Mobile learning and its effectiveness in mathematics

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Abstract. Mobile Learning is a development approach to distance learning. Extensive access to all mobile devices and unlimited learning opportunities for space and time, making mobile learning a critical role in the learning process. The purpose of this study is to determine how the characteristics of effective mobile learning based on the results of previous studies and to get an overview of the effectiveness of mobile learning in mathematics in senior high school. The method used in this study is an evaluative survey method with library research and field surveys. This study involved 75 eleventh grade students in one of the senior high schools in West Bandung District. The instruments used are questionnaires and interviews. Statistical analysis results show that the effectiveness of mobile learning in math learning is at a middle level. Based on the results of the survey can be concluded that the implementation of mobile learning on learning is an effective way of delivering mathematical content and able to impart self-reliance for students in enhancing the ability to understand the subject of his studies.

1. Introduction
The effectiveness of learning is influenced by the state of the teacher's knowledge carried on its interactions with learners who can influence the cognition and participation of learners in mathematical Learning [1]. By far the direct face-to-face interaction between teachers and learners is still considered effective. Different learning environments will restrict the development of knowledge differently [2], [3]. The advent of information technology provides a strong learning environment for teachers to experiment and share their knowledge as educational practitioners. However, for this to happen, teachers should assess and revise their knowledge and understand the cognition of students underlying mathematics learning. The idea of epistemic mediation to organize the role of technology as an effective tool of pedagogy. Technology utilization can help teachers build, activate, and expand knowledge to carry out distance learning [4].

Any digital communication tools can be used as distance learning solutions now. In this modern era, a student can access new information and knowledge easily, anytime, and anywhere. The industrial revolution 4.0 has changed the role of the teacher who has been the sole provider of knowledge, shifted by the availability of other sources of knowledge that have higher levels of accessibility. So, in this case, the role and presence of the teacher will be increasingly challenging and require very high creativity. Not enough content or pedagogical learning skills, but also special skills are needed, namely the use of technology in learning.
Technology is essential in teaching and learning mathematics, it influences the mathematics that is taught and enhances student’s learning. Numerous strategies can be used in learning that utilizes communication devices and technologies including electronic learning (e-learning), internet learning (i-learning), and mobile learning (m-learning). The submission of mobile learning has a great opportunity to develop the world of education through learning applications with high levels of accessibility. With mobile learning users can access learning content anywhere and anytime so that student’s self-regulated learning will grow because students can access educational content self-sufficiently, do not have to depend on the teacher, and without being bound by time and space.

Based on the above exposure, these studies were conducted to get a picture of the effectiveness of the use of mobile learning on math learning of high school students. This paper describes the process and the results of survey research applying the mobile learning model.

2. Methods

The method used in this study is an evaluative survey method with library research and field surveys. The purpose of this study is to determine how the characteristics of effective mobile learning in several countries and how the use of mobile learning in Indonesia. This study involved 75 eleventh grade students in one of the high schools in West Bandung District. The stages of the surveys are: (1) determine research problems, (2) create survey designs, (3) develop survey instruments, (4) determine samples, (5) conduct pre-tests, (6) collect data, (7) checking data (editing), (8) coding data, (9) Data entry, (10) processing, (11) Data analysis, (12) Data interpretation, (13) Making conclusions and recommendations.

The instrument used consisted of a mobile learning questionnaire shown in table 1.

| Table 1. Example of Item of statement of mobile learning |
| Statement | SA | A | D | DA | SDA |
| --- | --- | --- | --- | --- | --- |
| A | Student Attitudes towards Mobile learning |
| 1. I enjoy learning using a mobile device because I can study mathematics anytime and anywhere without limited space and time |
| 2. With mobile learning, I discovered new knowledge besides what I got from the textbook |
| 3. I like to participate actively in online discussions in virtual classes |
| B | Student Interest in learning with Mobile Learning |
| 4. Teaching materials displayed in virtual classrooms make me better understand the material being studied |
| 5. Working on the exercises online is just a waste of my time |
| C | Availability of Mobile Learning Devices |
| 6. I don’t have enough devices, so I can’t take maximum virtual classes |
| 7. I experienced network problems during the mobile learning activity |
| 8. Learning through virtual classrooms is a waste of quota |

3. Result and Discussion

3.1. mobile learning

Mobile learning is learning in which learners are using mobile devices such as PDAs (Personal Digital Assistants), laptop computers, mobile phones, smartphones (e.g., iPhone), digital players, media players, cameras (e.g., Augmented Reality [5], Virtual Reality), games consoles (e.g., Nintendo DS, Sony PSP), voting systems as well as customized hardware to enhance learning by gaining knowledge, skills, and experiences [6]. Learners can learn anytime and anywhere so learning can be very personalized, situated, and authentic. Based on these definitions, mobile learning is a learning model that utilizes information and communication technology in the form of mobile devices as a medium for the delivery of teaching material that can be accessed at any time by visualizing interesting material.

