Evaluating the Practices in the E-Learning Platform from the Perspective of Knowledge Management

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Abstract. A growing number of higher education institutions have adopted asynchronous and synchronous Web-based learning platforms to improve students' learning efficiency and increase learning satisfaction. To understand how students use e-learning platforms and what the implications are, we conducted an empirical study of the iCAN e-learning platform, which has been widely used in Fu-Jen Catholic University. We use the Analytic Hierarchy Process (AHP), a multi-criteria evaluation approach, to compare five practices of the teaching platform. We designed a questionnaire to measure *learners' perception of the e-learning platform* based on the theory of knowledge transforming process in knowledge management. Accordingly, the model considers functioning and objectivity in terms of the following three dimensions of learning effectiveness: *individual learning*, *group sharing* and *learning performance*. Twelve criteria with twelve evaluation items were used to investigate the effectiveness of the five practices. We also evaluated the strengths and weaknesses of the functions based on the types of courses in the iCan platform. We expect that the empirical evaluation results will provide teachers with suggestions and guidelines for using the e-learning platform effectively to facilitate their teaching activities and promote students' learning efficiency and satisfaction.

Keywords: Analytic hierarchy process, E-learning platform, Knowledge management practices, Learning analytics and modelling

1 Introduction

The development of computer technology and the Internet has affected the most basic form of education, i.e., the traditional face-to-face teaching; therefore, leading the way of education has been influenced significantly [2]. Chen, Kinshuk & Wang (2005) [2] advanced a cyber-schooling framework that uses the familiar traditional school structure as its basis and attempts to enhance it through the use of technology to overcome the shortcomings of traditional education and study without the time and space restrictions. The traditional teaching model is based on learning in a fixed location such as a classroom, which lacks of mobility [12]. Apart from fixed locations that restrict various teaching activities, the traditional teaching model has other limitations, e.g., the tuition times are inflexible [14].

Unlike traditional learning methods, e-learning platforms allow teachers to communicate with students and discuss course content anytime or anywhere. Thus, it is a very important that we determine how to combine technology and education to facilitate knowledge exchange across national boundaries without time constraints. In this study, we measured "*learners' perception of the e-learning platform"* based on the theory of knowledge transforming process in knowledge management (KM). KM is a cycle, sometimes repeated process, which generally includes creation, management and sharing activities [4]. Gray & Chan (2000) [8] advance a KM framework that seeks to categorize and integrate the creation, storage and propagation of knowledge into a single model on the view that the problem-solving process is a vehicle for connecting knowledge and performance. Knowledge can generate the value when it is used to solve problems, explore opportunities and make decisions. Therefore, many organizations adopt learning platforms to promote the inner communication of knowledge. Also, schools adopt learning platforms to enhance students' learning quality. Thus, teaching platforms are becoming important and useful tools for supporting students' learning activities.

In order to enhance the learning quality of students and encourage communication between students and teachers, many schools incorporated various kinds of teaching platforms and then counseled teachers and students on how to use them. The development of the e-learning platform paid more attention to the technology aspects than the user-centered design issues [7]. In this work, we aim to evaluate the e-learning platform from the aspect of the user's experiences. Furthermore, the evaluation of learning platforms is a multiple decision problem. A learning platform has many different functions that need to be completely considered. Therefore, we adopt the Analytic Hierarchy Process (AHP), a multi-criteria evaluation approach [15], to evaluate users' perceptions after using the learning platform. We adopted the AHP in this work because the approach was superior to traditional questionnaire methods in representing human perceptions [16]. The AHP not only gets the most important alternative but also ranks the results by conducting pair-wise comparisons for all estimated alternatives. We selected iCan as our research target, the main e-learning platform used by Fu-Jen Catholic University since 2005. To summarize, the objectives of the research are as follows:

- We adopted brainstorming approach to design a questionnaire based on the theory of knowledge transforming process. Three dimensions are considered in the questionnaire. They are individual learning, group sharing, and learning performance.
- We aim to investigate the strengths and weaknesses of different kinds of functions offered in the e-learning platform. There are five types of practices (functions) in the iCan are investigated in our questionnaire. They are homework, discussion board, material download, chat room, and learning index.
- To understand the functionalities of different practices offered in the iCan platform for types of courses, we will analyze and explain the empirical evaluation results based on the course types which are technology, and management courses.

