

Effectiveness and Usability Evaluation of 'Li2D' Courseware

Zuraini Hanim Zaini, Wan Fatimah Wan Ahmad

Abstract—Multimedia courseware has been accepted as a tool that can support teaching and learning process. 'Li2D' courseware was developed to assist student's visualization on the topic of Loci in Two Dimension. This paper describes an evaluation on the effectiveness and usability of a 'Li2D' courseware. The quasi experiment was used for the effectiveness evaluation. Usability evaluation was accomplished based on four constructs of usability, namely: efficiency, learnability, screen design and satisfaction. An evaluation on the multimedia elements was also conducted. A total of 63 students of Form Two are involved in the study. The students are divided into two groups: control and experimental. The experimental group had to interact with 'Li2D' courseware as part of the learning activities while the control group used the conventional learning methods. The results indicate that the experimental group performed better than the control group in understanding the Loci in Two Dimensions topic. In terms of usability, the results showed that the students agreed on the usability in multimedia elements in the 'Li2D' courseware.

Keywords—Effectiveness, usability and multimedia elements, Loci in Two Dimensions.

I. INTRODUCTION

MULTIMEDIA courseware is popular nowadays as a learning tool especially on the mathematics and science subjects [1]. Many arguments regarding the implementation of multimedia learning in the classroom include: a) Making the learning experience for students more exciting as it triggers the different senses of human such as hearing and seeing with the various available media b) accommodates multiple learning styles and skills [2].

Implementation of multimedia courseware in a classroom has highlighted the importance of design and integration of pedagogical elements in developing the effective multimedia courseware and brought along with it the importance of evaluation of the developed multimedia courseware [2].

Research has shown that students have problems in learning mathematics [9]. According to [1] students have problem in visualizing the concept of Loci in Two Dimension. Hence, the proposed courseware was developed for this topic.

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II. RESEARCH BACKGROUND

The main aim of the research is to develop and evaluate the Multimedia courseware titled 'Li2D' for teaching and learning of Mathematics for Form Two students on the topic of Loci in Two Dimensions. The framework for this research is divided into three stages as shown in Table 1.

TABLE I
RESEARCH FRAMEWORK

Stage	Description
I	Preliminary Analysis
II	Development Process (Analysis – Design – Development-Implementation-Formative Evaluation)
III	Testing and Evaluation

Stage I is a preliminary study. The analysis is based on interviews, questionnaire and reading on the past research on integrating the computer based technology into teaching and learning process. Stage II involves the analysis, design, development, implementation and formative evaluation. The data gathered from the analysis is used to design and develop the courseware. The heuristic evaluation has been conducted to evaluate the interface of the courseware. Stage III involves the courseware testing and evaluation. This paper will discuss the evaluation result in term of effectiveness and usability.

A. The overview of 'Li2D' Courseware

The 'Li2D' courseware was developed based on the topic of Loci in Two Dimension. In the Malaysian school syllabus, Loci in Two Dimension are taught in Form Two (14 year old students).

The 'Li2D' courseware consists of four modules: 'Lesson' module, 'Do it' module, 'Tutorial' module and 'Quiz' module. The multimedia elements used were combination of text, audio, hypermedia, image, narration and video. The interactive learning environment provided by 'Li2D' enables students to visualize the movement of the locus and steps in constructing the locus. 'Li2D' courseware is developed using Macromedia Flash 8 and Adobe Photoshop CS2. Samples of the 'Li2D' lesson page and tutorial page are shown in Fig.1 and Fig.2;



Fig.1 Screenshot of 'Lesson' module.

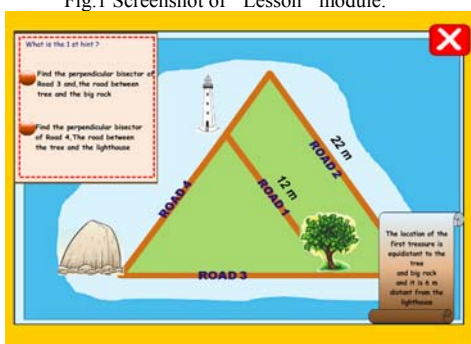


Fig.2 Screenshot of 'Tutorial' module.

B. Objectives of this paper

The objectives of this paper are:

- Describe the evaluation of 'Li2D' courseware
- Discuss the result of the 'Li2D' courseware evaluation in term of effectiveness and usability.

III. RELATED WORK

A. Effectiveness and Usability Evaluation

The courseware evaluation is conducted to measure the suitability of the materials, effectiveness of the courseware to students' learning and also the interfaces [3]. According to [4] the evaluation of a courseware involves measurement on the effectiveness and usability evaluation. The effectiveness evaluation is used to measure the student's achievement once having learnt from using the courseware. Waddah Ahmed Saleh Munassar et al. [5] had conducted a quasi-experiment to investigate the significant of two presentation modes on the students' gain scores in learning foreign language. The results showed that students who were exposed to the redundancy mode (experimental group) significantly outperformed their counterparts who exposed to the modality mode (control group).

