Independence	IND1	0.171	0.601	0.691
	IND2	0.332		0.572
	IND3	0.488		0.446
	IND4	0.620		0.376
Incentive	INC1	0.288	0.581	0.632
	INC2	0.440		0.432
	INC3	0.472		0.345
Improvement	IMP1	0.172	0.575	0.652
	IMP2	0.548		0.341
	IMP3	0.568		0.307
	IMP4	0.197		0.612

5.3 Validity

Exploratory factor analysis was conducted to test the validity of the construct of the 5i framework. The results are shown in Table 4.

Table 4. Exploratory Factor Analysis

Construct	Items	Loading
Initiative	INT1	0.805
	INT2	0.782
	INT3	0.578
Interaction	INTER1	0.849
	INTER2	0.833
	INTER3	0.737
	INTER4	0.561
Independence	IND2	0.596
	IND3	0.904
	IND4	0.444
Incentive	INC2	0.914
	INC3	0.440
Improvement	IMP2	0.888
	IMP3	0.785

This exploratory factor analysis did not take into account the 5 items that were removed following the reliability test, and this resulted in better results for the factors among the five elements in the 5i framework.

Confirmatory factor analysis was conducted to check further the validity of the framework. This was done by comparing the results when one of the individual elements from the 5i framework is omitted. The results are shown in Table 5.

Table 5. Confirmatory Factor Analysis

Framework	GFI	AGFI	CFI	NFI	χ^2/df
M1	0.66	0.51	0.93	0.65	1.70
M2	0.56	0.37	0.73	0.56	2.08
M3	0.56	0.37	0.53	0.38	2.13
M4	0.62	0.46	0.84	0.58	1.71
M5	0.57	0.39	0.73	0.54	2.12
5i	0.74	0.43	0.81	0.69	1.92

- M1: Initiative, Interaction, Independence, Incentive
- M2: Interaction, Independence, Incentive, Improvement
- M3: Initiative, Independence, Incentive, Improvement
- M4: Initiative, Interaction, Incentive, Improvement
- M5: Initiative, Interaction, Independence, Improvement
- 5i: Initiative, Interaction, Independence, Incentive, Improvement

The results show that the value of the Goodness of Fit Index (GFI) is 0.74 for 5i as a whole. Although a GFI value higher than 0.90 shows a better fit of the model to the data collected (Byrne, 1989), 0.74 is the highest value obtained for 5i and should be taken as the best fit to the data collected. The value of Normed Fit Index (NFI) is also the highest in 5i than other models that under tested. The ratio χ^2/df of 5i is 1.92. Although this is below 2 (McIver & Carmines, 1981) it is acceptable, and this further supports that the 5i framework has a good fit to the data collected. This analysis shows that, although not all the significant indices used in the confirmatory factor analysis have satisfactory or acceptable values, the validity of the 5i design framework is nevertheless significant and could serve as a useful model for further statistical analysis.

6 Discussion

The purpose of this study is to examine the validity of the construct of the 5i design framework for a course using a hybrid learning approach. Two courses that had formerly been conducted in a face-to-face mode were re-designed to include online activities. Both of these courses were re-designed on the basis of the five elements in the 5i design framework. The results of the t-test show that, although the two courses use different types of online activities and deal with different academic disciplines, there is no significant difference between the responses of the two groups of students. This confirms the value of the 5i design framework, in that it is not a strict guideline

for the design of a hybrid learning course that imposes any particular activities. The framework is, rather, an approach to be used by the course designer who should take into consideration what would be most useful and appropriate from the point of view of the students when designing the necessary course activities. The differences in the necessary activities for the hospitality and computing courses used for this study and the similarity of the results obtained from both of them are a good indication of the value of the framework.

The analysis supports the reliability and validity of the 5i design framework. It shows that the 5i design framework is constructed giving careful consideration to the affective and normative issues encountered by students when learning in a hybrid course environment. However, the questionnaire used for the analysis of the results was not effective in the selection of the items used to test each “i” in the framework, and some of the items had to be deleted following the exploratory factor analysis. It could nevertheless provide a solid platform for discussing the issues identified and to refine the “i” elements. The constructs of incentive and improvement had to be reduced to two items following the reliability test, so further studies are required to explore which other items should be used to examine these constructs.

The significance of the framework is enhanced by the examination of the experience in the two courses used in this study. The framework could serve as a reference model for instructors or course designers when preparing courses following a hybrid approach combining classroom and online activities. Feedback from the students is important (Timpson, 2009) with respect to both classroom and WebTL activities, and is also very useful both for improvement of the teaching and for the students’ learning progress (Timpson, 2009). As suggested by Timpson (2009), a mid-semester feedback from students is necessary and critical, so the author also made use of the Course and Teaching Evaluation (CTE) done in the previous year for these two courses when designing the current hybrid course structure.

Although it was the first time that these students had participated in a course that used an online environment for communication, the results of this study have shown that students can adapt to a hybrid learning environment even though they had no previous experience of how to work using a hybrid course (Kurnrow, 2007). The study also found that some students who originally had a sense of inferiority to their classmates in a classroom context produced satisfactory performance in the online mode (Chen, Bennett & Maton, 2008). This further proves that the most important factor in learning is not the learning environment but the interaction with the instructor and with other students to complete online and class works (Kurnrow, 2007). Hybrid learning is not a simple replacement of the traditional lecture format. Its main merit is to provide a help-seeking mode to the students as they work towards their academic achievement (Kurnrow, 2007). Course designers should not treat the new tools or environment of online learning as something which they or the students should be afraid of, however. Hybrid learning must achieve a proper balance and harmony of activities between the two modes of learning as they both have their strengths and weaknesses (Tabor, 2007).

The experience of carrying out this study has shown that the course contents and activities should be carefully designed because no one hybrid learning model is suitable for every student or even for every instructor. There should be appropriate elements in the design that take into account social and academic issues (Tabor, 2007)

and also cultural issues (Chen, Bennett & Maton, 2008), especially since colleges in Hong Kong are recruiting more students with different nationalities and diverse academic capabilities. However, no matter what the context, hybrid learning can still provide the benefits of increased opportunities for effective learning, flexibility and convenience in the delivery of teaching (Cramer, Cramer, Fisher & Fink, 2008). The hybrid learning approach is also better than a purely online mode for young students because they need a more direct and physical teacher-student relationship. If this is absent, it will affect the affective and normative approach of the students when using the online learning mode (Chen, Bennett & Maton, 2008). So building this relationship in the classroom will have a positive impact on the work of the students.

It is recommended that the framework's significance be studied further, in particular using different areas of programmes and fields of knowledge to consolidate the generalization of the framework. Practitioners and researchers are strongly encouraged to design their studies so as to include more aspects for each construct for analytical purposes, in addition to those used in this study, and in this way to further enhance the value of this framework.

7 Conclusion

The purpose of the 5i design framework is to serve as a source of reference for significant issues that arise when designing course contents using a hybrid approach. The ultimate purpose is to enhance the satisfaction of the students in terms of the design of the course, their benefit from working with their peers, and their self-determination in completing their assignments both in class and online and their understanding of the teacher's expectations (LaPointe & Reissetter, 2008). Moving some teaching and learning activities from the traditional classroom environment to online learning is a growing trend. It is still a challenge for teachers and course designers to design activities for students in such a way that they can nevertheless monitor the students' learning directly. This paper continues the study of the 5i design framework by assessing the reliability and validity of the construct of the framework by conducting an empirical study of students who had completed a course with a hybrid structure with reference to this framework. The results found that the 5i framework has a high level of reliability and validity and could be adopted as a useful approach when designing hybrid course contents.

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A Study of Applying Field Knowledge and Perception on Personnel Learning Recommendation Map

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Abstract. The study emphasizes on an online learning system to facilitate teachers with teaching and to assist students with learning, while assessing students' comprehension level for a field of study through a testing process on the platform. Students are given recommendation for further learning by offering recommendations for particular field of study, likewise in customizing students with a special learning plan to guide them through exploring the field, with a learning map in hand, or leading student to review course content from the previous level. 100 students successfully received recommendation list of learning courses through this system, and each of the students conducted course learning according to the list during a four-month period of online learning. Upon completion of the recommended learning course, a survey questionnaire was conducted to discover that 75% of the students approved the recommendation list of learning course was effective in assisting them with learning knowledge of that field.

Keywords: Learning Theory, Teaching methods, Recommendation system, Learning Map, Learning Portfolio.

1 Research Motivations and Objectives

Nowadays, as information technology and internet become more developed, acquiring knowledge also becomes quite easy, and so is teaching. A conservative teaching method will not result in an effective learning progress, based on the premise that distance and time are no longer issues that hinder one from keeping up with the society. Only continuous advancement in pursuing different teaching methods can enhance teaching efficiency and quality, which in turn will attract learners to stay and utilize the system[12]. For this reason, utilization of internet features, in addition to usage and development in information technology for building up digitalized teaching, will allow teachers and learners from different backgrounds to work together and participate in teaching and learning through internet, leading to a transformation of teaching models. In which not only the presentation of knowledge is changed but also the means of exchanging learning messages will also be changed. Additionally, the teaching environment as a result extends from a traditional in-class teaching environment to an online virtual learning environment. Teaching through internet has become inevitable trend that can lead to major challenges and progress.