2 Basic Concepts

2.1 Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process (AHP) is a well-known approach to resolving the decision-making problem about multiple criteria [15]. This method is an effective and practical approach that considers complex and unstructured decisions. The AHP systemically structures complex problems into a hierarchy and uses quantitative methods to evaluate alternatives that would help decision-makers choose the most appropriate solution. There are mainly three steps for considering decision problems through the AHP: constructing hierarchies, comparative judgment and synthesis of priorities. The first step is structuring the complicated problem into a hierarchy descends from an overall objective to various criteria, sub-criteria, and so on until the lowest level. The next step is determining the priorities of the elements at each level and developing the comparison matrix. The last step is synthesizing priorities from the second level down by multiplying local priorities by the priority of their corresponding criterion in the level above and adding them for each element in a level according to the criteria it effects [15].

2.2 Model Perception by Fuzzy Linguistic Approach

It is hard to assess qualitative problems by using precise values, leading to the use of the fuzzy linguistic approach [16]. The fuzzy linguistic approach is an approximating technique that could model human perception and help human decision-making. The fuzzy number plays a fundamental role in formulating the semantic meaning of the linguistic term, which represents the approximate value of each linguistic term. For assessing the relevance degree between objects (e.g., document, criteria etc.), the variable Relevance is defined and the corresponding terms–very low, low, normal, high, very high, perfect–are defined to express the context of Relevance. Notably, each linguistic variable is characterized by a quintuple (S, E(S), U, G, M) as defined in Definition I, and each linguistic term is modeled by a triangular fuzzy number (TFN) as defined in Definition II.

Definition I (Zadeh 1975) [16]: A linguistic variable is expressed as a quintuple (S, E(S), U, G, M) where S is the name of the variable; E(S) is the linguistic terms of S, that is the set of its linguistic values range over universe of discourse U; G is a syntactic rule (a grammar) that generates linguistic term set in E(S); and M is a semantic rule that assigns meaning, m(e), to each linguistic term e in E with a fuzzy set on U.

Definition II (Dubis & Prade, 1978) [5]: A fuzzy number **Z** is a "normal" and "convex" fuzzy set defined on the set **R** , and **Z** is a closed interval for every $\alpha \in (0,1]$. The membership function $f_z(x)$ of the triangular fuzzy number (TFN) $Z=(l, m, r)$ is given below.

$$f_{\tilde{z}}(x)=\begin{cases}(x-l)/(m-l) & l\le x\le m\\ (r-x)/(r-m) & m\le x\le r\\ 0 & otherwise\end{cases} \quad (1)$$

This work adopts the center of area (COA) method to calculate fuzzy numbers, owing to its simplicity and practicability. The COA method calculates the fuzzy mean under uniform probability distribution assumption [85],[11]. If the fuzzy number $\tilde{U}$ is triangular, where $\tilde{U}=(l, m, r)$ the crisp rating can be derived by the equation: $CV(\tilde{U})=[(r-l)+(m-l)]/3+l$

3 The Framework

We designed three directions from the perspective of the knowledge management system. Each dimension has its own associated criteria, as shown in Table 1. We explain each dimension briefly as follows. In addition, due to the page limitation, the statements of the criterion of each dimension are summarized in Table 1.

Individual Learning: Individual learning is defined as students who can build knowledge and experience personal growth through individual reflection and through their interactions with the others and the environment [6]. In this work, we focused on how students employ the e-learning platform to achieve individual learning. For example, students can download and review the materials, deliver homework, or do the quizzes on the learning platform. Specifically, we use four criteria to evaluate the dimension of individual learning, as listed in Table 1.

