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A Case Study on Web-based Learning Environment Evaluation in Higher Education: Learner Perspectives in a Private University in Malaysia

Zarina Che Imbi, Tse-Kian Neo & Mai Neo
zarina.embi@mmu.edu.my
Multimedia University

Abstract

In the era of digital learning, multimedia-based classroom has been commonly used in higher education including Malaysian higher education institutions. A case study has been performed to evaluate web-based learning using Level 1 to 3 of Kirkpatrick's model in a multi-disciplinary course at Multimedia University, Malaysia. In this study, mixed method research was employed in which triangulation was performed from multiple sources of data collection to give deeper understanding. Instruments used in this study were guided by Kirkpatrick's model that involved survey, questionnaire and test. Results showed that student reaction was positive in the web-based learning environment. Students perceived that learning with multimedia was enjoyable. They were also motivated in learning and engaged through the use of web module as multimedia was perceived to motivate them and make learning fun. Students showed significant improvements in their knowledge based on the pre-test and post-test results on learning evaluation. Students were perceived to transfer the learning from web-based learning into the learning outcome. The systematic evaluation can provide the feedback that educators and institution as a whole need to improve the learning environment and programme quality. This study contributes to the research field by adding another perspective in evaluations of web-based learning. It also provides empirical evidence on student perspectives, learning and behaviour in a private university. It demonstrated that the Kirkpatrick's model is useful as an evaluation tool to be used in higher education. The model may be used to evaluate other types of learning environments as well as different types of study domain that exist in higher education.

Keywords Evaluation; Web-based learning; Higher education; Kirkpatrick's model

Introduction

Multimedia technology use in the classroom has changed the ways of teaching and learning and has resulted in a fundamental shift from teacher-centred to student-centred learning strategies among educators (Anyanwu & Iwuamadi, 2015; Samarasekera, Nayak, Yeo & Gwee, 2014; Schreurs & Dumbraveanu, 2014). One mode of multimedia in the classroom involves the use of learning objects or web-based learning modules which falls under student-centred mode of learning. Students go through the objects or modules at their own pace and preference. The lecturer's online presence whether synchronously or asynchronously, can act as facilitators of knowledge in this mode of learning.

Concerns about the evaluation quality on higher education implementation of instructional technology have been raised by researchers (Aksoy, Guven, Sayali, & Kitapcioglu, 2019; Bullock & Ory, 2000; Gamage, Fernando & Perera, 2015; Krippel, McKee and Moody, 2010). Gamage, Fernando and Perera (2015) found in their review of literature that best practices and practical tools were created to address the fast growing issues of quality from international perspective while Aksoy, Guven, Sayali, and Kitapcioglu (2019) stated that comparison of different teaching methods was still scarce in the literature, thus the effectiveness of web-based learning has been investigated in their study. Williams (2002) posited that educational programmes involving learning technologies use in higher education should be evaluated based on local participants' specific needs and questions. This is further exemplified from diverse findings on educational technologies and learning environments by different studies that have been reported. Kim, Horta and Jung (2017) discovered that the research themes in education were diverse, focusing on policy-based or teaching and learning studies in the Asian countries. As a result, it was implicated that analytic studies should be conducted which would not perform media comparison and affirm the effect of characteristics of media on cognitive processes (Bozkaya, Aydin & Kumtepe, 2012) and different themes should be integrated that could be linked more to contextual characteristics (Kim, et. al., 2017). Thus, the research problem is the limited research on evaluation of technology use in higher education.

Over the years, different models of evaluation have emerged in evaluating learning in training or educational programmes. Among them, Kirkpatrick's model can be used in evaluating a learning environment as it is flexible in terms of allowing educators to decide on which assessments and methods that suit the higher education standard practice (Wang, 2011).

Web-based Learning Environment

Web-based learning is defined as the use of the web to deliver learning materials, facilitate communication and integrating learning activities in this study (Alessi & Trollip, 2001). In other words,

it is a type of learning in which the content is delivered online, with no face-to-face instruction or meeting (Kovacs, Peslak, Kovalchick, Wang & Davis, 2017). With networked computing and multimedia technologies, educators can use web-based learning to enhance students' learning process.

