JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Designing an mLearning Solution for Discrete Mathematics on the Mobile Platform

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Abstract

In this paper, we introduce a mobile-based system for learning discrete mathematics. This system aims to provide students with more convenient learning options for discrete mathematics on a mobile platform. This application was created on Knowledge, and the design methodologies and functional elements of this system were explained. The study objectives of this project separated the findings into two parts: creating the student mobile application and testing and assessing the system. Application performance was assessed using the black box technique, and experts' and students' satisfaction with system usability was gauged using questionnaires.

Keywords: discrete mathematics, Mobile system, black box technique

1. Introduction

A number of authors advocate the inclusion of discrete mathematics in the curriculum. Some discrete topics support and extend the more traditional curricula of various countries while other discrete topics enable a range of topics that do not fall into the traditional algebra to calculus paradigm (Anderson et al., 2004; Burghes, 1995; Hart & Martin, 2018)[1-3].

Smartphones have been widely used as important tools to help with many facets of life in recent years. Advances in technology have transformed e-learning and mobile learning systems by eliminating time and space constraints. "The exploitation of ubiquitous handheld technologies, together with wireless and mobile phone networks, to facilitate, support, enhance, and extend the reach of teaching and learning" is how MoLeNet[4] defines mobile learning. A technique called mobile learning was created to help teachers and students connect to the Internet using electronic devices. The shift from e-Learning to mLearning suggested that the revolution did not only alter terminology but also the mindset of learning environments, according to Laouris and Laouri (2008). Mobile learning expands the scope of education to enable students to learn at any time and from any location [4].

One of the most important subjects in computer science is discrete mathematics, which most students find difficult to grasp. In order to assist students in this subject, the goal of this research is to create a mLearning system for discrete mathematics. To improve the level of education and knowledge Web-based and mobile technologies have been modified to assist students and to oversee the lesson, activities, and content. Furthermore, applying this paradigm to other courses is advantageous as well. This is how the rest of the paper

is structured. Related works used in this study are presented in Section 2. Section 4 displays the experiment's findings, whereas Section 3 outlines the experimental design based on the intended model. Finally, the conclusion and future research are presented in section 5.

2. Related Works

This section explains the related ideas that were utilized in the particular literature and modified for the suggested application. To assess the efficacy of the suggested approach, Gwo-Jen Hwang, Po-Han Wu, and Hui-Ru Ke (2011)[6] ran an experiment on a natural science course in an elementary school. The findings of the experiment demonstrate that the suggested approach not only improves learning attitudes but also raises students' learning accomplishments. Price,S., Davies,P.,Farr,W., Jewitt,C., Roussos,G and Sin, G (2014)[7] explained that the application was made to be teacher-customizable and that, based on information gathered from interviews, video, and observation, the design process and trial show how to use the application, how it supports a geospatial approach to science education, and how it raises issues regarding adoption, teacher pedagogies, and mobile technologies.In the mobile learning environment, numerous studies have also been conducted. For instance, Schuck et al. (2013)[8] suggested a design-based approach to be implemented in smartphones, and Rattanachai et al. (2014)[9] created an Android-based application called Lifestyles of Thai Buddhists to learn about the lifestyles of Thai Buddhists. Additionally, this project took into account numerous related studies.

3. Experimental Design

Students who graduated throughout the academic year made up the sample for the mobile learning system we developed in this article for the topic of discrete mathematics. (1)A questionnaire and interview forms asking about the mobile learning course were among the tools used to gather data for this quasi-experimental study on the evolution of teaching and learning. (2) a lesson plan for a course on discrete mathematics; (3) a pre- and post-test on achievement; and (4) a questionnaire asking students about their thoughts on this application. The collected data were analyzed by the statistical means ($\bar{x}$)and standard deviation (S.D.).