Usability evaluation has been accepted as a tool that can provide answers regarding whether the system was designed and developed according to the user's requirements [6]. Nielson [10] defines usability evaluation based on the five constructs: learnability, efficiency, memorability, error and satisfaction. However, [3] had conducted courseware evaluation according to his five usability construct: effectiveness, learnability, ease of use, flexibility and attitude.

While [7] had also evaluated the courseware based on ease of use, screen design and navigation, information presentation and media integration. Therefore, the usability testing for 'Li2D' courseware was evaluated according to only four constructs which are learnability, efficiency, screen design and satisfaction.

There was variety of views on the number of participants in usability evaluation. Rosnaini Mahmud et al. [8] had conducted a courseware evaluation to assess the quality of the 'G-Reflect' courseware in terms of technical, pedagogy and content. There are 68 samples of Form Two students for control and experimental group respectively. According to [9] a group of 31 samples used is sufficient in the study. Johnson et al. [11] in [3] stated that sampling of 5 to 6 students are sufficient for usability evaluation. However, according to [12] a minimum sample size of 30 for each category is necessary.

IV. EVALUATION METHODOLOGY

Sixty three of form two students from Sekolah Menengah Kebangsaan Khir Johari, Tanjung Malim have participated in this evaluation study. The evaluation of 'Li2D' courseware involved two types of testing which are effectiveness and usability testing.

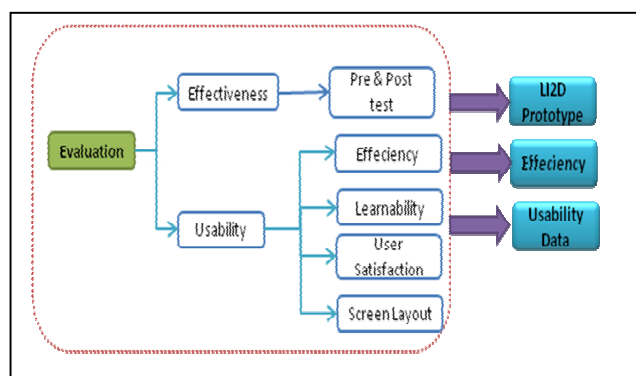


Fig. 3 Evaluation Phase in 'Li2D' courseware Life Cycle

The Quasi experiment design was deployed to measure the courseware effectiveness. The study involves two groups: they are control (X_1) and experimental (X_2) groups. Students in the control group are using the conventional teaching and learning method while students in the experimental (X_2) group use the 'Li2D' courseware as learning instrument. A pre test and post test have been conducted to both groups. The questions were designed to assess the students' understanding of the Loci in Two Dimensions topic. The results of these tests are compared to measure the students' performance.

TABLE II
SAMPLE NUMBER FOR EVALUATION

Type of Group	Number of students
Control Group (X_1)	30
Experimental Group (X_2)	33
Total	63

The usability evaluation was carried out by distributing a set of questionnaires to the experimental (X_2) group after they learned Loci in Two Dimensions using 'Li2D' courseware. Four usability factors were used to evaluate the courseware i.e. learnability, efficiency, screen design and satisfaction. These factors were also used to evaluate the usability of specific multimedia elements integrated into 'Li2D' courseware. The set of usability questionnaires were developed based on reviewed literature [3], [7], [9], [10].

V. RESULT AND DISCUSSION

The findings from the evaluation were carefully analyzed and presented in 3 parts: (i) the effectiveness of 'Li2D' courseware (ii) the usability of 'Li2D' courseware as a whole, and (iii) the usability of individual multimedia elements.

A. Effectiveness of 'Li2D' courseware

To test the research hypotheses, Independent T-test was applied in this study. T -test was chosen since there are two different sample sets (control and experiment) involved in the evaluation.

- Hypothesis 1 (H_01): There is no significant difference in the pretest scores between the control and experimental group.

Table III shows the result of Independent T-test for H_01 . The mean score for the pre test of X_1 is 36.13 while the mean score for the X_2 is 36.77. The Significant value, $p = 0.91$ is greater than $\alpha = 0.05$. This implies that H_01 is failed to reject and therefore there is no significant difference in the pre test scores between the control and experimental group.

TABLE III
 INDEPENDENT T-TEST FOR H_01

Independent T-test for H_01				
Variable	Mean	Std. Deviation	t	Sig. (2-tailed)
X_1_PRE	36.13	23.33	-0.11	0.91
X_2_PRE	36.77	23.44		

- Hypothesis 2 (H_02): There is no significant difference in the post test scores between the control and experimental group.

Table IV shows the result of Independent T-test for H_02 . The mean score for the post test of X_1 is 41.29 while the mean score for the X_2 is 62.26. The Significant value, $p = 0.00$ is less than $\alpha = 0.05$. This implies that H_02 is rejected and therefore there is a significant difference in the post test scores between the control and experimental group.

TABLE IV
 INDEPENDENT T-TEST FOR H_02

Independent T-test for H_02				
Variable	Mean	Std. Deviation	t	Sig. (2-tailed)
X_1_POST	41.29	24.32	-3.79	0.00
X_2_POST	62.26	19.61		

- Hypothesis 3 (H_03): There is no significant difference in students' increment scores between the group using the 'Li2D' courseware and the student with the conventional methods of learning.

