

A Framework for Evaluation of Learning Effectiveness in Online Courses

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Abstract. One of the hottest research topics today in higher education is E-Learning. Different issues and challenges such as pedagogical, technological, social, cultural, ethical and economical have been addressed in this context by many researchers. While online courses have always been a common approach to E-Learning, it is essential to develop some measurements in the form of quality assurance systems in order to reflect their learning effectiveness and improve the quality of teaching and learning. Therefore, a framework for evaluation of learning effectiveness in online courses is proposed in this article. A case study is presented to illustrate the use of the framework in a study programme. Finally, possible improvements and future directions of the framework are discussed in the conclusion.

1 Introduction

This article is about the evaluation of learning effectiveness in online courses. Section 2 describes the framework for evaluation of learning effectiveness in online courses, highlighting the implementation of online courses, the factors in learning effectiveness, the approach to evaluation methods and the implications of evaluation results. Section 3 is a case study that illustrates the use of the framework in a study programme. Section 4 concludes the article with a summary and a discussion about possible improvements and future research directions.

1.1 E-learning Trends

The rapid growth of the Internet and other emerging technologies has brought a new era of E-Learning in higher education. There are an increasing number of these technologies used to enrich the learning experience in higher education. Online courses have always been a common approach to E-Learning. Online courses provide an active learning environment and this shift in learning process can transform pedagogy with the use of online technologies. Many higher education institutions have been delivering online courses in conjunction with traditional classroom in their efforts to

improve learning effectiveness. However, online courses should not be viewed as another means of accessing the same materials and methods used to present in a traditional classroom [1]. It requires a different array of preparation, infrastructure, technical support, technology expertise, and course methodology [2]. Careful considerations of the use of supporting technologies in online courses would encourage learning and improve students' performance. In order to demonstrate the learning effectiveness in online courses, it is essential to develop some measurements in the form of quality assurance systems. Course evaluation is one of the essential educational delivery components to improve the quality of teaching and learning [3]. It can be used to evaluate the effectiveness in teaching and learning. Examples of course evaluation include questionnaires, databases and log files which are often used to capture data from users about their perceptions and learning activities within the online courses. Analysis of these evaluation results would help instructors to refine their teaching strategies and methods, thus enhance the quality of teaching and learning.

1.2 Framework Outline

The outline of the framework for evaluation of learning effectiveness in online courses is shown in figure 1 below. The framework consists of four major components, namely online courses, learning effectiveness, evaluation methods and evaluation results, which are described in detail in section 2. The processes between each component within the framework include implementation, feedback, analysis and implications, which are illustrated in the case study in section 3.

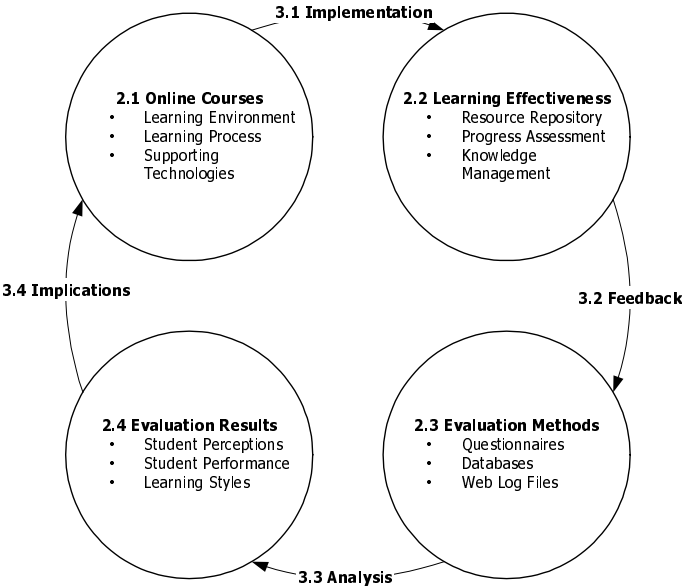


Fig. 1. Framework for evaluation of learning effectiveness in online courses

2 Online Course Evaluation Framework

This section describes the four underlying components of the online course evaluation framework, namely online courses, learning effectiveness, evaluation methods and evaluation results.