The term mobile learning (M-Learning) refers to the use of handheld and Mobile information Technology (IT) devices, such as PDAs, mobile phones, laptops, and tablet PCs, in teaching and learning. Mobile Learning (M-Learning) is part of electronic learning (e-Learning) so that, by itself, is
also part of distance learning (D-Learning). Of all types of mobile devices, mobile phones are the most popular among youngsters. Although there are still some technical issues with the provision of content over the phone, due to the small screen size. Mobile phones are perfect for activities such as sending short messages service (SMS) to students about dates, quizzes, video, and audio file storage. All this helps students to learn anytime, anywhere[7]. Mobile Learning is one of the solutions for remote learning. With mobile learning, students can access material across devices easily, quickly, and indefinitely. Many of the advantages we get by implementing mobile learning such as the speed of students ' understanding, and the ease of participants to review the lesson materials and training questions they get.

3.2. mobile learning utilization in Indonesia

It takes an innovative, creative, interactive learning model that can be used anywhere and anytime. One of them is learning with Android-based mobile learning. Mobile Learning is a creative and interactive step in the learning process, so students are happy and enthusiastic about learning. Android is an open-source operating system that means it's free and freely used for app developers. This makes it very easy for developers or developer Android apps to develop an app. Users are also very easy to get the app by downloading the necessary apps via the Play Store and installing on their mobile devices.

Some schools in Indonesia have followed the advancement of Technology by implementing Edutech (educational Technology), both online learning applications and platforms that have been circulating in the Google Play Store. One of the Learning management system platforms used includes Microsoft teams and Google classroom. Microsoft Teams and Google Classroom represent two education apps, with the former being new and the latter more established. At Sunway College's Canadian International Matriculation Program (CIMP), Google Classroom is the predominant e-platform for the dissemination of instructional material. Both education apps have been trialed for the instruction of A-level (ALE) Biology in 2015-2017 [8].

The LMS serves as a platform for managing to learn online, facilitating students and teachers organizing teaching materials, assignments, improving collaboration, and cultivating better communication. With this LMS, teachers can create classes, distribute teaching materials and assignments, rate them, students can discuss and comment on each other, send feedback, and see everything in one place. The tools used to convey the teaching materials in mobile learning activities include Ed Puzzle, Paddle, WebEx Meeting, zoom meeting, Youtube Video, and so on. Practice online using Google Form, Microsoft Form, Quizizz, and online student worksheet.

| Student attitude category on Mobile learning | Frequency | Percent | Valid Percent | Cumulative Percent |
|--------------------------------------------|-----------|---------|---------------|--------------------|
| Not good                                   | 13        | 17.3    | 17.3          | 17.3               |
| Good enough                                | 35        | 46.7    | 46.7          | 64.0               |
| Good                                       | 23        | 30.7    | 30.7          | 94.7               |
| excellent                                  | 4         | 5.3     | 5.3           | 100.0              |
| Total                                      | 75        | 100.0   | 100.0         |                    |

Table 2 shows students ' responses to trail learning using mobile learning. Based on 6 question items referring to the attitude of students to mobile learning, it is revealed that from 75 grade XI students showed 13 students had a poor attitude towards the implementation of mobile learning with a percentage of 17.3%, 35 students were good enough with the implementation of mobile learning (46.7%) while having a good attitude of 23 students (30.7%) And very good 4 people (5.3%). The overall result of the research data obtained the students can conclude a good attitude towards the implementation of mobile learning. This indicates that most of the respondents have a desire to take advantage of M-Learning facilities to the fullest.
Table 3. Student interest analysis on learning with Mobile Learning

| Student interest category on Mobile learning | Frequency | Percent | Valid Percent | Cumulative Percent |
|--------------------------------------------|-----------|---------|---------------|--------------------|
| Valid Low                                  | 8         | 10.7    | 10.7          | 10.7               |
| Middle                                     | 40        | 53.3    | 53.3          | 64.0               |
| High                                       | 27        | 36.0    | 36.0          | 100.0              |
| Total                                      | 75        | 100.0   | 100.0         |                    |

Table 3 shows student’s interest in trail learning using mobile learning. It can be noted that from 75 students of XI class showed 8 students showed low interest in mobile learning with a percentage of 10.7%, which showed interest in the category of being 40 students (53.3%) while showing a high interest in mobile learning is 27 students (36%).