Table 2. Statements of the criterion

Course types	Dimensions	Criteria	Statement
Technology and Management courses	Individual learning	Independent learning	Obtaining the ability to acquire the knowledge of courses by themselves successfully.
		Information use	Gaining the capability to apply knowledge learned from the platform.
		Finding the answers to questions	Obtaining the ability to discover answers of existing questions.
		Exploring new issue	Exploring new issues from the learning process at the learning platform.
	Group sharing	Learning support	Gaining the teaching support by communicating with instructors on the learning platform.
		Knowledge sharing	Sharing information and knowledge within the learning group in the platform. The learning contents and processes can be enriched.
		Enhancing learning attitude	Enhancing learning attitudes and enriching the learning contents by group learning processes.
		Collaboration	Improving the participation in team project.
	Learning performance	Efficiency	Increasing the efficiency because of the ease of finding the information from the platform.
		Learning achievement	Increasing the testing score and evaluation grade.
		Completeness of learning	Achieving the completeness of learning process more easily.

		process	
		Sense of accomplishment	Obtaining a sense of achievement by resolving the problems from the learning platform.

Group Sharing: Group sharing is defined as students working in a group to complete a specific task, make decisions or solve problems. The e-learning platform is a good technology for education to facilitate communication and collaboration for better knowledge sharing [1][9]. The difference between traditional learning and e-learning is that students can talk face-to-face in traditional learning. It is synchronic. On the other hand, with e-learning, students can share their thinking via the functions in the platform; sometimes it is synchronous and other times it is asynchronous. For example, a chat room is a function that allows students to discuss to each other synchronously, while a message board helps students discuss issues asynchronously. We use four criteria to evaluate the dimension of group sharing, as listed in Table 1.

Learning Performance: Learning performance may be measured by quantitative factors such as course grades or the time to search required data, or qualitative factors such as a sense of accomplishment or achievement [13]. It is an essential part of learning, and it is quite important for students and teachers to evaluate the learning and teaching results. In this paper, we use four criteria to evaluate the dimension of learning performance. They are *efficiency*, *learning achievement*, *completeness of learning process* and *sense of accomplishment*.

4 Evaluation Setup

We adopted the AHP approach to develop the framework used to evaluate the effectiveness of functions in the iCan e-learning platform. We talked with two professors and several graduate students to design the questionnaires. We will briefly describe each investigation issue from the results of the questionnaire.

4.1 Data collection

First, we selected the courses offered in Fu-Jen Catholic University's College of Management as the investigation target. In addition, the lecturers who are the top 50 login users of the iCan platform are another criteria used to select the target courses

Table 3. The information of the participants in technology and management courses.

Return Questionnaire	Effective Questionnaire	Effective Return Rate	User Information			
			Sex	Experience		
Technology courses						
50	36	72%	Male	18	Less than 1 year	31
					1—2 years	3
			Female	18	2—3 years	2
					More than 3 years	0
Management courses						
26	24	92%	Male	17	Less than 1 year	2
					1—2 years	16
			Female	7	2—3 years	0
					More than 3 years	8

for evaluation. Finally, we selected courses offered in 2011 that belong to one of two types of courses—technology or management courses. In technology courses, we chose Java 1 and Java 2 as our investigative objects. In management courses, we chose "Special Topic on MIS" and "Knowledge Management" as our investigative objects. We adopted some rules to select the two types of courses. For technology courses, we selected programming-based courses because they are more individualistic in nature. For management courses, we selected the courses that had team work, which can stimulate knowledge sharing and collaborative activities. The number of returned questionnaires, effective questionnaires and related information for two types of courses are shown in Table 2.

4.2 Determining evaluation dimensions, criteria, and ranking practices

We asked the participants to make pair-wise comparison estimation that compares the importance of every criterion. The questionnaire sample is shown in Figure 1.The participants check the boxes by importance. After we retrieved the completed questionnaires, we constructed a pair-wise comparison matrix and obtained the consistence index to ensure the consistency of the questionnaires. The data will show the importance of each dimension and criterion, i.e., weight; the greater the weight, the more important the dimension or criterion.