Table V shows the result of Independent t-test for H_03 . The mean score for the increment of X_1 is 5.16 while the mean score for the X_2 is 25.48. The Significant value, $p = 0.00$ is less than $\alpha = 0.05$. This implies that H_03 is rejected and hence there is significant difference in the increment scores between the control and experimental group.

TABLE V
 INDEPENDENT T-TEST FOR H_03

Independent T-test for H_03				
Variable	Mean	Std. Deviation	t	Sig. (2-tailed)
X_1_DIFF	5.16	10.29	-4.61	0.00
X_2_DIFF	25.48	20.63		

Based on the result, the pre test and post test that have been conducted on the control (X_1) and experimental (X_2) groups have shown that: students in X_2 group have achieved more through 'Li2D' courseware compared to the students in X_1 group who were taught using conventional method. The results are consistent with the findings by [13] when integrating the courseware technology into mathematics teaching.

B. Usability of 'Li2D' courseware

The usability of 'Li2D' courseware evaluation was based on the learnability, efficiency, screen design and satisfaction factors were evaluated using a set of questionnaires. The students rate the questionnaire using a five-point Likert scale ranging from "1 = strongly disagree" to "5 = strongly agree". The results obtained were analyzed using SPSS 11.5. The findings are presented in Fig. 4.

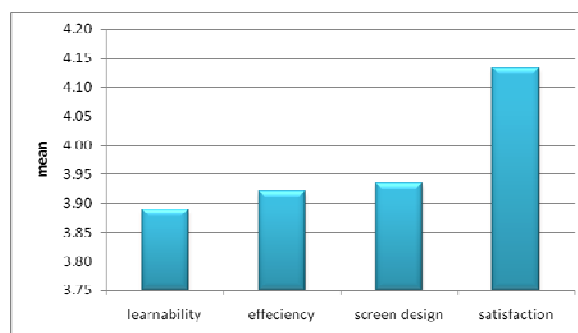


Fig.4 The mean score for the usability factors in 'Li2D' courseware

From Fig. 4, the satisfaction factor scored the highest mean value (4.13), followed by screen design (3.93), effectiveness (3.92) and learnability (3.88). The average for the four usability factors is 3.97 which is more than the median scores (2.50). Overall, the usability of the courseware is considered

acceptable to the students. The findings as indicate that students are satisfied with the efficiency of the courseware. This could be another reason why the students performed better when they learn Loci in Two Dimension using 'Li2D' courseware.

C. Multimedia Elements

Evaluation on the multimedia elements of the 'Li2D' courseware was conducted using questionnaire which involved only the experimental group. Seven multimedia elements were evaluated: text, graphic, audio, animation, interactivity, interface and suitability. The result of mean scores for multimedia element is depicted in Fig. 5. The average mean for each element is between 4.24 and 3.87. The highest mean value was text element while the audio element was the lowest mean values. It is due to some of the speakers that is not working. The students learnt via text that appears on the courseware. Interactivity, graphic and animation elements also attained high scored which are 4.16, 4.13 and 4.04. The interactivity elements in the 'Li2D' courseware such as games on tutorial module could increase students' interests during the learning process. The result is supported with research by [14] who reported courseware with game elements offered interest, curiosity, fun and enjoyment tend to increase students' interests in learning a subject. The animation in the 'Li2D' courseware involves the movement of the locus and steps of locus construction. These animations help the students to visualize the application of the locus concepts in the real world. Thus, these could have influenced their performances in the post-test. The average score for all multimedia elements in the Li2D courseware was 4.05 (high) which indicate that most students agreed on the suitability and accuracy of multimedia element that integrated into 'Li2D' courseware to assist them in learning Loci in Two Dimensions topic. The finding is consistent with [9]. According to [9] the combination of multimedia element such as text, audio, video and animation that integrated into the courseware can become an effective and positive communication medium to support the learning process.

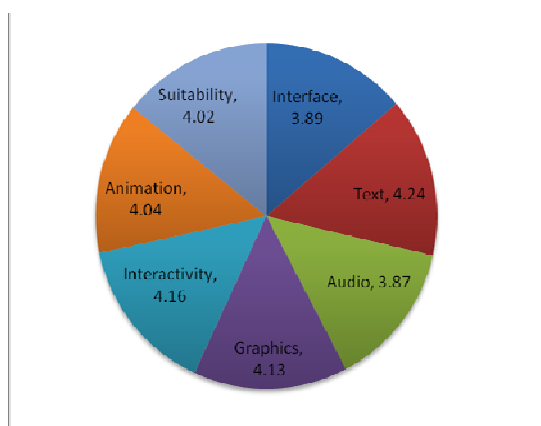


Fig. 5 The mean scores for multimedia elements in 'Li2D' courseware

VI. CONCLUSION

This paper has described an evaluation on the effectiveness and usability of a 'Li2D' courseware. The quasi experiment has been deployed for the effectiveness evaluation. The usability evaluation has been conducted based on learnability, efficiency, screen design and satisfaction. The result of the effectiveness of 'Li2D' courseware has received a positive feedback. This feedback will be used to further improve the courseware.

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