Generally positive findings in terms of the degree of student's perception or satisfaction have been reported on the use of web-based learning in higher education (Karvounidis, Chimos, Bersimis & Douligeris, 2018; Overbaugh & Nickel, 2011; Yang & Tsai, 2008). The use of hypertext and hypermedia provides interactivity, non-linear exploration of content and self-paced learning. Students can also construct new knowledge based on the past experience using multimedia technology. A web module of a subject matter is developed by the lecturer and preferably instructional designer or multimedia developer and delivered to the students via the internet. The web-based module should incorporate one of the popular models of multimedia learning as a guide for a good design. In this study, a web-based learning environment was evaluated using the Kirkpatrick's model for evaluation (Kirkpatrick & Kirkpatrick, 2016). The purpose is to provide a reasonable assessment of the students learning experience in a web-based learning environment. This paper seeks to provide insights into the quality of digital learning environment in a Malaysian private university setting.

Kirkpatrick's Model for Evaluation

There are four levels of evaluation starting from Level 1 to Level 4 in Kirkpatrick's model (Kirkpatrick & Kirkpatrick, 2016). Level 1 evaluates learners' reactions to the instructional materials and environment. It measures how participants feel about and react to various aspects of the instruction. Level 2 evaluates learning as the measurement of changes in the attitudes, knowledge, and skills of participants as a result of the programme. Measuring learning means determining whether any knowledge has been learned, any skill has been developed or improved, and whether there is any change of attitude (Kirkpatrick, 1996). Level 3 evaluates whether there was any change of behaviour or transfer of learning that resulted from the programme. In this level, any perceived transfer of knowledge, attitudes and skills after the course has ended is measured (Kirkpatrick, 1996). Level 4 measures the final results that occur because of the programme. This level is the final and the most difficult of all as it will determine what final results occurred because of the training (Kirkpatrick, 1996).

In order to apply this model for evaluating a learning environment, it is recommended to evaluate all the four levels but much of the time, this cannot be done. As in this study, Level 4 is not measured due to the irrelevancy to the context of education in which the instruction is used (Winfrey, 2002; Yusoff, Ahmad, Mansor, Johari, Othman & Hassan, 2016).

Kirkpatrick's model's popularity still remains in evaluating the effectiveness of training programmes (Chrysafiadi & Virvou, 2013). The advantages of this model over other available evaluation models are its flexibility, simplicity, completeness and practicality (Wang, 2011). This model helps evaluators to think about training evaluation criteria by providing a rough taxonomy for criteria. However, Paull, Whitsed and Girardi (2016) posited that this model had to be adapted to the context of evaluation in terms of the types of assessment for each level and the feasibility of each level that would be used. Therefore, not all levels need to be evaluated in an educational setting.

Research Method

A case study is the research method in this study. The principle of data collection in which the evaluation has been conducted in this study is the multiple sources of evidence (Yin, 2009). Its use supports triangulation and the type of triangulation being implemented is methodological triangulation. According to Cohen, Manion and Morrison (2000), methodological triangulation is the use of several methods to study a single programme that allows for different research methods to be conducted on the same object of study as to enhance the validity of the research findings. Therefore, mixed method approach was used in which it is a mix of quantitative and qualitative research methods because elements of both approaches are used (Creswell, 2009). Collected data were from multiple research instruments namely test, questionnaire and survey that were guided by Kirkpatrick's model. For every level, data were collected respectively based on the model's requirements.

There are three research questions that are in accordance to the Kirkpatrick's levels of evaluation:

1. What were the students' attitudes and perceptions of the web-based learning environment?
(Level 1)
2. Did students significantly improve their knowledge in the web-based learning environment?
(Level 2)
3. Were the knowledge and skills transferred by the students in the web-based learning environment? (Level 3)

By analysing quantitative and qualitative data, assertions could be made about the web-based learning environment as a whole and used to answer the research questions. As such, an evaluation of students' reaction, learning and behaviour (Level 1, 2 and 3 of Kirkpatrick's model) could be made in their natural setting.

The Study

In this study, university students were reached through a homogeneous sampling approach as well as the ease of the authors' access to the students and their willingness to participate in the study (Fraenkel, Wallen & Hyun, 2012). Based on the demographics data obtained at the start of the course, the age range of the enrolled students in the course was 21 to 25 years. They had high computer self-efficacy and have been using computer technology and application before.