We chose five practices of iCan (homework, discussion board, material download, chat room and learning index) and adopted the fuzzy linguistic approach introduced in Section 2.2 to obtain the estimative score of each practice. The score represents the degree of each practice supporting each criterion. The five practices and statements were shown in Table 3. Based on the result of the previous questionnaire, we can get the score of each criterion, and understand participants' viewpoints of every criterion.

AHP Questionnaire Sample

1. Please rank the importance of the three dimensions at first.

☆_____Individual learning (**IL** for short)
☆_____Group sharing (**G** for short)
☆_____Learning performance (**LP** for short)

2. Please make pair-wise comparisons

	Absolute		Very-strong		Strong		Moderate		Eqivalent	Moderate		Strong		Very-strong		Absolute		
	9 : 1	8 : 1	7 : 1	6 : 1	5 : 1	4 : 1	3 : 1	2 : 1	1 : 1	1 : 2	1 : 3	1 : 4	1 : 5	1 : 6	1 : 7	1 : 8	1 : 9	
IL																		G
IL																		LP
G																		LP

Fig. 6. The AHP questionnaire sample

Table 4. The evaluation practices of iCan learning platform

Practice	Statement
Homework	Deliver homework: Students can upload their homework before the deadline. Homework observation: Students can inspect and learn from each other's homework.
Discussion board	Students and teachers can communicate with each other on the discussion board.
Material download	Students can download the course material.
Chat room	Students can communicate just-in-time in chat room.
Learning index	It shows the learning history on the platform, including the log-in times, the summary of discussion and material download and the situation of the homework delivering.

5 Evaluation Results

5.1 Determining Evaluation Criteria Weight: Results and Discussions

The following section will show and describe the evaluation results.

Discussion of Evaluation the Weight of Dimensions: We used the data collected to calculate the weight of the three dimensions of evaluation the effectiveness of the platform, as shown in Table 4. For technology courses, the most important dimension is individual learning (C_1). That is, they think obtaining the ability and learning by themselves from the iCan learning platform is the most important dimension in technology courses. For management courses, the most important dimension is group sharing (C_2). Thus, they emphasize the knowledge or skill sharing in team work and expect that the learning contents and processes can be enriched by group sharing from the platform.

Discussion of Evaluation the Weight of Criterions: Table 5 shows the criteria with the associated weights of the two types of courses. For technology courses, information use (C_{12}) and independent learning (C_{11}) are the most two important criteria. The results show that users expect to gain the ability to apply the knowledge learned from the platform, and to acquire that knowledge successfully by themselves. In addition, they think enhancing learning attitude (C_{23}), and collaboration (C_{24}) are not very important in technology courses. For management courses, knowledge sharing (C_{22}) and learning support (C_{21}) are the most important criteria. Users expect they can share information and knowledge within the learning group in the platform, and gain the ability to apply the knowledge learned from the platform. In addition, they think obtaining a sense of achievement (C_{34}) by resolving problems from the learning platform and improving participation (C_{22}) in team projects are not very important

Table 5. The weight of each dimension of four courses for the evaluating e-learning platform

	Dimensions	Technology courses	Management courses
C_1	Individual learning	**0.46(1)**	0.35(2)
C_2	Group sharing	0.20(3)	**0.36(1)**
C_3	Learning performance	0.34(2)	0.29(3)

Table 6. The weight of each criterion of four courses for evaluating e-learning platform

	Criteria	Technology courses	Management courses
C_{11}	Independent learning	**0.144(2)**	0.088(7)
C_{12}	Information use	**0.145(1)**	**0.110(3)**
C_{13}	Finding the answers to questions	0.115(4)	0.091(5)
C_{14}	Exploring new issues	0.055(9)	0.063(8)
C_{21}	Learning support	0.084(5)	**0.113(2)**
C_{22}	Knowledge sharing	0.051(10)	**0.121(1)**
C_{23}	Enhancing learning attitude	0.029(12)	0.045(10)
C_{24}	Collaboration	0.038(11)	0.080(11)
C_{31}	Efficiency	0.126(3)	0.098(4)
C_{32}	Learning achievement	0.068(7)	0.089(6)
C_{33}	Completeness of learning process	0.077(6)	0.052(9)
C_{34}	Sense of accomplishment	0.068(7)	0.050(12)

Note: * The numbers in ( ) mean the order of each course.

criteria in management courses. Interestingly, users regard collaboration is not an important criteria for two types of courses. It indicates it is not effective to improve the participation in team project via the e-learning platform.

