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Mobile Learning Application Impact Towards Student Performance in Programming Subject

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Abstract. Writing a program is significant basic proficiency for computer science students. However, majority of the students found it is difficult to learn and score a high mark. In an era of rapidly changing technologies, mobile learning has received increasing emphasis and widely used among educational practitioners and researchers. Thus, the objective of this study is to investigate the factors that influence students learning performance and evaluate the effectiveness of mobile learning using Learn C application in Programming subject. Prior to the factors that influence students learning outcome, a survey was conducted with 88 first year undergraduate students from Faculty of Computer Systems & Software Engineering. Next, a preexperimental one group pretest-posttest research design was employed with 17 students as respondents to examine the impact of mobile learning application. The collected data was then analysed using thematic analysis, descriptive and inferential statistics. The results showed that there are several factors that affect students learning performance in programming that is, misunderstanding, lack of practices, poor logical thinking and problem solving, no prior knowledge, psychological disorder, less interest, ineffective teaching method and bad attitude. The paired sample t-test of student's pre-test and post-test scores demonstrate that there were no significant differences before and after the treatment through mobile learning application given. The study has gone some way in enhancing our understanding of factors that affect student in programming learning which could be used to facilitate the development of the students programming abilities.

1. Introduction

The education sector nowadays has undergone a process of change in teaching and learning styles [1]. This change can be seen from using whiteboard and chalk up to the use of mobile technology. Recently, the adoption of mobile learning has received increasing emphasis and widely used among higher education institutions. The acceptance of mobile learning among students can increase their understanding and access knowledge in freeing from the constraints of time and place [2].

Mobile learning has turn out to be a learning instrument that come with great benefit in both classroom and outdoor learning [3]. As the growth of mobile learning, there have been several investigations into the use mobile technologies in science learning to assist educators to expand their abilities [4][5]. Therefore, there are a high demand for programming subject due to a high dropout rate in higher education among Information and Communication Technology (ICT) students especially registered in computer science courses [6][7].

Writing a program is a significant fundamental skill for computing students. However, majority of the students face difficulty in learning and scoring a good mark [8]. One of the main reason of this

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difficulty is due to this subject is new to most of them [9]. Students interest in the subject is also important [10]. Moreover, how the teachers conduct the teaching and learning in a class also can be a influence the student to be less interested in the subject.

For many years, researchers have been looking for another possibility in teaching programming subjects. Lacking the comprehension in programming concept has reduced undergraduate's interests to pursue further investigation and self-experimentation. Computing field is facing a crisis in the current enrolment due to decreasing demand of computing as a career of choice [11] [12] and indirectly it effects on the reputation of the institute [13]. There are several factors that drag to this problems including students are loss of interest in programming course due to subject difficulties and it pushes them to the high failure and dropout rates [14]. This impact has been alarming many lectures especially from universities of developing countries [15]. However, computing lecturers have tried many efforts to overcome this problem especially approach a variety of instructional methods to assist the novice students [16].

Recent studies have discussed on the educational benefits that mobile learning application have garnered for programming learners. However, the evidences are mixed in terms of the usefulness of mobile learning application. Positive outcome with mobile based-learning have been reported [17] [18], however several studies found no difference in the outcome of utilization of mobile learning application. Therefore, in this study, the researcher seeks to determine the factors that influence students learning performance and investigate how far the effectiveness of integration of mobile learning application into programming course and find the inferences for teaching and learning practices.

2. Literature Review

Programming language is one of the main knowledge areas in the Computer Science curriculum. It covers programming paradigms, concepts, technologies, patterns and algorithm. Writing a program is considered as a vital skill that must be mastered by any individual interested in continuing a career in computer science field.

2.1. Factor that influence students learning performance in programming course

Several factors that may influence students learning outcome in programming course have been identified as shown in Table 1.

Authors	Factors that affect students learning performance					
[7]	Lack of problem solving skill					
[6] [19]	No prior knowledge					
[6] [15]	Low motivation					
[20]	Poor lecturer skill					
[7]	Poor mathematical knowledge					
[15]	Peer influences					
[12]	Lack of future expectation					

Table 1. Factor that affect students learning performance in programming

2.2. Mobile Learning

Mobile learning can be referring to the usage of mobile devices to access learning resources, to learn, collaborate and share ideas among each other at anytime and anywhere with the support of mobile devices and networks. Therefore, it considered as a fastest growing learning platform [21] across a number of dimension such as mobility of technology, learners, educator and learning [11].

In addition, academic achievement of the students is considered enhanced by mobile learning since it offers self-regulating learning environment which can nurture student engagement and provide chances to make learning process essential to their daily life activities [1]. However, the achievement must be supported by institution commitment to mobile learning and institution learning practices to the success of mobile learning [21]. There are several findings from previous studies claims that the mobile Apps has positive effect on the knowledge comprehension of the students [22] as well as support learning for the delivery of instruction [23] and majority of the students revealed favorable attitudes towards the practice and use of mobile learning apps.