Participants of this study were students who took multi-disciplinary course that was offered for computing, engineering and management students of Multimedia University, Malaysia. The objective of the course was to provide students with good understanding of interactive multimedia and the development of multimedia application.

The sample in this study consisted of 31 students (n=31). At the beginning of the course, students were briefed on the research that was going to be conducted and the consent to participate in this study was obtained by asking their willingness to participate in this study. A web-based module that has been created by adapting a theoretical framework for good design was used. The module used in this study has been used in courses that comprise the same topic of learning and the effectiveness of such design. The module was on a topic related to the course that was made available to the students via a server.

According to Tan, Kwok, Neo and Neo (2010), the content included relevant activities that could help students solve problems based on the theories learned in the module. Videos of expert opinions were integrated into the module and there were external links for students to explore different perspectives and the use of multiple media to explain the topics. Activities and quizzes at the end of each topic were included in the module to encourage students to reflect on what they have learned. Instructor's contact detail and clear explanation on each activity was provided to guide students going through the module (Tan, et. al., 2010).

Participants were given a period of one week to learn through the web module. Prior to that, a pre-test containing twenty multiple-choice-questions related to the web module were given to them. After experiencing this digital learning environment, survey was used to evaluate students' reaction which is equivalent to Level 1 evaluation. The same questions as in the pre-test were given as a post-test for Level 2 evaluation. For Level 3 evaluation, questionnaire was used to gather any knowledge or learning that was transferred into the learning outcome.

Results and Findings

Level 1 Results: Reaction

Likert scale survey ranging from 1 (Strongly disagree) to 5 (Strongly agree) was used to obtain student's reaction based on dimensions of good learning that have been identified from the literature. Statistical software was used to analyse the survey and determined its reliability (Cronbach's Alpha). In all of the dimensions, the Cronbach's Alpha coefficients were above 0.6, hence it was assumed as reliable in social science research and practised by other researchers (Lim, Khine, Hew, Wong, Shanti & Lim, 2003; Mohamad, Sulaiman, Sern & Salleh, 2015). Table 1 shows the survey results on student responses of the five dimensions, with the mean (M), percentage of positive response from students (%) and standard deviation in descending order of the mean. The grand mean that refers to the overall mean of a dimension and Cronbach's Alpha are shown for each dimension.

From the results, students showed very positive reaction towards web-based learning for example in terms of quality of learning activity, it scored the highest mean score of 3.97 where 86.5% of the students found the text to be easy to read and understand. 81.1% of students felt that important information or key concepts were easy to identify ($M=3.92$) and 70.3% of them found that pieces of information they had previously used were easy to be located ($M=3.70$). 59.5% of the students perceived that they were able to explore the module without difficulty ($M=3.59$).

Analysis on the survey items were further performed using inferential statistics in SPSS. The grand means of learning with multimedia, motivation, engagement, good design and learning activity were analysed to determine any significant difference in students' reaction towards these dimensions of learning. Before inferential statistics was performed, test of normality was also conducted to determine the sample's distribution. For sample sizes that are less than 50 as in this case, Shapiro-Wilk test was used as it is more reliable (Field, 2009). Table 2 shows that the p value is significant at 95% confidence level, hence it is assumed that the sample was not normally distributed.

Therefore, a non-parametric test using Wilcoxon Signed-Ranks Test was performed for the data by assuming that the means were equal to the medians when using this test. Table 3 shows the results of the analysis.

As seen in Table 3, the mean score of learning with multimedia was statistically significant against motivation, engagement and good design with $Z = -2.394, -3.458$ and -2.242 respectively and $p < 0.05$, two-tailed test, $r = 0.304, 0.439$ and 0.285 respectively. This result indicates their positive perception of learning with multimedia possibly due to their positive attitude towards the use of

multimedia in the web module. The rest of the test did not show any significant difference in terms of their perception in web-based learning, indicating more or less the same positive reaction across these dimensions.

