Mobile phone application for mathematics learning

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Abstract. This research was aimed to determine the role of the use of Mobile Phone Application (MPA) in Mathematics learning. The Pre and Post-test Quasy Experiment method was applied. The Pre-test was performed to understand the initial capability. In contrast, the Post-test was selected to identify changes in student ability after they were introduced to the application of Mobile Technology. Student responses to the use of this application were evaluated by a questionnaire. Based on the questionnaire, high scores were achieved, indicating the student's interest in this application. Also, learning results showed significant improvement in the learning achievement and the student learning behaviour. It was concluded that education supported by the MPA application gave a positive impact on learning outcomes as well as learning atmosphere both in class and outside the classroom.

1. Introduction

The use of mobile phones in mathematics learning in schools is a positive thing, but there are some challenges to be overcome: the lack of awareness of the benefits and disadvantages of mobile-learning [1]. The use of telephone applications in the learning process showed 92 percent of learners felt more familiar in learning with the concept of mobile learning for the subjects. By development of mobile device technology, the creation/modification of tutorials, communicating with web applications to update the learning management system can be executed from anywhere any part of the world. Thus the ease of accessing learning materials has many choices [2]. Meanwhile, respondents stated that they preferred to learn mobile apps. This was because the mobile apps assisted them to understand better with the help of audio (the sound of native speakers) and the sample graphics were showed in the application. Also, it was reported that the user felt satisfied with the high applications [3].

Mobile phones are part of daily student lives both inside and outside the classroom. Other technologies such as paper and pencil, as well as computer software, are also accepted in this collective. However, the most of a present generation in schools and universities cannot see the world without mobile technology [4]. With progress in the process of technological change in education, it should be recognized that moving learning is part of a new landscape. Mobile learning provides many opportunities for personal, informal and spontaneous learning. By the use of mobile devices, students of all ages and backgrounds were able to collaborate, engage and learn in different ways [5]. Other findings indicated that Mathematics teachers were interested in using mobile technology for Mathematics learning. In their view, this technology could increase student’s motivation and participation in Mathematics learning and provided a methods diversity of Mathematics training [6]. Student activity of classroom learning in Math learning improved when they used the mobile phones [7]. Other research showed that the online and mobile learning applications motivated students, making mathematics courses be more fun and interactive than ordinary teaching practices [8].
The positive results of mobile-based activities shown that the mobile devices were a viable alternative to desktop computers to aid in visualization and concept of mathematical concepts. At the same time, the mobile devices were utilized to promote collaborative learning environments. Also, recent studies have explored the mobility application of mobile devices to conduct mathematical investigations outside the classroom environment. On the contrary, studies conducted in the outside environment had no formal evaluation of achievement. This showed the potential of mobile technology to bridge class math to real-world mathematics [9]. Compared to the textbooks, the mobile application tools facilitated student’s perceptions of the learning importance of identification [10]. Hence, an interactive mathematical model of mobile learning applications for Android-based mobile devices using web services could facilitate learning everywhere. [11]. For example, some game has been infused with educational material and the mathematics as its main theme. The game might look simple, but it presented a challenge for users or students who are just beginning to learn the basic principles of mathematics and have fun at once [12].

Meanwhile, the use of mobile phones by teachers in the classroom learning depends on the age. It was found that the most respondents used their cell phones for teaching and learning [13]. Older teachers tend to have smartphones, less support for all items, less enthusiasm for features and find barriers to becoming more problematic in learning [14]. However, despite the increase in mobile phone reception in schools, the majority of schools continue to ban mobile phones in the classroom. Also, none of the educational programs provided instruction on the integration of mobile classrooms [15]. In this article, we discuss the effect of mobile phones on classroom mathematics learning. Learning is done by using mobile phone applications that contain mathematical content and learning is done in some schools. Observation of students using observations and assessments made before and after the use of mobile phone applications. However, the lecture learning is also performed to have direct communication with the students.

2. Methods
Design and e-learning tool using Mobile Phone Application (MPA) assisted APP Inventor was implemented in school with the quasi-experiment method by pre and post-test. Five schools were selected, and each school consists of one class. Data from this research was the achievement of students from each class of five schools. The student achievement is the initial value, the final value, and the observation data to the students' disposition on the way of learning (Figure 1). The initial stage of the test (pre-test) was performed to determine the initial ability of students in the classroom. Furthermore, at the end of the learning process, the final test (post-test) was carried out. The test was aimed to find out the result of learning after MPA was implemented. Critical disposition of student in learning process was evaluated by observation sheet to understand student attitude and student interest in learning mathematics both in the classroom and outside the classroom. The result of student achievement and the observation result of the disposition from each class in each school shows the level of change from the student's learning based on the questionnaire of disposition to the students' knowledge.
3. Result and Discussion

3.1. Questionnaire

Figure 2 shows the result of student questionnaire about an interest in mathematical learning. The first questionnaire was given to the students when the students did the pre-test. Then, the students were given trigonometric math learning by using MPA assistance. When the learning process was finished, the questionnaire was given back to the students with the same questionnaire. The questionnaire results indicated that there were differences in students' responses to mathematics learning. If before the learning by using MPA the interest of the student was rather low with an average of 53.30 out of five schools. After learning with MPA, the student's interest increased to 63.64. The figure confirmed
students' attitudes toward mathematics learning especially in trigonometry lessons using MPA have increased.