Rapid Application Development, or RAD, was utilized to develop the mobile learning application. User requirements were analyzed for design processes to determine students' interest in a mobile learning device, and this prototype is useful and effective in enhancing their abilities. Three components make up the system's architecture: the application, the user interface, and the data storage section, which houses the resources, students, and instructors. After receiving user input, the user interface component forwards the data to the appropriate sections for processing.

In order to establish the student profile, the student is required to take a pre-test after registering their profile with their personnel details, email address, username, password, and other details. Additionally, by selecting the words or phrases that show on the content page, students can search for additional information whenever they want. Content for online learning will be prepared in the learning content module. This module included indexing the topic and lesson contents in database content, converting instructor-provided lesson content, and creating a data file in the appropriate format. Results pertaining to the lessons will be shown by the search module.

4. Experimental Results

5.

The experimental results were divided into two sections in this section: creating an Android-based system for learning discrete mathematics and assessing the application's functionality and user happiness.

4.1. Developing the Discrete Mathematics Learning system based on Mobile system

In the experiment of this study, students took a pre-test and completed a questionnaire for analyzing their knowledge before participating in the mobile learning system. Students can search for available learning resources, learn the lessons that interest them, and take an exam. Teachers can check for available learning resources, add resources, and update resources. The example page in the back-end system is based on a web application that allows a teacher to add a resource, manage a class, and report to users. The new user must create an account profile.

3.2 Testing and Evaluating the Discrete Mathematics Learning system based on Android operating system

This study took places in a class with 40 students. The experimental results showed that the project can help student learning and reduce time consuming study. To evaluate the effectiveness of learning material collected data from test and post-test was analyzed and measured by using η1/η2 effectiveness with 80/80 condition.

$$\eta 1 = \frac{\frac{\Sigma s}{N}}{si} \quad \& \quad \eta 2 = \frac{\frac{\Sigma S}{N}}{sf}$$

When

η1 = the efficiency of process

η2 = the efficiency of performance result

∑s = total score from lesson testing

∑S= total score from post-test

s_i = Total score of lesson testing

s_f = Total score of post-test

N = total number of students

The result shows the post-test mean score was 49.25 or about 81.75% and the final-test mean score was 26.32 or about 81.35%. The efficiency of learning (η1/η2) was 82.08/87.73.

Table 1 The results of the efficiency learning

Test	Total Score	Mean	Staderd deviation	Percentage
Initail test Data	60	49.25	4.42	82.08
Final Test Data	30	26.32	2.23	87.73
The efficiency of learning (η1/η2) = 82.08/87.73				

To test and evaluate the qualities of the system, Black box Testing and Questionnaires by teachers and students were used to test this application. Black Box testing was assessed in the error of the project as following: functional requirement test, Function test, Usability test, Performance test and Security test. The ability of this application was evaluated by Functional Requirement test in needs of the users and Functional test was used to evaluate the accuracy of the system. Usability test was tested the suitability of the system. Performance test was used the processing speed of the system. Finally, Security test was evaluated the security of the system and Table 2 was shown the results of Black box testing.

Table 2 The results of Black box testing

	Teachers		Studentds	
	Mean	S.D.	Mean	S.D.
Function requirement test	4.11	0.68	4.10	.71
Functional test	3.82	0.69	4.10	0.62
Usability test	3.92	0.7	4.17	0.76
Performance test	4.01	0.52	3.98	0.78
Security test	3.89	0.53	4.18	0.72
Summary	3.98	0.63	4.09	0.71

The results were satisfactory as followed: Means for teachers and students were 3.98and 4.09, and standard deviation for teachers and users were 0.63 and 0.71 respectively.

5. Conclusion and Future Works

In this paper, the Discrete Mathematics Learning system based on Android operating system was proposed and this application can assists students to enhance student's abilities in discrete mathematics class. The experimental group had significantly better performance in learning achievements. This system can be beneficial to use in different courses so that students can enhance and improve their ability and also this system supports teachers in handle and manage their course. However, in term of the future experiments, we are looking forward to advanced algorithms to support in learning preferences and interest of learners based on social networks and to create adaptive learning for learners.

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