Statistical Data of research has already been a positive interest related to the implementation of M-Learning. This positive interest is thought to arise because students realize that it takes an innovative breakthrough to improve the effectiveness of learning in a dynamic curriculum as it is today. Learning by using the Learning mobile model can increase students’ interest in math learning [9]. Development of mobile learning as an alternative learning model, expected directly or indirectly can increase student’s interest and ability to mathematics so that mathematics becomes something of fun for them [10].

Table 4. The availability rate of Mobile Learning devices analysis

| The availability rate of Mobile Learning devices | Cumulative | Frequency | Percent | Valid Percent | Percent |
|-------------------------------------------------|------------|-----------|---------|---------------|---------|
| Valid Low                                       | 16         | 21.3      | 21.6    | 21.6          |
| Middle                                          | 33         | 44.0      | 44.6    | 66.2          |
| High                                            | 25         | 33.3      | 33.8    | 100.0         |
| Total                                           | 74         | 98.7      | 100.0   |               |
| Missing System                                  | 1          | 1.3       |         |               |
| Total                                           | 75         | 100.0     |         |               |

Table 4 shows the mobile learning device availability level analysis. Based on the data in table 4, it can be noted that from 75 grade XI students demonstrate 16 students have the availability of mobile learning devices that include the availability of communication tools, quota, and network to support the implementation of mobile learning in the low category with a percentage of 21.3%. Medium category 33 students (44%), while the high category of 25 students (33.3%). The overall results of the research data obtained the availability of mobile learning devices can be inferred in the medium category.

The results of a previous study by Buchori stated that with mobile learning teachers try to create a new and enjoyable atmosphere in learning, so learners feel joyful and comfortable but still serious in learning. There is a new nuance in learning to improve the spirit of learners in learning mathematics and to change the negative view of learners to mathematics. Student learning Results using mobile learning Math game media with TAPPS (Thinking Aloud Pair Problem Solving) model is better than conventional learning. Experimental classroom learning achievement using mobile learning higher than the control class learning performance [11].

Besides, Zefriyenni transforms learning resources from books into digital form following the development of today's mobile device technology, by creating a mobile learning application. This mobile learning app displays a system of two-variable linear equations featuring learning materials, news
menus, and task upload systems. Application is made in the form of a mobile application for android-based mobile devices. With this mobile learning app, you can improve your skills, and make it easy for students to learn math about the two-variable linear equation system [12].

Mobile learning can be used as an alternative in the achievement and enhancement of mathematical communication skills, the ability of mathematical representation, and the independence of student’s mathematics learning. Effective use of mobile learning in all groups of students, especially low-group students[13]. MLE and Moodle as applications for a mobile learning system are a solution to remote learning. Because all the functions of the teaching and learning activities already complete in the Moodle and Moodle itself can run on a variety of devices (mobile phones) different operating systems, platforms, machines, to different screen resolutions also. Thus, equitable access to teaching materials and teaching and learning activities can be fulfilled well.

3.3. application type of mobile learning
The included studies evaluate the use of two types of application or technology for learning; Either developed by a researcher or other developer. In software development, the evaluation of the software quality is mainly done to assess whether the software achieves the intended purpose and is usually done by at least three stages of testing involving people other than programmers who write code. These three levels of testing were conducted to ensure that as many defects as possible are found and repaired and, more importantly, to increase the likelihood of the end Software product meeting the real needs of the actual user, in this paper, the student's learning needs. When a mobile app is developed by a researcher/teacher and evaluated solely by the developer, it is possible that the software quality assurance process has not been followed quite strictly. The pedagogical cost of the application may not have been fully explored or tested properly if no other person is involved in the evaluation. Therefore, dividing an application into these two categories contributes significantly to telling us about the quality and relevance of the applications developed in connection with the pedagogical mindset that is our focus on this paper.

iPod Touch is used to help middle school students learn about algebraic equations and the inclination concept, absolute value, and elimination. The development of mathematical films for use on iPod Touch gives students mobile math information that exceeds the hours of study in the classroom. While research explores the use of mobile devices in eighth-grade mathematics classes, lessons learned are invaluable to those who want to implement mobile technology to support teaching and learning that can be accessed anywhere and anytime with typical software, such as iMovie, PowerPoint, and iTunes. iPod is very enjoyable for students and provides the ease of ownership of mathematical concepts developed into films. The films really helped me understand what I needed to teach better. This study shows that the use of iPod Touch to make math videos deserves to be done in secondary schools studied. The educators of mathematics, students, and school administrators, and university faculties are impressed with the ability of students to present difficult concepts in visual format and then discuss them with friends [14].