Level 2 Results: Learning

Pre-test and post-test were conducted to evaluate student learning that was equivalent to Level 2 in the Kirkpatrick's model. In order to determine the sample's distribution, the normality test was conducted before testing the significance of the mean score for pre- and post-test. Table 4 shows that the p value is less than 0.05 which is statistically significant, therefore the sample is assumed to have non-normal distribution. Their means were compared using Wilcoxon Signed-Ranks Test after the pre- and post-tests have been conducted and assuming that the means are equal to the medians when using this test. Figure 1 shows the average score of the pre-test and post-test while Table 5 shows the results of the test, with the mean score of pre- and post-test.

There was a statistically significant difference of pre-test and post-test as the p value is less than 0.05 since statistical significance is accepted where p is below 0.05 when testing for 95% confidence. This shows that there was significant progress in student learning process after they were exposed to the web-based learning environment.

Level 3 Results: Behaviour

Students were asked in the questionnaire to elaborate on whether they felt that learning has been transferred according to Level 3 of the model (behaviour). Students were asked to elaborate on whether they felt that they have transferred the knowledge obtained from web-based learning to the learning outcome. Majority of them responded positively by stating that they managed to apply all or some of the knowledge learned from the module but a few students claimed that they were not sure or there was no transfer of knowledge.

Most of the students responded that they had transferred all of the knowledge learned from the web-based learning by stating that they had followed the principles and managed to complete the multimedia application, as well as having good interface design:

“Yes, the interface design was good so I think I transferred well”

“Yes, transferred all principles and technique from web-based learning”

“Yes, I able to follow and memorized the steps and apply”

Some students thought that they managed to transfer some of the knowledge because they worked in groups, did not apply everything and needed improvement. The sample responses were “*Yes but not all since this group work so I just apply a bit of what I knew*”, “*Yes, I've transferred from web based learning but might not perfect - cannot transfer all I learn*” and “*Some only because the multimedia still need improvement*”. This partial transfer that was perceived by them was not a problem and was considered as perceiving that the transfer has occurred from web-based learning.

Four of the students responded negatively by commenting that they were not sure or did not transfer any knowledge because they did not go through the module until the end or did not understand everything in the module. One student did not state any reason on this:

“Not really, I did not finish the module until the end”

“No because I didn't understand some part”

“Not sure, maybe at the idea before I start only”

This finding indicates that students possibly perceived in such a way pursuant to their negative reactions towards web-based learning that in turn led to their negative perceptions of transfer at the end of the course as it was also consistent with the assumption of Kirkpatrick's model.

The results indicate that students perceived that they managed to transfer the learning or behaviour change has occurred possibly due to the desire to change that was observed through their interest and positive attitude, knowing what to do and how to do it, working in the right environment and be rewarded in terms of good grades as suggested by Wittenborn (2008).

Discussion

The overall findings showed positive reaction in the survey from majority of the students with grand means of above 3 for all dimensions and the mean score were found to be statistically significantly different from other dimensions. This is consistent with other research such as in Kang, Hahn, Yoo and Kim (2011); Moos and Marroquin (2010) and Ouyang and Stanley (2014). Past research has indicated that students liked web-based learning for several reasons including the interactivity, self-paced learning and non-linear exploration of the content as well as improving their attitude towards learning (Yang & Tsai, 2008; Yang, Hwang, Yang & Hwang, 2015). However, its effectiveness depends on good design, online presence of the instructor and interaction tools (James & Poonam, 2015). This can be seen by the minority of students who were undecided or had negative reaction towards this type of

learning. This finding highlights the much positive as well as minor negative reaction to this type of learning.

The average student score for the pre-test was 8.19. Post-test result was improved as the average score was 10.52 (as shown in Table 5). When testing for 95% confidence, the test result was statistically significant as p value was below 0.05, which showed that students significantly improved their knowledge.

From questionnaire results, it was found that most of the students responded favourably by stating that they have managed to transfer all or some of the knowledge obtained from web-based learning. They also felt that they had applied all or some of the knowledge although a minority of them responded negatively by stating that they did not transfer any knowledge acquired through web-based learning because of reasons such as they did not understand everything.

It has been demonstrated that Kirkpatrick's model is able to evaluate web-based learning by implementing its Level 1 to Level 3. Therefore, it is suited to be used in the educational setting to gauge the quality of the learning environment based on its three levels namely Reaction, Learning and Behaviour. By having a systematic approach in evaluation as demonstrated in this study, the ultimate goal of improving the learning outcome can be achieved in higher education.