In sum, the ultimate goal of distance teaching is to integrate technology, teaching materials, and faculty to enhance learning desires and effectiveness. For this reason, a number of international and domestic studies with emphasis on distance teaching have emerged. Furthermore, television campaign for “online-teaching” increases in popularity and trigger my interests in exploring more information regarding “distance teaching,” and to discuss issues in this aspect[12].

In the approach to this area, the study has discovered this field of study is quite abstruse. “Distance Teaching” can be further subdivided into “Synchronous Teaching” and “Asynchronous Teaching”; whereas in “Synchronous Teaching,” teachers can distribute teaching in online multicast environment, while the number of learners could be taught on a one-to-one or one-to-many basis, which is similar to an online classroom. Teachers implement video system in teaching at one end, while students may learn at home, which enable the teachers and students to overcome obstacles in synchronous teaching due to long distance involved. On the other hand, “Asynchronous Teaching,” most commonly implemented in website for “Distance Teaching,” uses multimedia materials such as words, voice, picture, imagine and animation to attract users to use the system. In addition, with respect to repetitive learning, users many also engage in interactive thinking and share their learning experience through the use of forum.

In order to proceed further on study for “Asynchronous Teaching,” an online platform for distance learning has been built to integrate all study subjects from the platform into different fields, whereas each field also contains various courses. For example, the field of IT application contains programming language in Visual Basic, C++ or ASP as the teaching materials, while the teaching zone, study assignment zone, examination zone and discussion zone are offered, in addition to conducting survey questionnaire for online research. The study aims at facilitating teachers with teaching and assisting students with learning in a learning course recommendation system. After the learning process, students are assessed for their comprehension level and interests for that particular course, and provided with recommendations for course learning, which is similar to customizing a special learning plan for students by having a learning map in hand to guide them through exploring the field. Then gradually lead students with content review from the previous level and to replace the professional guidance of a real teacher, enabling the students to learn easily in gradual path.

2 Literature Review and Related Works

2.1 Learning Theory

Thorndike is an American psychologist who is quite influential in the contribution of education, who is also considered as the “father of educational psychology.” Thorndike believes that learning is a connection formed between stimulus and response. This connection is mediated through trial and errors with constant revision and reinforcement; whereas when the correct response is reinforced, the connection between stimulus and response (S-R) eventually also reinforces.

Thorndike further induced Three Law of Study[2]:

1. Law of readiness: To determine if a connection between stimulus and response is generated, the state of readiness is one important determinant key. When ready for leaning but fails to do so, or not ready for learning but obliged to learn, the result is complete agony.
2. Law of exercise: The connection between stimulus and response becomes stronger when the number of practices is increased and when time approaches. On the contrary, the number of connection between stimulus and response will result in a weaker connection.
3. Law of effect: Law of effect is the most significant law among Thorndike's law of study. When individual responds to stimulus, followed by satisfying results will reinforce the connection between stimulus and response, while enabling studying to become more effective and last longer.

2.2 Learning Effectiveness

On the other hand, Gagné et al. (1992) identifies five categories of learning effectiveness[5]:

1. Intellectual skills: Intellectual skills involve the interaction between the way individual use symbols or conceptualization with the environment, starting from basic language proficiency to various kinds of science and engineering skills.
2. Cognitive strategies: Cognitive strategies refer to the ability which individual control self-learning, memory and thinking. Cognitive strategies are a self-management of behavior. Individuals tend to choose applicable cognitive strategies when encountering a problem, whereas these cognitive strategies usually resulted from accumulated experiences from past.
3. Verbal information: Verbal information refers to the information expounded from individuals as well as superficial information. Most of us have learned substantial verbal information, for example, the number of counties and cites in Taiwan and major historical events...and so on.
4. Motor skills: Motor skills refer to individual ability to apply familiar tools such as typing, operating computer, and driving.
5. Attitude: Attitude refers to the individual's response to emotions, whereas the effects of attitude will cause an individual to magnify the degree of responsiveness positively or negatively. The attitude strength can be applied in various environments, in which a stronger attitude will generate greater assistance while on the contrary a weaker attitude will generate less assistance. Appropriate aspects are discovered according to these fives categories and to be inspected for the learning effectiveness in an online teaching and learning environment[8,6].

2.3 Learning Portfolio

The relevant theory derived from learning course is classified as behavioral learning theory with discussion in changes among learner behaviors, while the cognitive learning theory discusses changes in cognitive level.

Scholars who advocate on behavioral learning define learning course as conditioning, in other words, learning refers to the learner response under certain conditions. Learner changes its behavior subject to conditioning resulted from behaviors[11].

Cognitive learning emphasizes on discussion of changes in the internal cognitive level for learners, which mainly include theories from information-processing theory and constructivism. Information-processing theory primarily describes the process of how information is processed, memorized or retrieved in the learner's mind[3]. Whereas constructivism theorists advocate that learners do not receive knowledge through memory, facts or truth but through active construction. Cognitive knowledge is a consensus reached by interactive consultation between learner and others, and knowledge is a rationalization or practicability of learner experiences.

2.4 Distance Learning

In the domestic aspect, the study on pilot system for distance teaching defines distance education as an integration of information and communication technology, providing a non-face-to-face, bilateral and interactive learning course for everyone, in order to popularize and circulate knowledge[4]. Wang points out that distance education is a situation in which teacher and learner are separated in two locations, a teaching method implemented with applications of various teaching medium beyond time and space; simply put, distance education refers to the application of different medium and information media to transfer teaching resources, breaking the special gap between teachers and learners, as well as forming a education model centered for self-learning learners.

In the international field, Keggan claims that the characteristics of distance learning are: 1. Separation between teacher and learner; 2. Learners are influenced by distance learning institution, particularly with the preparation of teaching materials and plan; 3. Using technology media to connect teachers and students with broadcasting for teaching content and a bilateral communication; 4. Teacher and learner can set a meeting on a non-regular basis; 5. Industrialization of Education is implemented[7]. Moore (Moore, M.G. & Kearsley, G. □ 1996) believed that the so-called distance in distance learning is more than geographical distance, it is more like a psychological and media gap between the teacher and learner. Due to the distance between teacher and learner, Moore believed that distance learning system should contain two elements, conversation and structure[9]. "Conversation" refers to the interactive communication in educational activities, teacher and learner, whereas "Structure" refers to the individual requirement for learners, which the educational activities must fulfill. On the other hand, Portway & Lane (Portway P. & Lane C. □ 1994) believed that teacher and learner are separated in two locations in distance education. Furthermore, teaching content relies on transferring distance education, which includes distance teaching and distance learning electronically[10].

In brief of the foregoing claims of distance teaching held by the national and international scholars, we have gained an insight to the special and timely separation between teacher and learner in distance teaching, that teaching material and educational methods could have influence the effectiveness of distance education, while the learner attitude and motivation also contribute influences on the efficiency of distance education.

2.5 Recommendation System

In "The Art, Science and Business of Recommendation Engines" published by the columnist Alex Iksold of ReadWrite/Web in 2007, the article categorized the recommendation

system into four categories, taking into consideration the observation angle of a consumer using services: Personalized Recommendation, Peer Recommendation, Product-Oriented Recommendation and a General recommendation combines the previously-mentioned three technology. This type of classification has a surprising corresponding relationship with the classification of academia using information interpretation[13].

The proprietor first calculates particular consumer's tendency of preference for each product in the recommendation system, then determine the promotional locations and measures. For example, the world's largest bookstore network, Amazon, has an operation mode of using the plainest words to promote. The recommendation system will make prediction on the consumer's acceptance level for each product according to the consumer transaction records, merchandize content, and information on consumer satisfaction on merchandise in a recommendation system. From the predicted result, proprietors may arrange corresponding marketing, allocation of all resources on the area that are most likely to generate greater values[1].

In a recommendation system, the recommendation algorithms consist of Memory-Based and Model-Based methods:

Memory-Based: When users require recommendation for specific objects from the system, the system will perform a complete algorithm on the database; although this method will achieve a higher accuracy, the calculating speed will become more slowly than Model-Based.

Model-Based: When users require recommendation for specific objects from the system, the system will perform an algorithm on the object through a mathematical model; although this model can achieve a faster calculating speed, the level of accuracy will perform worse than Memory-Based.

3 Related Works

3.1 The Study Architecture

The foundation of the collaborative recommendation system adopted by this paper follows the memory-based recommend algorithm. A recommendation system with open source code is found online and modified, then worked in collaboration with questionnaire database and calculation, users are provided with a recommendation list.

The following figure is the study framework. The platform teaching system will evaluate on the level of comprehension and interests for that particular field of study according to the results of users using the teaching system, then provide a learning course recommendation for the field similarly to customizing a special learning map for the students in order to guide through the students in exploration of that field step by step. After users enter any subject to study, they are evaluated and finally provide appropriate recommendation for learners according to the result. Learners will be recommended to study at the next stage or if they still do not comprehend the content of that level, they will remain and continue to study or learners are recommended to return to the previous level and to re-study on the course content.