5.2 Rank practices in E-learning Platforms by Fuzzy Scores

Herein, we combined the crisp rating of each dimension or criterion (i.e., perception of usage experiences) with the associated weight (i.e., perception of importance) to calculate the fuzzy score for ranking practices in E-learning platforms. The crisp rating is derived from the fuzzy linguistic rating according to the COA method in Section 2.2.

Technology courses. Based on the previous results, information use (C_{12}) and independent learning (C_{11}) are the most two important criteria for technology courses. Table 6 shows that the practices of downloading materials and homework support these two criteria. Notably, homework, discussion boards, and downloading materials are practices that all enhance learning support (C_{21}). On average, downloading materials performed best in each category. Moreover, we found that the scores of the chat room and learning index practices were not high, which might be the case because students seldom use them in technology courses. Interestingly, the criteria of finding the answers to questions (C_{13}) and learning achievement (C_{32}) were not ranked in the top 3 criteria supporting each practice. This indicates that the platform lacks a function to help participants discover answers to existing questions.

Management courses. Knowledge sharing (C_{22}) and learning support (C_{21}) are the most two important criteria for management courses. Table 6 shows that the practices of downloading materials and using discussion boards support these two criteria. On average, downloading materials performed best in each category. Notably, we found that the score of the chat room practice is lower than other practices. According to our preliminary observations, users seldom use the function; this may due to its low quality. Finally, only the criterion finding the answers to questions (C_{13}) was not ranked in the top 3 criteria supporting each practice.

Table 7. Combining fuzzy scores to rank practices (technology and management courses)

	C_{11}	C_{12}	C_{13}	C_{14}	C_{21}	C_{22}	C_{23}	C_{24}	C_{31}	C_{32}	C_{33}	C_{34}
Technology courses												
Homework	69.6	71.4 (2)	67.5	61.4	72.4 (1)	71.2 (3)	63.2	68.1	71.2	70.3	69.2	67.8
Discussion board	60.7	63.4	68.6	66.4	73.1 (1)	70.8 (2)	64.2	64.7	70.8 (3)	67.9	66.7	61.0
Material download	**82.0 (3)**	**82.7 (2)**	79.6	70.4	**83.3 (1)**	73.5	64.0	66.0	80.7	74.8	79.5	68.1
Chat room	45.0	43.2	43.0	47.4 (3)	46.1	46.3 (4)	49.1 (2)	52.2 (1)	45.1	44.7	45.2	44.3
Learning index	59.2 (3)	56.3	56.3	56.0	58.5	53.1	53.0	55.2	54.4	54.3	59.7 (1)	59.3 (2)
Management courses												
Homework	78.6	82.0	79.7	79.2	71.5	**84.6 (2)**	73.9	81.1	82.3 (3)	87.7 (1)	80.6	79.9
Discussion board	74.2	79.2	82.4	83.8 (2)	80.9	**86.0 (1)**	77.7	82.6 (3)	81.2	82.2	79.3	76.7
Material download	86.6 (3)	87.3 (1)	84.9	80.4	**87.1 (2)**	85.1	72.7	72.2	83.7	80.9	85.5	69.6
Chat room	57.1	57.8	56.3	54.2	58.7	60.4 (3)	62.1 (1)	58.6	62.0 (2)	55.7	57.8	53.1
Learning index	71.8	64.3	64.9	60.8	65.3	65.8	73.3 (2)	60.3	71.5	62.5	72.2 (3)	73.4 (1)