2.1 Online Courses

Online courses differ from traditional classroom in many aspects. Their differences in terms of learning environment and learning process are discussed. With the emerging Internet technologies in recent years, a growing number of e-learning software systems are being developed and used in higher education. Supporting technologies in online courses such as learning management system, synchronous/asynchronous communication, content management and student portfolios are also described in this sub-section.

Learning Environment. Online courses support high quality learning by offering different kinds of environments such as synchronous or asynchronous or both. Some environments and approaches facilitates student learning while others impede it [4]. For example, computer-mediated communication such as threaded discussion cannot effectively substitute for certain specific properties of voice communication, especially the intimacy and the spontaneity of response [5]. A traditional classroom only provides a face-to-face learning environment where instructors can direct and take active immediate role in class at a fixed time and place. In online courses, both instructors and students can teach and learn regardless of time and location. Online courses provide alternative opportunities for current on-campus students to take classes that they could not take otherwise due to time conflicts with other courses or work [5].

Learning Process. Learning process can be self-paced, independent, collaborative and continuous in online courses. In traditional classroom, it is often instructional where the instructors transfer the knowledge directly to the students. It does not reflect the students' understanding of the knowledge effectively. However, the dynamic nature in the online courses supports better communication such as self-reflections and peer-to-peer reviews. This change in communication transforms the learning process where knowledge is constructed actively by cognition [6].

Supporting Technologies. Learning management system (LMS) is one of the most mentioned E-Learning technologies. LMS is defined as a distinct, pedagogically meaningful and comprehensive system by which learners and faculty can participate in the learning and instructional process at anytime and any place [7]. For example, WebCT, one of the well-known LMS developed by the Department of Computer Science at the University of British Columbia, is a web-based application to create an online learning environment. WebCT is a powerful tool designed to create a versatile

OLE and has become rich in both features and usage [8]. It can be used to create an entire online course or to publish materials that supplement courses that use an online component [9].

Synchronous and Asynchronous communications are important features in LMS. Synchronous communication can be achieved with the use of Chat room and White-board where instructors and students interact with each other at real time. Asynchronous communication is supported with the use of threaded discussion and internal mail. These tools can promote text-based communication. The opportunity for reflective interaction can be encouraged and supported, which is a feature not often demanded in traditional classroom settings where discussion is often spontaneous and lacks the reflection that is a characteristic of asynchronous online interactions [1]. Collaboration and discussion are advantageous in LMS because they make students more central to the learning process [10]. Active interaction and participation are essential for both instructors and students to enhance their learning experiences, which cannot be achieved in a traditional classroom.

Content management capability of the LMS must be able to organize different kinds of content materials of the online course such as teaching and learning instructions, lesson objectives, multimedia video and audio clips, hyperlink and book references and glossaries, etc. The development of these web-based materials should be of high quality in order to encourage students to learn online. Support staff for content development may be required because instructors may not have the expertise and skills to create these content materials. A team approach is recommended for the creation of web-based materials [11] where instructor is the designer and support staff is the developer of the content materials.

Access logs and databases of the LMS provide a powerful tool in capturing the students' activities and their learning process in the online courses. These data can be analyzed and presented in the student portfolios, which are the development of learning resources such as questions, writing notes, homework, self-reflection and diary [12]. Student Portfolios allow instructors to better understand the progress of the students, thus improve instructions and guide their learning.

2.2 Learning Effectiveness

Online courses offer a new opportunity to deliver education with an aim to improve quality of teaching and learning. Online courses provide a different kind of learning environment for instructors and students. They can be accessed regardless of time and location. They also provide new learning tools that cannot be found in a traditional classroom. However, it is not to say that online courses can replace the traditional classroom. The hybrid approach may be used to enhance the learning experience when proper teaching and learning strategies are applied. This sub-section describes the learning effectiveness in online courses, particularly resource repository, progress assessment and knowledge management.

Resource Repository. There are many different kinds of learning resources on the Internet such as reference links, online glossary and dictionary. These resources can be high-quality, multimedia, web-based materials consisting of video clip and Flash animation. They can surely encourage students to learn other than reading text from lecture notes and books. The use of hyperlinks and search engines can effectively organize these resources in online courses. Instructors and students can access in a timely manner and evaluate the usefulness of these different learning resources.