2.2.1. Learn C Apps. Learn C Application is a programming tool for learning C language. The app can be access through the browser of Android device and also can be installed through Google Play. The apps consist of the following features: various notes covering overall chapter in Programming Technique subject, code example supports with pictures, various of C programs, downloadable notes for quick revision, MCQ type tests, helpful interview questions, useful links to refer to resources and quizzes. Table 2 presents a comparison characteristic between C programming language apps. Within seven apps, Learn C apps is chosen to be used as a learning tool in with the integration of mobile learning.

Criteria	Learn C	Learn C#	C Prowess	101 C Programmin g Problems	C Programmin g	All C Program s	C Programmin g - 200+ Offline Tutorial and Examples
Navigation	Easy	Hard	Easy	Easy	Easy	Moderate	Easy
Interface	User- friendly	User- friendly	User- friendly	User-friendly	User-friendly	User- friendly	User-friendly
Content of learning	Covered	Covered	No Flowchar t and algorithm topic	None	No Flowchart and algorithm topic	None	No Flowchart and algorithm topic, control statement 1,File Processing
Connectivity method	Offline	Offline	Offline	Offline	Offline	Offline	Offline
Compiler	No	No	No	No	No	No	No
Storage size	11 Mb	5.3 Mb	3.3Mb	5Mb	2.5Mb	6.9Mb	3.6Mb
Language	English	English	English	English	English	English	English
Exercises/Quizze s	Both	Both	Both	No	No	No	No
Example of programs	Yes	No	No Flowchar t and algorithm	Yes	Yes	Yes	Yes
Developer	ReezX	SoloLear n	Faiz & Daneyal	AppsFacto	SNJ	Mahidhar Guggilam	Ravrani Software Developers
Purchase	Offer in- app	Free	Free	Free	Free	Free	Free

Table 2. Comparison characteristics between C programming language apps

3. Methodology

3.1. Research Design

This study used a research design of a quantitative approach with pre-experimental design of one group pre-test post-test design. The researcher tended to use a "single group study", due to the researchers concern on threats of internal validity [24]. Any direct or indirect interaction between the respondents in an experimental or control group can invalidate the comparisons between these two groups. Furthermore, quantitative data analysis method is suitable for this study because it offers a quantitative explanation of student's feedback in programming concept [25].

3.2. Participant

The samples involved in this research were categorized into two sets. Set I included students who were involved in answering the first objective. The sample consisted of 88 first year undergraduate students from Faculty of Computer Systems & Software Engineering. These participants were carefully chosen as they were within the targeted population and just begun to learn programming subject. In set II, 17 students from set I students were involved to answer the second objective that were included in the present study.

3.3. Research Instruments

There are two instruments were employed in this study. They consisted of online questionnaire and student's performance tests. A questionnaire is adopted and adapted from the instrument developed by [27] to assess the factors, perception of the difficult programming topics and revision methods. This questionnaire aims to discover the factors that influence the learning performance of the students based on their learning experience. Prior to the effectiveness of mobile learning application, a pre-test and post-test assessment was used in this study. The test comprised of structured questions which were constructed based on the previous final exam questions. The test has been validated and verified by two subject content experts.

3.4. Procedure

Figure 1 displays the stage of the experimental design. At the beginning of the semester, the online survey is conducted among 88 participants who take the Programming Technique subject in their second semester and the Data Structure and Algorithms at the present. Approximately 5 minutes are taken by the participants to complete the survey. It seeks to examine the factors that influence student learning and analyze the difficult topics of programming concept in terms of their learning experience.

The pre-test is administered in the second week of the semester. The participants were provided one hour to complete the test. The aim of the pre-test is to assess the prior knowledge in programming concepts. From the (n=88) students, 17 students are employed for the experimental group.





The mobile learning application is accessible to the experimental group in the third week of the semester along with the conventional. The conventional learning is defined as when the lecturer interacts face-to-face with students while delivering instructional material. Along the treatment period, students were using mobile learning in the class as self-learning tool. They explore the mobile apps on their own while the lecturer act as facilitator. In the seventh week of the semester, the post-test is administered by experimental group to measure and correlate their learning performance. The collected data then analyzed using thematic analysis, descriptive and inferential statistics.