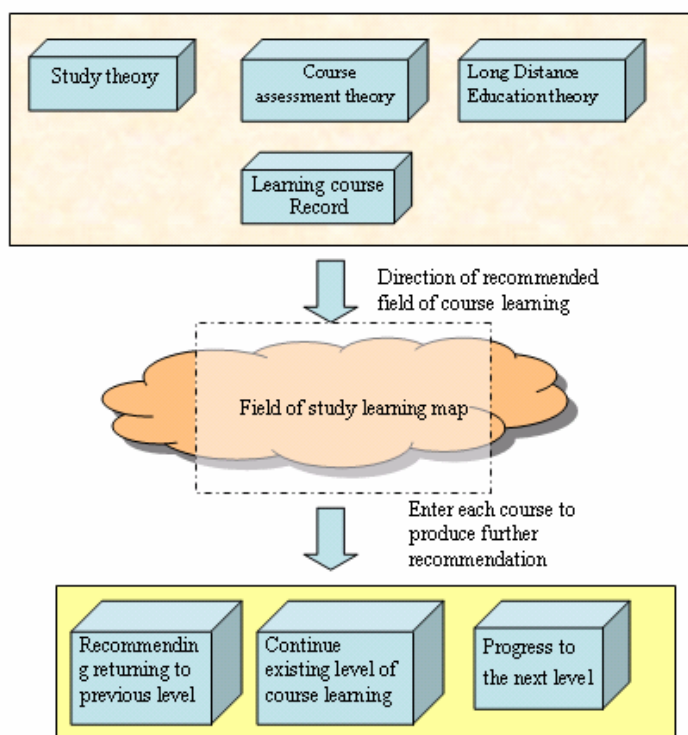


Fig. 1. Study framework

3.2 Experimental Design

(1) Summarize and analyze relevant study literature for distance teaching: Collate theories of distance teaching to compare and to find out which course content for distance teaching are in urgent need, then summarize a fundamental framework which will comply with a distance teaching environment and course design.

Learning system and course material design: In compliance with the fundamental framework for distance teaching environment and course design, build an online teaching environment platform and prepare teaching material items for course teaching.

(2) Implement a 4-month recommended course learning on the course learning progress of 100 students using learning course recommendation platform.

(3) Conduct survey questionnaire to prove the accuracy and practicability assessment for the recommended courses offered by the course learning recommendation platform for revision.

3.3 Recommendation Procedures

When users enter the system at the beginning, learners might prefer a particular field of study, therefore this system obtain user preference from interested field for users and expected learning effectiveness, to set up the final course familiarity to be completed by the users.

Personal learning map recommendation system

Personal Information

Major Field of interest ☐ Programming

Age ☐ Information management

Gender ☐ Advertising Design

Subject good at ☐ Industry Case Study

Expectation Cabability ☐ Financial accounting and practices

☐ Financial insurance

Next

Fig. 2. Main Screen of the system

Press the “Next” button to generate questions related to that field as the referred in the following figure:

- 1 What are supply chain management systems?
- 2 Describe the major econmic theories?
- 3 What are the three basic building blocks of the Internet?
- 4 Why is system testing important?
- 5 What are the advantages of digital checking payment systems ?
- 6 Why is offline advertising still important?
- 7 How do safe harbors work?
- 8 How would you describe the top 10 online retailers as a group?
- 9 How do I find the right software?
- 10 How can I increase my web traffic?
- 11 How do I get more clicks to my website?
- 12 How can I create a social networking platform?

Fig. 3. Questions list

After users have replied, the system will accumulate scores from the option content of “Personal Information Questionnaire” and the “Collective questionnaire for relevant field.”

Perform a memory-based recommend algorithm according to the foundation from collaborative recommendation system, to generate a recommendation learning map, as referred in the following figure:

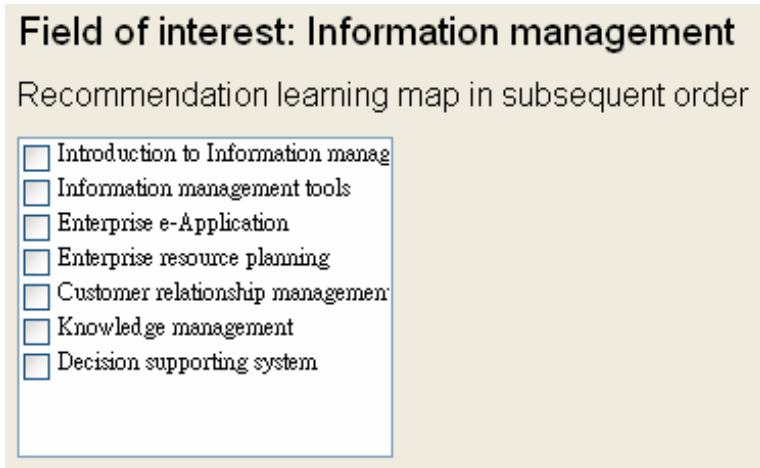


Fig. 4. Recommendation learning map

Will convert into a figure as referred in the following figure:

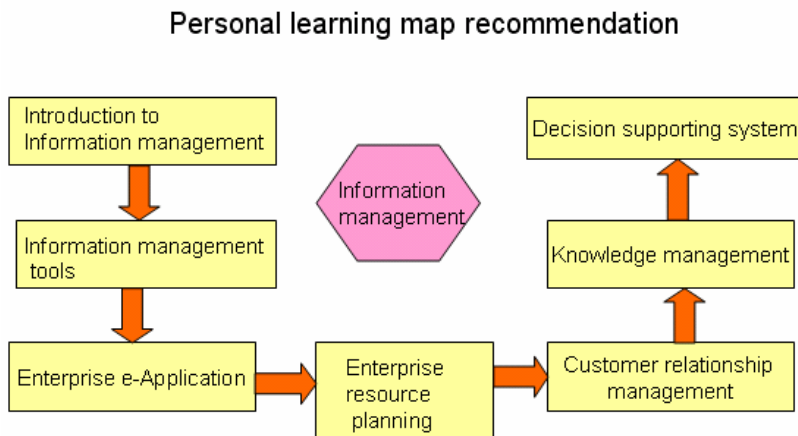


Fig. 5. Recommendation learning map convert into a figure

Then perform study and evaluation for each recommended course and evaluate based on the expected learning result of the user as the standard for an end to the course.

3.4 Conducting Experiment

In order to prove the effectiveness and accuracy of the learning course map, actual course experiments have been conducted and to adopt each sampling. Choose 100 students to use this learning platform and perform 4-month learning through collaboration

of recommended learning map from the system with courses offered at this platform. The recommended learning course will be completed in order and to achieve study goals setup up by the users. The questionnaire given to learners is listed below:

4 Results

According to the questionnaire given, 75% learners are satisfied with the recommended learning map by the learning course platform. We will waste much time and energy in finding something suitable for us without the accumulated experiences from the predecessors. The recommendation list from the study will accurately reduce the time users explore in each field and to find out the appropriate learning direction for the users as soon as possible. The study emphasizes on this issue with integration of computer and internet technology to develop a solution.

The study will apply recommendation system on the learning of teaching, and through a system platform built on historical data, with basis on theoretical foundation design, recommendation system will highlight on the internet smart system developed from personalization problem, to facilitate us in fast finding the information or products interested, and to generate relevant recommendation. If the system is applied on e-Commerce, consumers who believe that the purchased products can meet their habits, and will eventually increase trust in the system and more frequently purchase through the system. The system can accurately predict the preference of consumers on purchased products, in order to promote trading transactions of electronic products, as well as increasing sales volume for the company.

5 Conclusion

The study emphasizes on the learning objectives of students (favorable subjects and expected level for achievement), and to automatically generate discriminating tests according to his or her learning objectives. The score of the user obtained from the test is used to control his learning objectives and to provide learners with an effective learning course recommendation map.

The empirical experiment of the 100 learners reveals that 75% of the subjects show satisfaction on the learning course recommendation map from the system, which in turn proves the effectiveness of the system recommended learning course.

Effective learning must accompany learners' personal willingness to provide recommendation. On the other hand, due to learners' self insufficiency in knowledge for designing learning course, therefore this study result provides a simple and feasible automatic recommendation system for demand in these two aspects.

Students often get lost during self-learning course, in which they often pick of bits of information and lack of directions and plans in the process. The study proposes a recommendation system to take the test result of an experienced learner and inform the learner the field of knowledge and the proportion in sequence. It is a practical and useful system.

5.1 Future Study

1. The study explores educational theories in depth based on existing results, which will produce a more precise system and benefit to the learners.

2. Upon completion of the learning course recommendation map, satisfaction questionnaire can be generated to develop some dimensions, including operating convenience, smooth flow, curriculum richness and recommendation accuracy, in order to feedback to the system for improvement and contribute more effectiveness and benefits to learners.
3. Learning partners are recommended to join the learning process in order to keep company in learning and to continuously maintain learning interests and motivations. Therefore a learning list can be recommended to close friends to provide learners a list of good friends who share the same interests. For examples, E-mail or Blog...etc. are a good way to start with.
4. If there is a discussion board, then a list of knowledge and article related to learning can be recommended there.