Conclusion

As demonstrated in this study, a web-based learning environment can be evaluated using Kirkpatrick's model by mixing a few types of quantitative and qualitative measures. The model has been used to evaluate the environment in terms of students' reaction, the learning that has occurred and their changed behaviour or transfer of knowledge. Based upon the quantitative and qualitative statistical analysis performed and triangulation of multiple data sources, the web-based learning environment was found to be successful overall as perceived by students and performance scores. Majority of them reacted positively, managed to increase their knowledge and significantly transfer their knowledge in the web-based learning environment.

This study has its limitations. As this research was conducted at one university and for one course, the findings may not be generalized. However, the case study has been used to demonstrate how the levels are used for evaluation in higher education institution. Another limitation is that Level 4 of the model was not done due to irrelevancy to the context of education where the instruction was applied (Winfrey, 2002).

Research contribution that resulted from this study is in providing empirical evidence on perspectives, learning and behaviour of students as well as giving further insights into evaluations in web-based learning environment that is based on the three levels of Kirkpatrick's model. It has been demonstrated that the Kirkpatrick's model is useful as an evaluation tool to be used in higher education. It may be used to evaluate other types of learning environments as well as different types of study domain that exist in higher education.

A pedagogical implication of the study is the web-based learning module can be designed to have appropriate multimedia elements following any good design principles that could be seen in the module used in this study. The positive findings also support the outcome-based education that is commonly used in higher education so students would be more engaged and motivated to learn. One quality improvement measure that can be taken to strategically improve the offering of the course in the future is in terms of its evaluation in which educators may opt to use the three levels of Kirkpatrick's model with appropriate assessment items according to the courses taught.

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Author's Bio

Dr Zarina is a lecturer at Multimedia University, Cyberjaya. She obtained Bachelor of Computer Science (Hons) from University of Malaya and Master of Science (Creative Multimedia) from Multimedia University. She also obtained PhD from Multimedia University in the area of blended learning and evaluation.

Prof. Dr. Neo Tse Kian is a Professor at the Faculty of Creative Multimedia, specialising in Multimedia Technology in Education and Constructivist Learning Environment. He is currently the Director of Digital Education Research Institute. His research area includes creative learning environments and design.

Prof. Dr. Mai Neo is the Director of the Office of Academic Development for Excellence in Programmes and Teaching (ADEPT) for Multimedia University, and Professor in the Faculty of Creative Multimedia. Her research interests are in the design of constructivist learning environments and supervises Masters and PhD students in the areas such teaching and learning methods, problem-solving learning, collaborative and cooperative learning and multimedia microlearning environments.

Tables / Figures

Table 1 Results of Level 1

Item	Dimension	Mean	%	Std. Dev.
	Learning with multimedia			
1	Multimedia made learning fun and motivating	4.05	83.8	.705
2	I was able to learn better with multimedia content	4.03	86.5	.645
3	Multimedia made understanding the content better	3.95	81.1	.664
4	Learning with multimedia was appealing to me	3.92	86.5	.547
5	The multimedia environment managed to hold my attention	3.78	73.0	.821
Grand mean = 3.95				
Alpha = 0.777				
	Motivation			
6	I was motivated to learn in this environment	3.73	70.3	.693
7	Rank your overall satisfaction of this type of learning (web-based learning)	3.70	64.9	.661
8	I prefer learning in this environment	3.70	67.6	.702
9	I enjoyed learning in this environment	3.65	64.9	.676
Grand mean = 3.70				
Alpha = 0.863				
	Engagement			
10	I found learning in this environment engaging	3.84	75.7	.646
11	I found learning in this environment interesting	3.68	70.3	.709
12	I felt excited to learn in this environment	3.62	59.5	.721
13	I was not bored with this method of learning	3.49	56.8	.870
Grand mean = 3.66				
Alpha = 0.701				
	Good design			
14	I found the graphical user interface or GUI user friendly	3.84	78.4	.501
15	The interface was attractive and appealing to me	3.84	75.7	.553
16	The interface was clear and well designed	3.76	73.0	.683
17	The module provided sufficient interactivity for me	3.76	75.7	.641
18	The design of the interface was suitable for me to learn the content	3.68	67.6	.709
19	I liked the colour of the interface	3.68	62.2	.669
Grand mean = 3.76				
Alpha = 0.698				
	Quality of learning activity			
20	The text was easy to read and understand	3.97	86.5	.600
21	Important information or key concepts were easy to identify	3.92	81.1	.547
22	I found it easy to locate pieces of information I had previously used	3.70	70.3	.571
23	I was able to explore the module without difficulty	3.59	59.5	.686
Grand mean = 3.80				
Alpha = 0.618				