4. Result and Discussion

4.1. Factors that influence students learning performance in subject of Programing Technique

The first objective attempts to recognize the factors that influence students learning performance in subject of Programing Technique. Based on Figure 2, there are 65.1 % students are facing the problem of Pointer Operations and Expression topics followed by Pointer to Pointer (62.8 %), Multi-dimensional array (53.5%), Pointer variables (47.7%), Pass by value and pass by reference (46.5%), End of file and file verification (43%), Writing and reading file (37.2%), Array of character and string (37.2%), Basic operation and declare file (31.4%), One-dimensional array (31.4%), Open and close file (27.9%), Calling and return function (24.4%), User-defined function and prototype function (19.8%), Pre-processor directives and header file, Identifier Variables and Constant, Programming Keyword and Reserve Word (16.3%), Loop-while, Do-while and For (11.6%), If-else, Switch-case, continue and break (10.5%),Pseudocode and flowchart (8.1%), and Input and Output operation (4.7%). Therefore, the researcher can identify that Pointer to pointer is the most difficult topic for students to understand in programming concept.



Figure 2. Percentage of respondent's selection by topics

Figure 3 shows the difficult topics with number of students. Based on the results, the number of students is higher for four critical topics in subject of Programming Technique such as Function, Array, Pointer and File Processing compared with other topics. However, only a few students think that topic of Operator and Expression is difficult. Figure 4 shows the domain factor that affect students learning performance. Compared to other domain factors, 33 % of students are misunderstanding of programming concepts, following by 22 % of students are poor in logical thinking skills and problem solving, 10% of students have no prior knowledge, 6% of students are psychological disorder, 5% of students are blaming to the ineffective of lecturers teaching method, 4% of students are less interest in programming subject, and 1% are students bad attitude such as laziness to study instead of do practices.

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Figure 3. Topic difficulty by grade



4.2. Effectiveness of mobile learning application in Programming Technique

Figure 5 illustrates the differences of the learning outcome before and after using mobile learning in this study. It revealed that there is a small difference between a scores in pre-test and post-test assessment. To add, the result showed that the participants understanding of the subject is increasing for 8 students while 7 students is decreasing and 2 students have a same score and no differences after using mobile learning application.



Figure 5. Comparison of pre-test score and post-test score

Prior to determine the significant difference between the mean of pre-test and post-test assessment scores, the researcher had undergone a normality test. Shapiro-Wilk used to determine whether the distribution of the data was normally distributed. The significant value of Shapiro – Wilk normality test for pre-test data is .065 and post-test data is .012. Since the value is greater than the chosen alpha level, which is concluded that the data is normally distributed.

With the proven that the data was normally distributed, the researcher continued in conducting paired-

sample t-test analysis. Table 3 presents the descriptive analysis for pre-test and post-test assessment. For N=17, mean for pre-test is 30.4, standard deviation is 20.2 and standard error mean is 4.9 while mean for post-test is 38.7, standard deviation is 22.5 and standard error mean is 5.5.

Table 3. Descriptive analysis					
Descriptive analysis					
				Std. Error	
	Mean	Ν	Std. Deviation	Mean	
Pre-Test	30.4171	17	20.21203	4.90214	
Post-Test	38.6976	17	22.50843	5.45910	

Table 4 showed the result for paired sample t-test for this study. The result indicated that t(16) = -1.233, p > 0.005. Because of the means of the two test scores and the direction of the p-value, the researcher can conclude that there was no statistically significant enhancement of understanding towards the programming concepts in Programming Technique for experimental group which essentially states that the intervention mobile learning application is not give a huge impact.

Table 4. Paired Sample T-Test								
Paired Samples Test								
Paired Differences								
		Std. Std. Error		95% Confidence Interval of the Difference				
PreTest - PostTest	Mean	Deviation	Mean	Lower	Upper	t	df	Sig. (2-tailed)
	-8.28059	27.69644	6.71737	-22.52078	5.95961	-1.233	16	.235

Based on the analysis performed on investigation the factor that affect students learning performance, the study found that students are posing four critical topics in programming Techniques such as Function, Array, Pointer and File Processing. Moreover, misunderstanding in learning the programming concepts bring them to the major factor to the dropout rate and then fail. The study also found that eight participants understanding of the subject in increasing while seven students is decreasing and two students have a same score.

5. Conclusion

In this investigation, the aim was to classify the factors that influence students learning in programming subject and the effectiveness of mobile learning application impact towards students' achievement in programming subject. This study has found that several factors that affect students learning performance in programming. Based on these factors, the finding can give some initial understanding and guidelines for the educators to improve the pedagogical strategy in teaching programming subject. The integration of mobile learning application in this study also revealed that one of these differences were statistically significant.in the students' performance. Learn C apps is chosen to be utilized as it covers all chapter studied in Programming Technique, an easy navigation, user-friendly in use, stand-alone apps after installation, consists both assessment including quizzes and exercises and several of example of programs. Taken together, these findings can contribute to the features that might have to be use in mobile application that can give more effect toward programming understanding. This research extends our knowledge on the factors and effect of mobile learning application in programming concept. The generalizability of these results is subject to certain limitations. For instance, the experimental group used in this study were relatively limited. Therefore, further research is needed to account for a larger sample.

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