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The Research and Discussion of Web-Based Adaptive Learning Model and Strategy*

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Abstract. This paper proposes a new adaptive learning model through studying the theory of adaptive learning and combining the shortages of E-learning model in the practice of teaching. This new learning model can provide individualization learning content and strategy according to the otherness of learners to realize the teaching aim of teaching students in accordance of their aptitude. This paper also analyses the key technology and model in the model at some level, and estimates them objectively, which would improve the whole model in the future step by step.

Keywords: Adaptive learning, E-learning model, learning strategy, individualization teaching.

1 Introduction

With the advent of the internet age, more and more people choose to Digital Teaching. However, traditional digital learning system is to study the content and the learning process into a fixed computer program, knowledge learning process is decided by the pre-entered information and pre-defined algorithm, and learners can not be in accordance with the learners' needs in the process of learning and teaching to carry out adaptive learning. Using such system, students may be treated as the same, and not be according to their ability, so that teaching and learning can not achieve the desired effect. Thus, the personality of teaching is born in such big environment, we call it adaptive learning.

Adaptive learning is a kind of "customization" of the idealized form of education, and it ensures students' personality unassuming, embodies the essence of quality education, it is a revolution of curriculum reform. Adaptive learning method makes good use of its characteristics, such as rich media manifestations, good adaptation and feedback system, and rapid communication systems and so on. It has become a substantial leap forward and a break of today's online education.

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2 Adaptive Learning Theory

2.1 The Concept of Adaptive Learning

Adaptive learning refers to in the learning process, the individual has a wide range of differences, such as the ability, background, learning style, learning objectives and so on, even the individual themselves, in the learning process, the state of knowledge is in the constantly changing. In fact, adaptive learning is focused on individual differences in learning, is to enable the learning environment, learning content, and learning activities to adapt to each person's different characteristics and highly individualized learning process. Adaptive learning varies from person to person, which is full of personality. Actually, this concept is very similar with Confucian teaching thought that according to the differences of people's ability to use different teaching methods, both of them advise different students with different learning methods, learning strategies and study content, so that enable the students study more quickly and more effectively.

2.2 The Characteristics of Adaptive Learning

Adaptive learning fully takes teaching behavior individualize and learning behavior individualize into account to break the structure of traditional study group, the student as an individual is placed in a more personal scenes. It is in essence breaking the tradition of distance learning content, is a new concept and study learning, it will become the trend of future distance education model development. This study has to have the following main features:

- ◆ Resource-based Learning: Teaching Resources (including text, images, sounds, video, software, etc.) can be combined in different background to meet the requirements of individualized teaching.
- ◆ Active Learning: Learners can under the guidance of teachers, take the initiative to develop and implement learning plans, control the entire learning process, and assess the study results,
- ◆ Knowledge Self-construction: The way learners access to knowledge through their own exploration and communicate to build their own knowledge system rather than teacher-oriented teaching. In this process, learners not only can learn knowledge, but also master the self-study methods and communicate skills.
- ◆ Students' Individual and human nature is the main feature: Because of students' different learning objectives, learning pathways, learning methods and learning scope, each student's learning process is also different. All students are studying according their own condition, and is not a member in a complete synchronization study group.
- ◆ Quick Feedback: Including the guidance of teachers and communicate among students, so that from all angles to understand their knowledge, enrich their own knowledge structure.
- ◆ To advanced digital technology, network technology and intelligent technology as support.

2.3 Adaptive Learning Strategy

Generally speaking, students with different learning styles according to their own, using learning strategies are not the same. In the adaptive learning system, students learning strategies commonly used have the following three:

2.3.1 Teaching-Learning Strategy

Generally speaking, in the traditional teaching mode, teachers lecture on the rostrum, while students mainly listen to is the most frequently used study strategy, it is a one-way teaching communication. This strategy's performance can be enriched in adaptive learning, for example, students can watch video online or learn courseware to obtain relevant knowledge. The problems encountered in the learning process can be solved via an online consultation for synchronized interaction, or by e-mail for asynchronous interaction.

2.3.2 Exploratory Learning Strategy

It is a strategy that students in the learning process, through their own substantial collection of information and choose some useful knowledge to solve the problems. This method can subvert the situation that students accept knowledge passively in tradition study, enable them to acquire knowledge actively and positively, it is easier for students to stimulate the desire for knowledge and enthusiasm for study. There are four basic elements of this strategy: questions, information, tips and feedback. If the four elements can be organized and converged well, good teaching results will be achieved in such a simple technical background.

2.3.3 Collaborative Learning Strategy

This strategy refers to on background of computer network and related multimedia technology, provide a platform for mutual communicating and cooperating between learners, so that the students can better understand the extent of knowledge, and it is also good for their ability of communication with others, cultivating the spirit of teamwork.

3 Traditional E-Learning Model and Its Shortages

E-learning refers to under the network environment, uses the modern educational thought and learning theory as a guide, gives full play to the network's various educational features and a wealth of online education resources, provides educators and learners a network of teaching and learning environment, delivery of digital content and conduct learner-centered non-face-to-face teaching activities. According to our own teaching situation, we propose a corresponding E-learning model, as follows:

However, to some extent there are some shortages in E-learning teaching model:

- 1) Teaching system mostly adopt Static Display Technology. Network Course only expresses the content of their textbooks with a simple digital technology, or shows the teachers' lecture content directly, so that this boring approach can't arouse the study enthusiasm of students.
- 2) System interaction is too single. Because of the limitation of teaching model, now most of online teaching systems are mainly based on a one-way page, rather than interactive, discussion-based study.

- 3) Teaching content is lack of personalized, and do not well show the principle that according to the differences of people’s ability to use different teaching methods. The learning system can not in accordance with learners’ cognitive level and cognitive characteristics to generate study content dynamically.
- 4) Not well reflect the navigation and evaluation of study. Basically Network Courses consist of a pile of pages, and each of them is connected by hyperlinks, it’s very complex, because of that learners may be easy to lose themselves, as a result, affecting the grasp of knowledge.
- 5) Not consider the students’ emotional state in the learning process. In the daily teaching, teachers can adjust their teaching strategies according to the students’ status, while the teaching strategies of general teaching systems are not related to students’ study emotional state, and this precisely effect students’ learning efficiency. Of course, this technology in the system is very difficult to realize, it needs an emotional teaching database, and computers are used to identify the person’s facial expression to determine the mood of the students. Therefore, in the improved adaptive model, we didn’t add the emotional teaching.

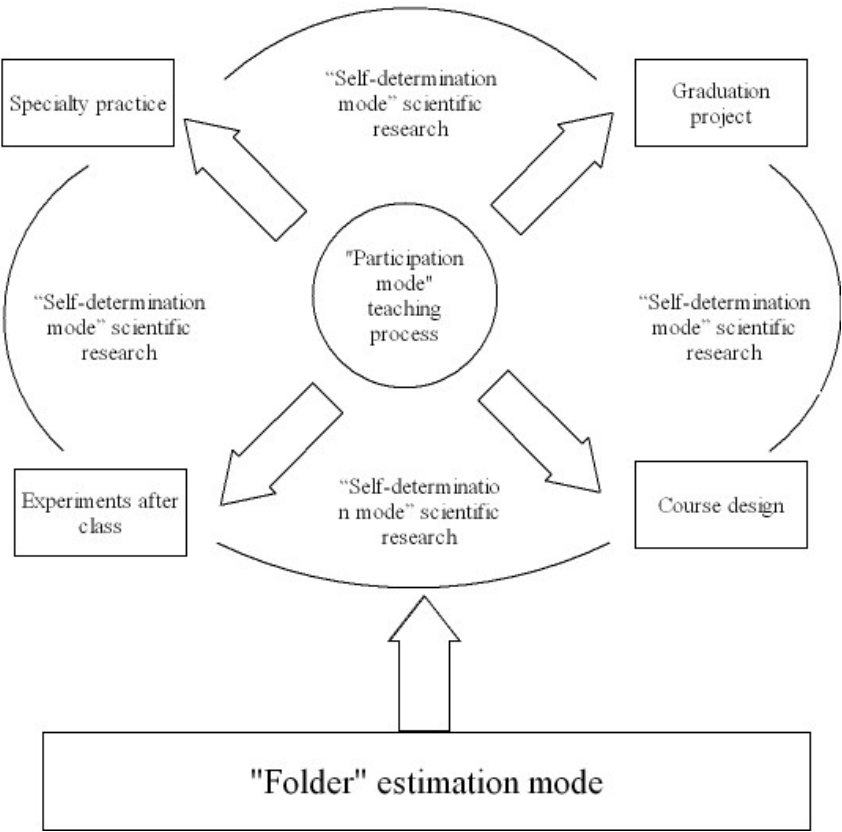


Fig. 1. E-learning model

4 Adaptive Learning Model

There are a number of problems exist in E-learning Model, and with the development of teaching theory and artificial intelligence, network information and digital technology, therefore, more and more researchers begin to pay attention to Adaptive Learning Model not only the implementation in teaching practice, but also the application. In this paper, to solve the personality problem in the process of teaching, we propose a new Adaptive Learning Model which is combined with adaptive learning theory and computer intelligence technology. Specific as in the figure below:

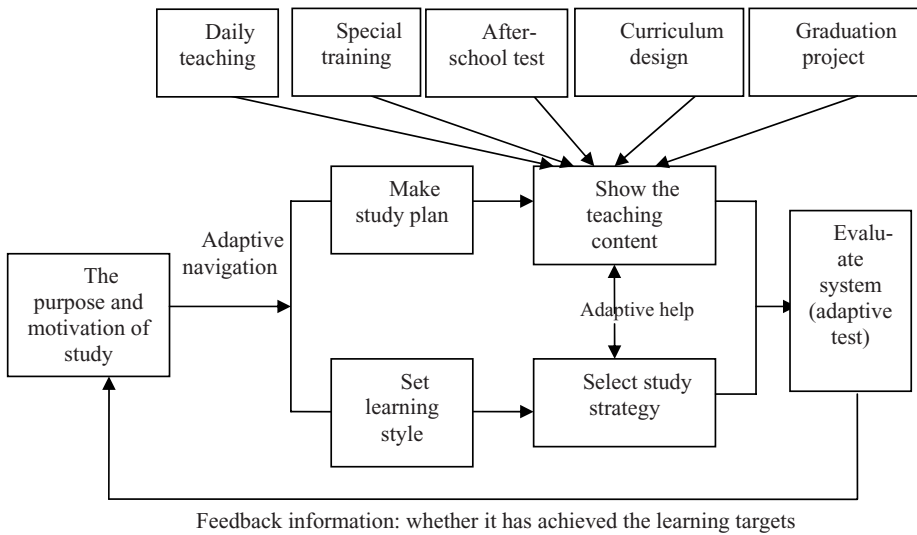


Fig. 2. Adaptive learning model

Adaptive learning model provide learning support system suited to individual characteristics for the differences in the individual learning process. It can provide a user view which is suited to the personalized features; such personalized study view not only includes personalized resources, but also includes personalized learning process and strategies. Adaptive model can provide adaptation according to individual needs of different learners: adaption of diagnostic study, adaption of learning content, adaption of students self-select learning strategies. Though the learning contents may be the same among the students, Adaptive Learning provides different ways to different student, and different students learn the same knowledge through the Adaptive Learning System, there will be different learning path, learning strategies and learning content. The study provided by Adaptive Learning System is individual, vary from person to person, and is in line with students' individual study situation. Under its support, learners can study faster and more effectively.

Three modules required implementation of this model are: adaptive navigation, adaptive show of teaching content and adaptive test.

4.1 Adaptive Navigation

Adaptive Learning Model can make adaptive navigation, set up their own favorite learning style, and choose different study strategies, according to different students' study objectives and motives. Since each student's study process and study efficiency is different, it is a very crucial step to each student to make their different learning programs. This model can realize adaptive show of teaching content by accept learners' plan dynamically. This teaching content includes five components of E-learning model mentioned above.

4.2 Adaptive Show of Teaching Content

Adaptive show of teaching content refers to when a user select a study unit, the system can show the appropriate page content according to learners' existing level of knowledge, favorite learning style, study habits and interest in learning. Also the model can be in accordance with historical records of the learner and ability to estimate, select the teaching content which they don't have or have not been studying and present to the learners. Therefore, if we want to solve adaptive show of teaching content, we need to be aware of students' studying history, and evaluate their cognitive ability in real-time. Of course, students also can choose different teaching modules to complete their own teaching plans according to their own needs. We take the course called Data Structure and Algorithm Analysis as an example; this model will combine the learning content Generating the Smallest Binary Tree dynamically in the next learning stage according to the test results of Binary Tree in the last stage.

4.3 Adaptive Test

Through the analysis of students' study history and their practice history, we can determine the new test questions, so that we can avoid repetition practice of the acquired knowledge or omission of the unknown knowledge. After testing, it is necessary to give the test results, such as the extent of knowledge grasp, and give the next stage of study recommendations, such as the study and review in the next stage. For example, a student after study "Sorting Algorithm", but he/she can't finish the application related to "Insertion Sort" and "Bubble Sort" in the test, than the model will prompt the students to continue studying this unit, until all the sorting algorithms they have mastered, they will be allowed to move on to study the next unit.

5 The Key Technology and Implement

We have mentioned above that the Adaptive model mainly includes three key aspects: study diagnosis, dynamic organization of studying content and selection of study strategy, these aspects is performance of this model's adaption.

5.1 Study Diagnosis

Study Diagnosis refers to test students using the exercises which are determined by measurement theory, estimate students' ability and the mastery extent of their knowledge field according to their test results, it is an important basis for the system organizing the study content dynamically. Generally, in this Adaptive Learning Model, the

requirements of this diagnosis is very high, it must have the same results in different environments and different time, what's more, use the test content as small as possible to judge the true ability of students. It can happen in the beginning of study, the process of study or the end of study.

- ◆ Testing in the beginning of their study, it can know students' existing level of knowledge and cognitive level. Combining the history records in the study process, it can estimate students' knowledge level and competence, so that it can give the most suitable study strategy for the students' study, as well as some proposals to enable the students study more efficient.
- ◆ Testing in the learning process, mainly taking more practice to consolidate students' weak links.
- ◆ At the end of study testing, testing whether the students achieve the desired teaching objectives. For those who have achieved, may propose the termination of study or the next phase of the study, but those who haven't achieved, they should be proposed tutorial unit.

5.2 Dynamic Organization of Learning Content

Dynamic organization of learning content refers to organize and show the most relevant content of learners' current study ability dynamically, according to the result of study diagnosis and students' historical records of study. It has two meanings: First, the selection of learning content; Second, organization of learning content.

Content selection is defined as according to the historical records of study and the ability of estimate, select the teaching content that students do not have or have not been.

Content organization bases on hypermedia, the differences are mainly reflected in the level of connection and the unit of connection, which varies according to the students with different abilities. Adaptive Learning Model can combine the cognitive modules dynamically, and form the most suitable teaching course ware for the students, according to the study strategies selected by students, the ability level and knowledge level. At a certain point of knowledge, although various cognitive modules have different forms, the knowledge required to master and the ability obtained is the same, in other words, the teaching objectives are consistent.

5.3 The Selection of Study Strategy

The selection of study strategy is defined as take study method according to the specific learning content when students study. Generally speaking, different students according to their different learning styles, adopt different study strategies. Also a student at different time can adopt different study strategies, what's more, even a student can adopt a variety of learning strategies when study the same learning content. A variety of learning strategies have their own unique features and these features can complement each other. Specific learning strategies we have mentioned above in the adaptive theory, here not to undertake the introduction.

5.4 Function Structure Implement

In the system, we mainly implement the following functions to improve the teaching quality. The details are presented in the fig.3.

Innovative education platform contains several following modules.

- ◆ Logging in: it identifies and manages all the users who entering into the system.
- ◆ Learning environment: it aims at the designing idea of students' learning. Under the environment, learners can get their learning goals using different tools, measures and information. During the process of learning, system would select different learning content dynamically due to the ability of different students, which would adapt students' self-determination learning. It includes three sub-modules: course learning, discussion and communication and information management.
- ◆ Self-testing: it mainly tests students' knowledge level and cognitive ability. System would analyse and judge how students go to learning through the feedback of self-testing.
- ◆ Teaching management: teachers can watch how students get along with learning and give students some suggestions to help them to adapt the rapid learning rhythm. Teachers also can maintain test questions database, put out bulletins and offer other assistant functions.

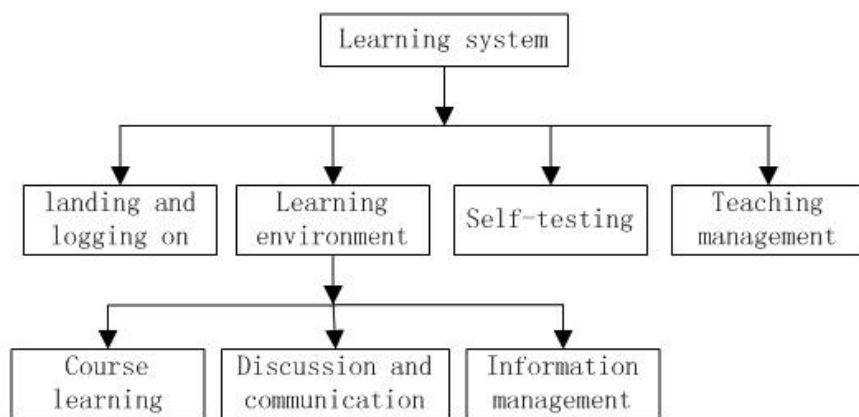


Fig. 3. System function structure graph

6 Conclusion

Under the guidance of modern educational theory, web-based adaptive learning system combines with the actual development level, makes use of artificial intelligence technology, web technology and web-based database technology, to build a web-based learner-oriented personalized adaptive learning model to achieve the initial purpose of their aptitude. The model embodies the principle of "student-centered"

education idea, and selects the adaptability navigation strategy based on the theory of cognitive flexibility, it is basically embodies the principle of "individualized education" of the idea. Of course, there are also some shortages exist in this model, which will be improved and enriched in teaching practice in the future, and its corresponding adaptive learning system also needs further development and research.