Progress Assessment. Student portfolios can be used to track the students' progress in online courses, evaluate their performance and promote learning outcomes [12]. Student portfolios consist of activities such as interaction in chat room, participation in discussion forum, reading in online materials, reflection to learning resources, etc. They provide a collection of the students' work assembled over a period of time. They encourage the critical thinking and decision making of the students and provide an effective communication channel and media for them to interact with others.

Knowledge Management. Discussions and ideas are not recorded in a traditional classroom. This type of implicit knowledge is important in learning. The communication tools such as threaded forum and chat room in online courses provide a convenient method to capture this knowledge. Instructors can moderate the discussion with immediate and consistent feedback. This will encourage the students to participate actively and improve the quality of learning.

2.3 Evaluation Methods

Evaluation of learning effectiveness in online courses can help instructors to refine their teaching strategies, thus enhance the quality of learning. It is necessary to develop some measurements in the form of quality assurance systems in order to demonstrate the learning effectiveness in online courses. In this sub-section, several evaluation methods such as questionnaires, databases and web log files are discussed.

Questionnaires. Questionnaires are widely adopted in course evaluation to capture information about learning experience from students. For example, they are used to evaluate the usefulness of learning resources [13], the effect of asynchronous discussion forum [14] and the adaptation of learning tools in LMS [15]. The design of the questionnaires to evaluate the learning effectiveness in online courses should focus on three aspects, namely the impacts on teaching and learning (Process), the involvement of instructors and students (People) and the capabilities of online tools in LMS (Technology).

Databases. Databases are primarily used in online courses to store data and information such as learning resources, discussion topics and their relationships to the students. The presentation of data extracted from the databases can be organized into the format of student portfolios to allow instructors to keep track of the students' learning

progress. For example, student portfolios are developed using frames (functions) such as reports, notes, questions, homework, self-reflections, agendas, plans and journals, which are stored in databases [12]. Thus, the records and their relationships in the databases can be built into student portfolios for evaluating the learning effectiveness in online courses.

Web Log Files. One of the criteria of learning effectiveness in online courses is the availability of the LMS platform. Most LMS platforms are running in a web server such as Apache and IIS. In order to effectively manage a web server, it is necessary to obtain feedback about the activity and performance of the web server as well as any problems that may be occurring. Most of the web servers provide very comprehensive and flexible logging capabilities such as access log. The logging mechanism is quite complicated and will not be discussed in this article. The server access log records all requests processed by the server, including information such as the IP address of the clients, the date and time of the requests, the location and the referrer of the resources.

2.4 Evaluation Results

The analysis results from the evaluation methods can reflect the learning effectiveness in online courses. These results have implications for the overall effective design of learning strategies, policies and online tools. Implications of student perceptions, student performance and learning styles are discussed in this sub-section.

Student Perceptions. The feedback of the students from the questionnaires can provide an in-depth understanding of their perceptions of learning effectiveness in online courses such as the ease of use and accessibility of the LMS, the organization of course content, the usefulness of online tools and other comments about the impacts on their learning. These perceptions can be used to refine the teaching and learning strategies and to enhance the functionalities of online tools, thus improving the quality of learning.

Student Performance. The development of student portfolios to track their learning progress allows instructors to monitor their performance and ability in critical thinking and decision making. The assessment of the student progress allows instructors to refine their short-term learning goals and re-align student learning in the right direction.

Learning Styles. The access frequency and sequence from the analysis of web log files provide a good indication of how students adapt the learning style in online courses. For example, the access sequence of online tools may indicate their importance to learning effectiveness. Understanding the students' learning styles can not only provide an individualized instruction satisfying their diverse needs, but also carry a more equitable evaluation in online courses [16].

3 Case Study: Online Courses in a Study Programme

This section presents a case study to illustrate the use of the proposed framework. The case study describes the processes of evaluation in a study programme where online courses have been implemented as a supporting component in conjunction with tradition classrooms in their efforts to improve learning effectiveness.