6 Conclusion and the Future Work

We have several interesting findings and their implications from the survey results of this research. Basically, different types of courses need different kinds of practices to achieve the goals of the course. For example, for technology-based courses, learning performance is the most important dimension, and group sharing is the most important dimension for management courses. In addition, our preliminary results show that the iCan platform cannot satisfy the needs of the type of management course. Furthermore, students think information use is very important in technology courses. Thus, teachers should refer the results to refine the courses and to help students achieve the object of information usage much easier by using the e-learning platform. We expect that our empirical evaluation results will provide teachers with suggestions and guidelines for using the e-learning platform effectively to facilitate their teaching activities, and promote students' learning efficiency and satisfaction. Ćukušić et al. (2010)[3] pointed out that a clear link exists between planning and controlling of the e-learning process and its learning outcomes. Accordingly, we will consider how to refine the usage condition of each function in the e-learning platform to help teachers achieve their teaching goals and assist students to attain the learning outcomes they expect. In the future, we expect to extend the types of courses to understand of the effectiveness of the practices in the e-learning platform for different kinds of courses. We also continue using an auxiliary questionnaire to understand the users' using experiences of the e-learning platform to assist us have a further investigation.

References

1 Beckman, M.: Collaborative Learning: Preparation for the Workplace and Democracy. College Teaching. 38(4), 128-133 (1990).

2 Chen. N. S., Kinshuk, Wang. Y. H: Cyber Schooling Framework: Improving Mobility and Situated Learning. International Journal of Engineering Education. 23(3), 423-431 (2005).

3 Ćukušić, M., Alfirević, N., Granić, A. Garača, Ž.: E-Learning Process Management and the e-Learning Performance: Results of a European Empirical Study. Computers & Education, 55(2), 554-565 (2010).

4 Davenport, T. H., Prusak, L.: Working Knowledge–How Organizations Manage What They Know, Boston, MA: Harvard Business School Press. (1998).

5 Dubis, D., Prade, H.: Operations on Fuzzy Numbers, International Journal of Systems Science. 9 (3) , 613-626 (1978).

6 Forcheri, P., Molfino, M.-T., Quarati, A.: ICT Driven Individual Learning: New Opportunities and Perspectives. Educational Technology & Society, 3(1), 51-61 (2000).

7 Granić, A., Ćukušić, M.: Usability Testing and Expert Inspections Complemented by Educational Evaluation: A Case Study of an e-Learning Platform. Educational Technology & Society, 14 (2), 107-123 (2011).

8 Gray, P. H., Chan, Y.E.: Integrating Knowledge Management Practices Through a Problem Solving Framework. Communications of the AIS, 4(12), Article 12 (2000).

9 Johnson, D. W., Johnson, R. T., Smith, K. A.: Cooperative Learning: Increasing College Faculty Instructional Productivity. ASHE-FRIC Higher Education Report. 4. George Washington University, Washington, DC. (1991).

10 Lee, E. S., Li, R. L.: Comparison of Fuzzy Number based on the Probability Measure of Fuzzy Events. Computer and Mathematics with Applications, 15, 887–896 (1988).

11 Liu, D.R. Wu, I.C. Yang, K.S.: Task-based K-Support System: Disseminating and Sharing Task-relevant Knowledge. Expert Systems with Applications, 29(2),408-423 (2005).

12 Norris, C., Soloway, E., Sullivan, T.: Log on Education: Examining 25 Years of Technology in U.S. Education. Communications of the ACM, 45(8), 15-18 (2002).

13 Patterson, F., Hobley, S.: A New Way To Evaluate Learning and Training?, KM Review, 6(3), 20-23 (2003).

14 Riffell, S. K., Sibley, D. F.: Student Perceptions of a Hybrid Learning Format: Can Online Exercises Replace Traditional Lectures? Journal of College Science Teaching. 32, 394-399 (2003)

15 Saaty, T. L.: A Scaling Method for Priorities in Hierarchical Structure. Journal of Mathematical Psychology. 15(3), 234-281 (1977).

16 Sato, Y.: Questionnaire Design for Survey Research: Employing Weighting Method. In: VII International Symposium on the Analytic Hierarchy Process, Honolulu, Hawaii (2005).

17 Zadeh, L. A.: The Concept of a Linguistic Variable and Its Application to Approximate Reasoning. Information Science. 8(4), 199-249 (1975).