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Relationships between Students' Demographic Background, Subject Areas, and Learning Patterns in Post-secondary Education of Hong Kong

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Abstract. The present study is based on the results of an administration of a Chinese translation of the Inventory of Learning Styles (ILS) to a large sample of post-secondary students in Hong Kong. The ILS was originally developed in a Dutch higher education context to capture variation in students' learning patterns. In what is believed to be the first analysis of ILS data obtained in a Chinese response-context, empirical support is found in 'small' effects of students' demographic background and subject areas on students' learning patterns. Support is also found in 'moderate' effects of students' learning orientations and conceptions of learning on students' regulation strategies, and 'large' effects of the other ILS components on students' processing strategies, especially those from students' regulation strategies. Despite possible cultural differences, the present findings largely corroborate the results of other published work, especially the posited central explanatory role of regulation strategies among the ILS components.

Keywords: Student Learning, Inventory of Learning Styles, Regulation Strategies, Effect Size.

1 Introduction

With the rapid expansion of the post-secondary education sector of Hong Kong in its education reform [1], the question of how students engage themselves in learning, and with what likely consequences, is an important consideration for various stakeholders. One well established methodology for addressing this question lies in the development of appropriate research instruments for capturing variation in students' educational experiences [2], and particularly their experiences of learning insofar as these can inform endeavors aimed at enhancing the quality of both learning and teaching.

Student learning is a complex phenomenon involving many constructs [3], and no single research endeavor can practically investigate the relationships among all of them. The study reported in this paper is part of an investigative project for exploring the possible relationships between some of these constructs which were selected from two major domains, namely the *personological domain* with a focus on students' learning patterns, and the *contextual domain* with a focus on students' perceptions

of their learning environment. The project aims to promote a rigorous approach to developing quantitative instruments for the collection of credible data on student learning for quality assurance purposes. To a large extent such a practice is currently lacking in the post-secondary education of Hong Kong. For the project, a composite research instrument was adapted from the Inventory of Learning Styles (ILS) and the Course Experience Questionnaire (CEQ), two existing quantitative instruments developed and validated in western higher education contexts, for application in the new response-context of Hong Kong post-secondary education. To the knowledge of the authors, the project is the first attempt to adapt the two instruments for research in this new response-context. This paper focuses on the ILS-portion of the instrument; readers interested in the CEQ are referred to the relevant literature, e.g. [4] and [5].

An extensive survey of the ILS can be found in [6]. Unlike earlier research instruments used in many previous studies of student learning that focus on students' processing strategies and learning motivations, e.g. the Study Process Questionnaire (SPQ) and the Approaches to Studying Inventory (ASI) (cf. Chapters 5 and 6 of [7]), the design of the ILS is based on an integrative theory and conceptualization of student learning which encompasses students' *processing strategies*, *regulation strategies*, *learning orientations* and *conceptions of learning*, with an aim to facilitate the investigation of interrelationships among these four components. The construction process of the ILS and its psychometric properties for application in the Dutch higher education context are reported in [8]. During its development the ILS has been tested and fine-tuned several times, reducing its number of items from 241 to 144, and finally to 120 and 100.

Aiming at a more economic design of the instrument, the 100-item version of the ILS was selected for adaptation. Among the four ILS components, processing strategies refer to the thinking activities that students use to process the learning content. These strategies are measured by 25 instrument items in five scales, namely *Relating and Structuring*, *Critical Processing*, *Memorizing and Rehearsing*, *Analyzing*, and *Concrete Processing*. Regulation strategies refer to students' activities for regulating and controlling the processing strategies and therefore indirectly lead to learning outcomes. These strategies are measured by 25 instrument items in five scales, namely *Self-regulation of Learning Processes and Results*, *Self-regulation of Learning Content*, *External Regulation of Learning Processes*, *External Regulation of Learning Results*, and *Lack of Regulation*. Learning orientations refer to the whole domain of students' personal goals, intentions, motives, expectations, attitudes, concerns and doubts with regard to their studies. These orientations are measured by 25 instrument items in five scales, namely *Personally Interested*, *Certificate Oriented*, *Self-test Oriented*, *Vocation Oriented*, and *Ambivalent*. Conceptions of learning (or mental models of learning) refer to a coherent system of knowledge and beliefs about learning and related phenomena, such as the nature of knowledge and the roles that should be assumed by teachers, classmates and the students themselves in students' learning. These conceptions are measured by 25 instrument items in five scales, namely *Construction of Knowledge*, *Intake of Knowledge*, *Use of Knowledge*, *Stimulating Education*, and *Cooperative Learning*. The ILS components, their constituent scales, and brief descriptions of scale content are shown in Table 1, more details can be found in the relevant literature, e.g. [8] and [9].

Table 1. Scales of the ILS and their content

Domain: Sub-domain Scale (Number of Items)	Description of Content
I. Processing Strategies:	
1. Deep Processing	
1a. Relating and Structuring (6)	Relating elements of the subject matter to each other and to prior knowledge, structure these elements into a whole.
1b. Critical Processing (4)	Forming one's own view on the subjects that are dealt with, drawing one's own conclusions, and being critical of the conclusions drawn by textbook authors and teachers.
2. Stepwise Processing	
2a. Memorizing and Rehearsing (5)	Learning facts, definitions, lists of characteristics and the like by heart by rehearsing them.
2b. Analyzing (5)	Going through the subject matter in a stepwise fashion and studying the separate elements thoroughly, in detail and one by one.
3. Concrete Processing (5)	Concretizing and applying subject matter by connecting it to one's own experiences and by using in practice what one learns in a course.
II. Regulation Strategies:	
4. Self-regulation	
4a. Self-regulation of Learning Processes and Results (6)	Regulating one's own learning processes through regulation activities like planning learning activities, monitoring process, diagnosing problems, testing one's outcomes, adjusting and reflecting.
4b. Self-regulation of Learning Content (4)	Consulting literature and sources outside the syllabus.
5. External Regulation	
5a. External Regulation of Learning Processes (5)	Letting one's own learning processes be regulated by external sources, such as introductions, learning objectives, directions, questions or assignments of teachers or textbook authors.
5b. External Regulation of Learning Results (5)	Testing one's learning outcomes by external means, such as tests, assignments and questions provided.
6. Lack of Regulation (5)	Having difficulties with the regulation of one's own learning processes.
III. Conceptions of Learning:	
7. Construction of Knowledge (5)	Learning viewed as constructing one's own knowledge and insights. Most learning activities are seen as tasks of students.
8. Intake of Knowledge (5)	Learning viewed as taking in knowledge provided by education through memorizing and reproducing, other learning activities are tasks of teachers.
9. Use of Knowledge (5)	Learning viewed as acquiring knowledge that can be used by means of concretizing and applying. These activities are seen as tasks of both students and teachers.
10. Stimulating Education (5)	Learning activities are viewed as tasks of students, but teachers and textbook authors should continuously stimulate students to use these activities.
11. Cooperative Learning (5)	Attaching a lot of value to learning in cooperation with fellow students and sharing the tasks of learning with them.
IV. Learning Orientations:	
12. Personally Interested (5)	Studying out of interest in the course subjects and to develop oneself as a person.
13. Certificate Oriented (5)	Striving for high study achievements, studying to pass exams and to obtain certificates, credit points and a degree.
14. Self-test Oriented (5)	Studying to test one's own capabilities and to prove to oneself and others that one is able to cope with the demand of higher education.
15. Vocation Oriented (5)	Studying to acquire professional skill and to obtain a(nother) job.
16. Ambivalent (5)	A doubtful, uncertain attitude toward the studies, one's own capabilities, the chosen subject area, the type of education, etc.

2 Background and Context

Students participating in the investigative project came from six institutions of the Caritas Community and Higher Education Service, an organization which operates under the auspices of Caritas – Hong Kong. At the time of undertaking the study these students were enrolled in various kinds of post-secondary Certificate, Diploma, Associate Degree and Higher Diploma programmes. Over a three-month period (March – May, 2005), and with the assistance of teachers from the participating institutions, access to convenience samples was made possible, the aim being to involve the entire student population. Precise enrolment data for the programmes involved was not collected, but the total student enrolment (size of the population) was estimated to be 2515, based on the number of copies of the research instrument requested by the individual institutions for use in the study. Valid responses were obtained from 1572 students, representing a response rate of 62.5%.