Table 2 Test of normality

	Shapiro-Wilk		
	Statistic	df	Sig.
Learning with multimedia	.924	31	.030**
Motivation	.906	31	.010**
Engagement	.863	31	.001**
Good design	.955	31	.212
Quality of learning activity	.905	31	.009**

**Significant at $p < 0.05$

Table 3 Wilcoxon Signed Ranks test of reaction

	Learning multimedia ($M = 3.95$)	with Motivation ($M = 3.70$)	Engagement ($M = 3.66$)	Good design ($M = 3.76$)
Motivation ($M = 3.70$)	$Z = -2.394^a$ $p = 0.017^{**}$ $r = 0.304$			
Engagement ($M = 3.66$)	$Z = -3.458^a$ $p = 0.001^{**}$ $r = 0.439$	$Z = -1.121^a$ $p = 0.262$		
Good design ($M = 3.76$)	$Z = -2.242^a$ $p = 0.025^{**}$ $r = 0.285$	$Z = -.479^b$ $p = 0.632$	$Z = -1.146^b$ $p = 0.252$	
Quality of learning activity ($M = 3.80$)	$Z = -1.847^a$ $p = 0.065$	$Z = -.401^b$ $p = 0.689$	$Z = -1.479^b$ $p = 0.139$	$Z = -.345^b$ $p = 0.730$

a. Based on negative ranks.

b. Based on positive ranks.

**Significant at $p < 0.05$

Table 4 Normality test result of learning

	Shapiro-Wilk		
	Statistic	Df	Sig.
Pre-test	.917	31	.020**
Post-test	.966	31	.418

**Significant at $p < 0.05$

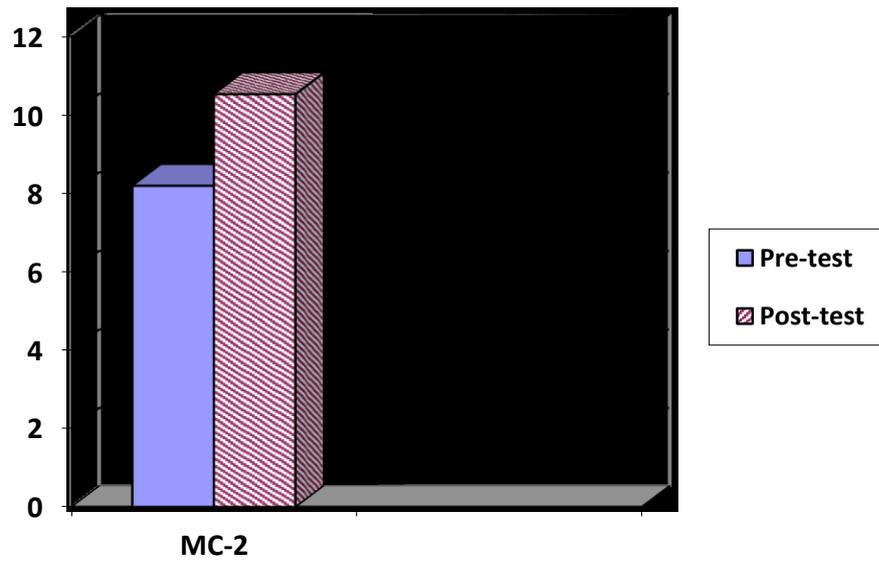


Figure 1 Average Score on the Pre/Post-test

Table 5 Wilcoxon Signed Ranks test of learning

	Pre-test ($M = 8.19$)
Post-test ($M = 10.52$)	$Z = -4.637^a$ $p = 0.000^{**}$ $r = 0.589$

- a. Based on negative ranks.
- b. ****Significant at $p < 0.05$**

-END-



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