3.1 Implementation

A course template was developed and organized into eight functions, namely Information, Schedule, Download, Content, Reference Link, Glossary & Online Dictionary, Discussion and Assessment. The course template was used in each of the online courses. This would save time and effort for setting up the course structure and allow consistency in user interface of each course. The content materials were prepared in advance before it became available to students. The update of content materials was an ongoing and continuous process in order to reflect any changes in the online courses. Table 1 describes the details of each function. Figure 2 below illustrates the design of the course template.

3.2 Feedback

The target group of users for the online courses was the year-one and year-two students from a part-time study programme. A questionnaire to evaluate the effectiveness of the online courses was conducted. The response rate in both classes was around 67% (see Table 2). The purpose of the questionnaire was to evaluate the usage frequency, the LMS, the organization and the functional effectiveness of the online courses.

3.3 Analysis

The student usage of the online courses is summarized in Table 3. At least 90% of the students have accessed the online courses with average login over 100. The technical support for students using online courses was minimal as they are good in computer literacy. The participation in the discussion forum was not active. The results show that the average number of articles posted and read were insignificant when compared to the class size. The forums were not moderated and the instructors were passive and did not provide timely response. Thus, collaboration and interaction among students were not encouraged. It is essential that the instructors take the initiative and keep the discussion flow going in the asynchronous environment.

Table 1. Description of functions in online courses

Function Name	Description
Information	Displays the details of the course such as syllabus, outline, contacts of lecturer and tutor, textbooks and reference books.
Schedule	Consists of a timetable and a calendar. The timetable outlines the details of the lectures and tutorials. The calendar was a tool from the LMS showing all the announcements such as public holidays and academic events.
Content	Provides web-based multimedia course materials. Students could browse the online notes using a tree-like table of content. Learning tools such as forum, glossary and links can be attached to each chapter of the online notes.
Download	Allows instructor to disseminate their lecture slides, tutorial handouts and recommended articles.
Reference Link	Serves as a bookmark for the course. Lecturer-reviewed websites are listed here to allow students to access course-related information.
Glossary & Online Dictionary	Serves as a reference material for students to look up technical terms.
Discussion	Consists of threaded forum, chat room and whiteboard. It allows the instructors and the students to interact and communicate asynchronously and synchronously.
Assessment	Consists of Assignment, Quiz and Self Test. Students can submit their homework online. Instructors can conduct survey and short quiz to evaluate the student performance.

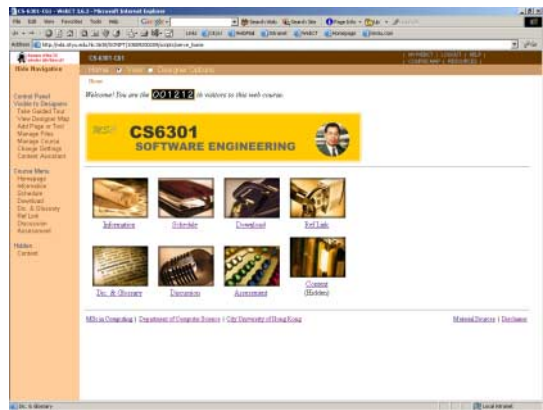


Fig. 2. Design of the course template

Table 2. Response rate of the questionnaire

	# Students	# Response	% Response
Year I	66	44	67%
Year II	47	32	68%
Total	113	76	67%

Table 3. Student usage in online courses

	Course				
	A	B	C	D	E
Number of Students	68	68	67	46	113
Students accessed	68	66	61	46	113
Access ratio	100%	97%	91%	100%	100%
Total login	12119	9753	8950	6386	3377
Average login	178	148	147	139	30
Total articles posted	0	0	7	12	0
Average articles posted	0	0	0.1	0.3	0
Total articles read	0	53	365	416	0
Average articles read	0	0.8	6	9	0

Usage Frequency. The result shows that students frequently access the online courses while they are attending lectures and tutorials in classroom. Table 4 summaries the usage of the online courses. Over 60% of the students spent more than one hour per week. Over 50% of the students accessed the online courses at least five times per week.