In view of the low English proficiency of some participating students, the composite research instrument is written in Chinese with its 146 items mainly divided into three parts¹. The first part is a Chinese translation of the 100-item version of the ILS. The second part is a Chinese translation of the 36-item version of the CEQ, with an additional item to assess students' overall satisfaction with the quality of the learning context, which is typically used as a simple means for the criterion-related-validity checking of the CEQ. The third part comprises nine items and aims to collect the following demographic and other background information from students: age, gender, type of programme being studied, current year of study, major subject area of programme, prior academic performance before studying the programme, perceived difficulty level of the programme, level of interest in the programme, and expected performance in the programme. These background items add further dimensions to the investigative domain not covered by the ILS and the CEQ. For example, the age, gender and prior academic performance of students may also be influential observables from the personological domain. The type and subject area of programmes may also be influential observables from the contextual domain. Following the practice of some reported studies (e.g., [10]), the time span for responding to instrument items in the present study was set at the semester-specific level, and the participating students were asked to report on the perceptions and experiences in their study specifically about the past semester.

Before systematic relationships among the relevant student learning constructs were explored, the ILS and CEQ scales were construct validated for application in the previously unexplored context of the post-secondary education of Hong Kong, mainly through considerations of exhibited values of Cronbach's coefficient alpha (for assessing the internal consistency of the scales, see [11] for brief introduction), and exploratory factor analysis (for assessing the construct validity of the scales in relation to empirical structure, see [12] for brief introduction). Due to space limitation a detailed report on these analyses cannot be provided. It is simply mentioned in summary that for the ILS-portion of the instrument, in regard to internal consistency the alpha values associated with the 20 ILS scales ranged between 0.50 and 0.79, with 12 of them

¹ In this regard, the ILS and CEQ items were first translated from English to Chinese. The Chinese items were then translated back to English for verification before their incorporation into the composite research instrument.

greater than 0.70². The results are summarized in Table 2, which also indicates the means and standard derivations of the scale scores. The alpha values are comparable to those reported in three other studies, namely the original study of the ILS in a Dutch response context [8], a study adapting the ILS for application in an Indonesian response-context [13], and a crosschecking study of the ILS in a British response-context [14]. In regard to construct validity, the present findings on variation in students' learning patterns resembled more closely the findings of [13] rather than those of [8]. This result is not surprising, given that the response-context of the former study (Indonesia) arguably resembles more closely that of the present study. The reliability and validity of the ILS are thus broadly confirmed for application in the new response-context of post-secondary education in Hong Kong.

Table 2. Means, standard derivations and coefficient alphas of the ILS scales (n=1572)

ILS Scale	Mean	Standard Derivation	Alpha
Processing Strategy:			
Relating and Structuring	2.44	0.67	0.78
Critical Processing	2.38	0.74	0.73
Memorizing and Rehearsing	2.72	0.64	0.62
Analyzing	2.49	0.64	0.73
Concrete Processing	2.77	0.68	0.72
Regulation Strategy:			
Self-regulation of Learning Processes and Results	2.58	0.66	0.75
Self-regulation of Learning Content	2.44	0.75	0.73
External Regulation of Learning Processes	2.71	0.61	0.62
External Regulation of Learning Results	2.82	0.64	0.66
Lack of Regulation	2.78	0.64	0.60
Mental Model of Learning:			
Construction of Knowledge	3.31	0.63	0.71
Intake of Knowledge	3.34	0.64	0.63
Use of Knowledge	3.50	0.67	0.71
Stimulating Education	3.35	0.65	0.75
Cooperative Learning	3.05	0.73	0.73
Learning Orientation:			
Personally Interested	3.19	0.59	0.50
Certificate-oriented	3.46	0.75	0.69
Self-test-oriented	3.29	0.74	0.75
Vocation-oriented	3.70	0.76	0.79
Ambivalent	2.99	0.68	0.65

Scale scores range from 1 to 5

3 Selected Analytical Results

In the investigative project, possible systematic relationships among the relevant student learning constructs were explored via multiple regression analyses with the evaluative results being assessed mainly from two perspectives: *statistical significance* and *effect size*. Some analysis results on the relationships between the ILS components

² Many researchers consider an alpha value of at least 0.7 as desirable and adequate; however, see [11] for more details on the theory and applications of coefficient alpha.

based mainly on considerations of the statistical significance (and changes in magnitude) of standardized regression coefficients are reported in [15]. This paper reports the results of two studies of the relationships concerned from an alternative perspective, basing mainly on considerations of effect size as denoted by *coefficient of determination* (R^2) whose magnitude can be interpreted as the proportion of variation in the dependent variable that is explained by the regression model (cf. page 118 of [16]). To shed more light on the present findings, the analysis results are compared to those of other published work as deemed appropriate.

In the first study, multiple regression analyses were conducted with students' demographic background (i.e. age, gender and prior qualification) and the subject area of their study programmes comprising the set of predictor variables, and each of the ILS scales being the dependent variable. The analysis results are summarized in Table 3³, which can be compared to the results of a similar study conducted by Vermunt [9] that are summarized in Table 4. Viewed from the proportion of explained variance (i.e. the R^2 values) found in the two studies, it is obvious that students' demographic background and subject area serve as better predictors for most of the ILS scales in Vermunt's study than in the present study, as the latter results vary in a very narrow range of 1% (e.g. for *Certificate-oriented*) to 7% (e.g. for *External Regulations of Learning Results*), while the former results vary in a wider range of 2% (for *Stimulating Education*) to 21% (for *Certificate-oriented*). Part of the reason behind this phenomenon could be due to the different response contexts of the two studies, and the different operationalization of some predictor variables (e.g. age, prior qualification and subject area) for which the range in the present study was always narrower.

Nevertheless, the 20% difference in explained variance (i.e. 21% vs. 1%) between the two studies in the regression of *Certificate-oriented* is worthy of further examination. From the standardized regression coefficients, it can be seen that in the current findings students' subject areas made no contribution to R^2 (possibly due in part to more homogeneity in the participating students' certificate-orientations, which were largely unaffected by the disciplines being examined in the study). However, in Vermunt's findings students' subject areas assumed a relatively important role in predicting their certificate-orientations, as students who studied Psychology, Arts or Sociology were found to be less *Certificate-oriented* than the other students. Vermunt also found older students to be less *Certificate-oriented*, whereas in the present findings students' age has no identified effect (possibly due in part to the narrower age range of the students participating in the study). It is also interesting to note that while male students were found to be more *Certificate-oriented* by Vermunt, contrary results were found in the present study.

The magnitude of all the standardized regression coefficients in Table 3 are less than 0.2 and most of them less than 0.1, suggesting weak relationships between the dependent and predictor variables concerned. Overall, the findings in the first study indicate that the predictive power of students' demographic background and the subject area of students' study programmes on students' learning patterns are low in the context of post-secondary education in Hong Kong.

³ The number of valid cases is 1548 (instead of 1572), this being due to the automatic removal of cases with missing values by the SPSS system.

Table 3. Standardized regression coefficients of age, gender, prior qualification, and subject area as predictors of learning patterns based on the stepwise regression model (n = 1548), proportions of explained variance (R²) by this model, F-values and significance levels

ILS Scale	Predictor						R ²	F
	Age	Gender	Prior Qualification	BABS	HOTO	Subject Area LANG IT Others		
Processing Strategy:								
Relating and Structuring		-0.13***				+0.11***	0.04	8.62***
Critical Processing		-0.17***	+0.06*			+0.12***	0.05	10.75***
Memorizing and Rehearsing				+0.07*		+0.12***	0.04	10.81***
Analyzing		-0.07**				+0.11***	0.02	5.27***
Concrete Processing		-0.11**	+0.07*	-0.17***	-0.15***		0.05	10.78***
Regulation Strategy:								
Self-reg.: L. Proc. & Results		-0.08**				+0.12***	0.03	7.03***
Self-reg.: L. Content	+0.08**	-0.09**		-0.14***	-0.09*	+0.08*	0.06	10.26***
External Reg.: L. Processes			+0.07*			+0.08**	0.02	5.98***
External Reg.: L. Results	+0.10**				-0.08**	+0.07*	0.07	15.39***
Lack of Regulation		-0.07*			-0.07*		0.02	3.66**
Mental Model of Learning:								
Construction of Knowledge	+0.06*	+0.09**	+0.06*			+0.08**	0.07	13.20***
Intake of Knowledge		+0.13***				+0.07*	0.03	6.68***
Use of Knowledge		+0.08**	+0.07*				0.04	10.11***
Stimulating Education		+0.10***				+0.07*	0.04	7.80***
Co-operative Learning	-0.07*					+0.10***	0.02	3.80**
Learning Orientation:								
Personally Interested		+0.10***		-0.14***			0.03	6.73***
Certificate-oriented		+0.10***					0.01	3.23**
Self-test-oriented		+0.07*					0.03	6.55***
Vocation-oriented		+0.16***					0.06	16.84***
Ambivalent			-0.09**			+0.06*	0.01	3.30**
Subject area: BABS - Business Administration/Business Studies; HOTO- Hospitality /Tourism; LANG - Language Studies; IT - Information Technology; SOCSC - Social Science								

* p<0.05; ** p<0.01; *** p<0.001 (two-tailed test)