Mobile phones should be viewed as new cultural resources that operate in individual, mobile, and convergent mass communications. Mobiles and other mobile devices serve as a resource for learning in a formal and informal context. The task of education is to use a mobile device to assimilate the learning of students in daily life as indigenous and naïve experts. For us, the context of school-based learning will benefit from distracting attention in some cases to the context of learning in an informal setting where the original and naïve experts of everyday Life Act in a generative and participatory manner[15].

Villareal and Borba show how the chalkboard is no longer always in the classroom, and how this artifact, as well as others, plays an important role throughout history. Student access to mobile technology creates student-mathematics relationships that have not been widely embraced by mathematical educators, who interfere with the traditional flow of knowledge of mathematics from teachers to students [16].
4. Conclusion
Based on the results of the survey can be concluded that the implementation of mobile learning on learning is an effective way of delivering mathematical content and able to impart self-reliance for students in enhancing the ability to understand the subject of his studies. The survey in this study was conducted on a relatively small sample. In future studies, it is recommended that surveys be conducted on a broader sample.

5. References
[1] Sowder J T, 2007 The mathematical education and development of teachers Second Handb. Res. Math. Teach. Learn.
[2] Shulman L S and Shulman J H, 2004 How and what teachers learn: A shifting perspective J. Curric. Stud.
[3] Shulman L S, 2007 shulman_ThoseWhoUnderstandKnowledgeGrowthTeaching_1986-jy Educ. Res. 15, 2 p. 4–14.
[4] Chinnappan M and Lawson M J, 2005 A framework for analysis of teachers’ geometric content knowledge and geometric knowledge for teaching J. Math. Teach. Educ.
[5] Hasanah A Kusumah Y S and Rahmi K, 2020 Rounding-augmented reality book and smartphone for deaf students in achieving basic competence in Journal of Physics: Conference Series.
[6] Traxler J, 2007, Defining, discussing, and evaluating mobile learning: The moving finger writes and having writ..., International Review of Research in Open and Distance Learning.
[7] Moura A and Carvalho A A, 2008 Mobile learning: Teaching and learning with mobile phones and Podcasts in Proceedings - The 8th IEEE International Conference on Advanced Learning Technologies, ICALT 2008.
[8] Davidson P Long E Molnar A Chui T M and Yee C, 2018 Ms Teams and Google Classroom: Preliminary Qualitative Comparisons & User Feedback 5th PreUniversity Sunw. Acad. Conf. 2018, Malaysia 2014, August p. 1–7.
[9] Nugroho S, 2014 PEMANFAATAN MOBILE LEARNING GAME BARISAN DAN DERET GEOMETRI UNTUK MENINGKATKAN MINAT DAN HASIL BELAJAR MATEMATIKA SMA KESATRIAN 1 SEMARANG J. Indones. Digit. J. Math. Educ.
[10] Yuliani R E, 2010 Pengembangan Mobile Learning (M-Learning) Sebagai Model Pembelajaran Alternatif Dalam Meningkatkan Minat Dan Kemampuan Siswa Terhadap Matematika J. Pendidik. MIPA.
[11] Buchori A Rahmawati N D and Baedowi S, 2015 Pengembangan Mobile Learning Dengan Model Tapps Pada Materi Barisan Dan Deret Kelas X Semester I Di Sma Nasima Semarang Jkpm.
[12] Zefriyenni Z and Mardhiyah H, 2017 Pengembangan Mathematics Mobile Learning Application (Mmla)-Sistem Persamaan Linear Dua Variabel (Spldv) Untuk Siswa Kelas 8 Sebagai Sumber Pembelajaran Mandiri Berbasis Android J. Teknol. Inf. dan Pendidik. 10, 2 p. 25–36.
[13] Ipin A, 2018 Mobile learning development of games based model using RPG Maker MV in ecosystem concept ICMScE.
[14] Franklin T and Peng L W, 2008 Mobile math: Math educators and students engage in mobile learning J. Comput. High. Educ.
[15] Cook J Fachler N and Bachmaier B, 2011 Ubiquitous mobility with mobile phones: A cultural ecology for mobile learning E-Learning Digit. Media 8, 3 p. 181–196.
[16] Borba M C Askar P Engelbrecht J Gadanidis G Linares S and Aguilãr M S, 2016 Blended learning, e-learning and mobile learning in mathematics education ZDM - Math. Educ.

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