Table 4. Usage frequency

Hours spent per week		Number of accesses per week	
Hours	Percentage	Frequency	Percentage
0 – 1	34.2%	0 – 2	19.7%
1 – 2	42.1%	3 – 4	22.4%
2 – 3	9.2%	5 – 6	17.1%
3 – 4	5.3%	7 – 8	14.5%
> 4	9.2%	> 8	26.4%

Learning Management System. A LMS is used to support the delivery of the online courses. Over 80% of the students felt that the LMS is user friendly and easily accessible on the Internet. It is important that the LMS provides a functional and stable environment to encourage students’ participation. Table 5 summaries the evaluation of the LMS in the online courses.

Table 5. Learning management system (LMS)

	Very Easy	Easy	Fairly Difficult	Difficult	Very Difficult
Ease of Use	21.1%	61.8%	14.5%	2.6%	0.0%
Accessibility	19.7%	61.8%	6.6%	7.9%	3.9%

Course Effectiveness and Organization. More than 80% of the students found the effectiveness and the organization of the online courses were better than average. Table 6 summaries the evaluation of the effectiveness and organization of the online courses. Online courses allow students an alternative mean to access information about the course when students cannot attend lectures and tutorials due to time conflicts. They also provide extra learning tools that cannot be achieved in classroom. Good organization is needed in order to be more effective in online courses.

Table 6. Course effectiveness and organization

	Very Good	Good	Average	Bad	Very Bad
Course Effectiveness	3.9%	38.2%	46.1%	10.5%	1.3%
Course Organization	3.9%	19.7%	64.5%	9.2%	2.6%

Functional Effectiveness. The functions in the online courses can be divided into three categories, namely Content, Communication and Assessment. The result shows that Content functions are more effective than Communication functions, which in term are more effective than Assessment functions. Table 7 summaries the evaluation of the effectiveness of the functions in the online courses.

Table 7. Functional effectiveness

	Strongly Agree	Agree	Disagree	Strongly Disagree	N/A
Content	3.9%	71.1%	15.8%	2.6%	6.6%
Communication	2.6%	50.0%	28.9%	13.2%	5.3%
Assessment	0.0%	44.7%	36.8%	13.2%	5.3%

Comments. The positive comment about the online courses is that they allow self-paced studying, provide centralized learning resources and can be accessed at anytime and any place. However, a lack of high quality web-based content materials and inadequate response from instructors discourage students using online courses. Moreover, the students found the study load had not been decreased with the use of online courses.

3.4 Implications

The evaluation results show that there is a high access ratio of students and the online courses are effective and well organized. The LMS platform is user-friendly and easily accessible. The content tools are used more often than the communication and the assessment tools. There is a lack of high quality web-based content and inadequate responses from instructor. The workload has not been decreased with the use of online courses. The implications of these results are discussed below.

Enhance the Value of Learning Resources. Students frequently access the learning resources such as lecture notes in online courses. However, these resources from traditional classroom should be viewed as reference materials. It is essential to develop high-quality, interactive, multimedia, web-based learning content to encourage students’ learning. Instructor’s recommended learning resources such as articles, journals, papers and reference links can be useful readings for students. A mechanism to review these resources by students can also increase their values and students’ participation.

Utilize Other Online Tools. Instructors mainly use the online courses to distribute their teaching materials. That is why the content tools are accessed more often than the communication and the assessment tools. They can use the assessment tools to allow students doing assignments online. This will reduce their workload from marking the assignments.

Develop a Knowledge Forum. Inadequate responses from instructors result in low participation from students in the discussion forum. Instructors can take an initiative role and define learning topics for students to post their comments and opinions. This

will encourage students to express their thoughts and create a knowledge base about the topics. When students cannot attend classes, they can access the forums and keep up-to-date with others.

4 Conclusion

This article describes a framework for evaluation of learning effectiveness in online courses and illustrates the use of the framework with a case study. It also highlights the implementation of online courses, the issues in learning effectiveness, the approach to evaluation methods and the implications of evaluation results. From the case study, a lack of online tools for developing student portfolios restricts the assessment of student progress and performance. Students' learning styles are also not reflected due to insufficient information from the web log files.

Based on the current framework, possible improvements may include the development of standard templates for evaluation questionnaire and the use of Web Mining techniques on web log file to explore new knowledge about learning effectiveness in online courses. The framework may also be adopted for the evaluation of teaching effectiveness in online courses for further research directions.

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