Table 4. Standardized regression coefficients of age, gender, prior qualification, and subject area as predictors of learning patterns based on the total regression model (n = 792), proportions of explained variance (R²) by this model, F-values and significance levels, adapted from Vermunt (2005)

ILS Scale	Predictor							R ²	F
	Age	Gender	Prior Qualification	M.I.S.	Econo	Ecotry	Subject Area Socio	Psycho	Arts
Processing Strategy:									
Relating and Structuring	+0.11*		+0.09*	+0.09*		-0.12*		+0.06	6.9***
Critical Processing	+0.19***	-0.14***		-0.10*		-0.09	+0.06	+0.09	10.6***
Memorizing and Rehearsing	-0.06		-0.11*	-0.11*				-0.06	2.9*
Analyzing		-0.09*	-0.11**	-0.09			-0.11*	-0.19***	7.1***
Concrete Processing	+0.15***	-0.11**				-0.17***		+0.11*	9.7*
Regulation Strategy:									
Self-reg.: L. Proc. & Results	+0.10*	-0.06						+0.15**	4.7***
Self-reg.: L. Content	+0.35***	-0.09*				-0.08			12.5***
External Reg.: L. Processes			-0.11*	-0.06		-0.06		-0.23***	4.1***
External Reg.: L. Results		+0.14***	-0.07	+0.16***	+0.20**	+0.22**		-0.14**	14.2***
Lack of Regulation	+0.16***		-0.15***	+0.09*	+0.10*	+0.11*	+0.06	+0.08	2.4*
Mental Model of Learning:									
Construction of Knowledge	+0.27***	+0.08*		-0.08		-0.11*			12.7***
Intake of Knowledge		+0.06	-0.22***			+0.09*	-0.07	-0.15**	12.1***
Use of Knowledge						-0.11*	-0.09	-0.17**	3.0**
Stimulating Education	+0.07	+0.07	-0.09	+0.06		+0.11*	+0.07		1.7
Co-operative Learning		+0.18***	-0.09*	+0.10*	+0.14**	+0.20***	+0.09		5.6***
Learning Orientation:									
Personally Interested	+0.15***	+0.07	-0.07	+0.06			+0.06	+0.20***	9.4***
Certificate-oriented	-0.15***	-0.15***	-0.07				-0.15**	-0.26***	20.8***
Self-test-oriented									0.6
Vocation-oriented		-0.07				-0.11*	-0.19***	-0.07	5.5***
Ambivalent		+0.08*	-0.08	+0.12*		+0.19***	+0.08	-0.20***	3.8*

Subject area: M.I.S. - Management Information Science; Econo - Economy; Ecotry - Ecotry - Sociometry; Psycho - Psychology
* p<0.05; ** p<0.01; *** p<0.001 (two-tailed test)

Table 5. Standardized regression coefficients of regulation strategies, mental models of learning and learning orientations as predictors of processing strategies based on the stepwise regression model, and significance levels of the F-values

Processing strategies	Relating & Structuring		Critical Processing		Memorizing & rehearsing		Analyzing		Concrete Processing	
	BDD	PS	BDD	PS	BDD	PS	BDD	PS	BDD	PS
Regulation strategies										
Self-regulation of										
Learning processes & results	+0.38	+0.52***	+0.51	+0.49***	+0.18	+0.26***	+0.26	+0.40***	+0.31	+0.20***
Learning content	+0.12	+0.30***	+0.20	+0.33***		+0.13***		+0.24***	+0.16	+0.33***
External regulation of										
Learning processes			-0.17		+0.43	+0.22***	+0.19	+0.20***	-0.19	+0.20***
Learning results	+0.23		+0.23			+0.18***	+0.35	+0.13***	+0.17	+0.20***
Lack of regulation		+0.07***				+0.10***				+0.08***
Mental models										
Construction of knowledge							+0.17			+0.07**
Intake of knowledge	-0.21			-0.05*						-0.11***
Use of knowledge							-0.15	-0.06**	+0.31	+0.17***
Stimulating education	+0.19				+0.15					
Co-operative learning										
Learning orientations										
Personally interested						-0.04*			+0.18	
Certificate-oriented		-0.06***								-0.09***
Self-test-oriented										
Vocation-oriented										
Ambivalent			-0.14	-0.08***		+0.08***			-0.18	+0.06*
				+0.09***			-0.15		-0.12	
R²	0.49	0.60	0.56	0.55	0.29	0.48	0.44	0.61	0.50	0.54
F	40.5	590.7***	56.9	388.3***	30.5	207.3***	30.5	494.7***	32.5	203.5***

BDD = study of Boyle, Duffy & Dunleavy (2003); n = 156; information on test of statistical significance was not provided
PS = present study; n = 1572; * p<0.05; ** p<0.01; *** p<0.001 (two-tailed test)

Table 6. Standardized regression coefficients of mental models of learning and learning orientations as predictors of regulation strategies based on the stepwise regression model, and significance levels of the F-values

Regulation Strategies	Self-regulation of learning processes and results		Self-regulation of learning content		External regulation of learning processes		External regulation of learning results		Lack of regulation	
	BDD	PS	BDD	PS	BDD	PS	BDD	PS	BDD	PS
Mental models										
Construction of knowledge	+0.33	+0.29***	+0.25	+0.23***		+0.14***		+0.09**		
Intake of knowledge	-0.23		-0.16		+0.32	+0.15***	+0.16	+0.09**	+0.14	+0.08**
Use of knowledge	+0.13			-0.08*					+0.19	+0.08**
Stimulating education	+0.16		+0.21				+0.17	+0.09*		
Co-operative learning			-0.13							
Learning orientations										
Personally interested		+0.12***		+0.20***						
Certificate-oriented		-0.14***		-0.14***	+0.19		+0.14			
Self-test-oriented		+0.18***		+0.13***		+0.09**	+0.15	+0.10**		
Vocation-oriented		-0.11***		-0.13***		+0.10**		+0.13***		
Ambivalent			-0.19		-0.12		-0.26		+0.46	+0.29***
R²	0.27	0.16	0.26	0.12	0.16	0.14	0.16	0.15	0.30	0.12
F	24.4	59.1***	18.5	36.2***	16.3	61.3***	11.0	55.2***	34.1	72.8***

BDD = study of Boyle, Duffy & Dunleavy (2003); n = 156; information on test of statistical significance was not provided
PS = present study; n = 1572; * p<0.05; ** p<0.01; *** p<0.001 (two-tailed test)

In the second study, two multiple regression analyses were conducted. In the first analysis, each of the processing strategies was set as the dependent variable, with the regulation strategies, mental models and learning orientations serving as the predictor variables. In the second analysis, each of the regulation strategies was set as the dependent variable, with the mental models and learning orientations serving as the predictor variables. Table 5 and Table 6 show the results of the first and second analysis respectively, together with the results of a similar study conducted by Boyle's group [14] in the UK higher education context.

As shown in Table 5, in the present study a 'large'⁴ proportion of the variance in students' processing strategies was explained by the regression model, as indicated by the R^2 values which ranged from 48% (for *Memorizing and Rehearsing*) to 61% (for *Analyzing*). In general, the effects found in the present study were more salient than those found by Boyle's group, in which the R^2 values ranged from 29% (for *Memorizing and Rehearsing*) to 56% (for *Critical Processing*). As shown in Table 6, in the present study a 'medium' proportion of the variance in students' regulation strategies was explained by the regression model, as indicated by the R^2 values which ranged from 12% (e.g. for *Lack of Regulation*) to 16% (for *Self-regulation of Learning Processes and Results*). In general, the effects found in the present study were less salient than those found by Boyle's group, in which the R^2 values ranged from 16% (for *External Regulation of Learning Processes*) to 30% (for *Lack of Regulation*).

4 Concluding Discussion

It can be seen from the standardized regression coefficients in Table 5 that the influence on students' processing strategies was dominated by students' regulation strategies, and in most cases the effects of the other two ILS components were not salient when variations in students' regulation strategies were controlled by the regression model, suggesting that they were mostly indirect effects mediated by students' regulation strategies. It can also be seen from Table 6 that to a moderate extent, each of the students' regulation strategies was affected by various constructs in students' mental models and students' learning orientations, the most salient effects being between *Construction of Knowledge* and *Self-regulation of Learning Processes and Results*, and between *Ambivalent* and *Lack of Regulation*. Overall, it is clear that the present findings largely corroborate the results of other published work, especially the central explanatory role of regulation strategies among the ILS components, as posited by Vermunt [8]. These findings complement those reported by Law and Meyer [15] in indicating that the ILS is able to capture the variation in students' learning patterns in the new response-context of Hong Kong post-secondary education. Institutions of this sector can thus consider employing an appropriate adaptation of the ILS for various quality assurance purposes, e.g. as part of a diagnostic system for addressing the possible problems of students in their learning, or as a formal tool for collecting credible data on student learning to inform possible improvements in the teaching and learning processes.

⁴ Following the suggestion of Cohen [17], an R value of at least 0.14, 0.36 and 0.51 (and consequently an R^2 value of at least 0.02, 0.13 and 0.26) is considered as representing a 'small', 'moderate' and 'large' effect respectively.

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