![Bar chart showing N-gain questionnaire criteria](image)

**Figure 2. Questionnaire**

The increase of student interest in mathematics learning is shown in Table 1. The table displays that the increase of student interests in all school is categorized as a medium criterion with an average $N$-gain score of 0.33.

| No  | School | $N$-gain | Criteria |
|-----|--------|----------|----------|
| 1   | A      | 0.32     | medium   |
| 2   | B      | 0.34     | medium   |
| 3   | C      | 0.33     | medium   |
| 4   | D      | 0.35     | medium   |
| 5   | E      | 0.32     | medium   |
|     | average| 0.33     | medium   |

**Table 1. $N$-gain questionnaire criteria**

3.2. Pre Test and Post Test

Figure 3 presents the value of pre-test and post-test students taken at different times. According to the graph, it shows an increase of average student learning outcomes in each school. The post-test was conducted as well as taking data through a questionnaire, which is made after the students did the learning process with the help of MPA.

![Bar chart showing pre-test and post-test](image)

**Figure 3. Pre-test and post-test**
Students learned in the classroom directly with lecture methods and utilized MPA facilities used both inline and online. Outside of the classroom learning time, students can open the trigonometric material through the MPA media wherever the student is located without an internet network. Thus, it indicates that the use of Mobile Phone Application can increase the interest of students in learning mathematics to facilitate trigonometric problem-solving.

The results of pretest conducted in five schools as illustrated in Figure 3 obtained the lowest average score for pre-test, i.e., students in school A with an average value of 32.23. On the contrary, the highest average is obtained by students of school E with an average of 52.86. According to the average values, it is found that that the pre-test results are still below the average value of completeness, where the value of the completeness of 70. Also, the post-test results show the average value of the lowest students in school A with an average value of 66.21 and for the highest grade of school B with an average of 77.68. The post-test results indicate a significant increase in pre-test results and post-test results using MPA learning technology.

4. Conclusion
Learning using Mobile Phone Application gave a positive result on student achievement. According to the post-test and pre-test and questionnaire data given to the students obtained an improvement of test results and student attitudes toward learning mathematics. The increase in student test scores was high, while the development of student’s attitude toward learning is still in the middle category. This is because mobile phone technology has become a necessity for students in every day, so the utilization of this technology is still not getting a high response in learning mathematics.

5. Reference
[1] Hamat A, Embi M A, and Hassan H 2012 Procedia - Soc. Behav. Sci. 59 406
[2] Chary V R 2014 Procedia Comput. Sci. 34 583
[3] Chachil K, Rias R M, Engkamat A, and Sarkawi A 2015 Procedia - Soc. Behav. Sci. 167 267
[4] Borba M C, Askar P, Engelbrecht J, Gadamidis G, Linares S, and Sánchez M 2016 ZDM Math. Educ. 48 589
[5] Skillen M A 2015 Mobile Learning: Impacts on Mathematics Education,” in Proceedings of the 20th Asian Technology Conference in Mathematics 205–214.
[6] Taleb Z, Ahmadi A, and Musavi M 2015Procedia - Soc. Behav. Sci. 171 83
[7] Kachepa A and Jere N 2014 Int. J. Sci. Knowl. Comput. Inf. Technol. 55 6
[8] Drigas A and Pappas M A 2015 Int. J. Interact. Mob. Technol. 93 18
[9] Fabian K, Topping K J, and Barron I G 2016 J. Comput. Educ. 31 77
[10] Jeno L M, Grytnes J, and Vandvik V 2017 Comput. Educ. 107 1
[11] Kotecha K, Jain D, Chhajed A, Tatiya P, Shah M, and Sanghavi M 2011 Mathematical Model of M-Learning Application for Android-based Mobile Devices using Web Services in International Conference in Computational Intelligence (ICCIA) 7–10.
[12] Diah N M, Ehsan K M and Ismail M 2010 Procedia-Soc. Behav. Sci. 8 670
[13] Mtega W P, Bernard R, Msungu A C, and Sanare R 2012, “Using Mobile Phones for Teaching and Learning Purposes in Higher Learning Institutions : the Case of Sokioine University of Agriculture in Tanzania,” in Proceedings and report of the 5th UbuntuNet Alliance annual conference, 118–129.
[14] O’Bannon B W and Thomas K M 2014 Comput. Educ. 74 15
[15] O'Bannon B W and Thomas K M 2015 Comput. Educ. 85 110