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Use of Learning Management Systems in Mathematics Learning during a Pandemic

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Abstract

This study aims to describe learning process that is suitable to be applied during a pandemic and learning outcome in form of learning media that are effective, practical, easily obtained, economic and easily understood by university students in receiving material. As class setting (online learning) is 8th semester lecture in the ICT-Based Mathematics Learning Media course using action research method. This research design used 3 cycles, with each cycle passing through the plan-act-observe-reflect stage. Data collection technique is by using observation related to the skills of designing and developing simple math learning applications based on android. Research data analysis was carried out based on: (1) initial ability analysis; (2) reflection related to the online learning process (3) learning outcomes. The conclusions of this study are: (1) distance learning during a pandemic is to implement simple application and to use clear tutorial; (2) learning outcomes in the form of learning media with Android-based applications.

Keywords: *LMS, Action Research, Pandemic*

Abstrak

Penelitian ini bertujuan untuk mendeskripsikan pembelajaran yang cocok diaplikasikan selama pandemi dan luaran pembelajaran berupa media pembelajaran yang efektif, praktis, mudah didapat, faktor ekonomis serta mudah dimengerti mahasiswa dalam menerima materi. Sebagai seting kelas (pembelajaran *online*) adalah perkuliahan semester 8 pada mata kuliah Media Pembelajaran Matematika Berbasis ICT dengan menggunakan metode action research. Desain penelitian ini menggunakan 3 siklus, dengan masing-masing siklus melewati tahapan *plan-act-observe-reflect.* Tenik pengumpulan data dengan observasi, terkait keterampilan merancang dan mengembangkan aplikasi pembelajaran matematika sederhana berbasis android. Analisis data penelitian dilakukan berdasarkan: (1) analisis kemampuan awal; (2) refleksi terkait proses pembelajaran *online* (3) luaran pembelajaran. Simpulan dari penelitian ini: (1) pembelajaran jarak jauh pada masa pandemi adalah dengan menerapkan aplikasi sederhana dan menggunakan tutorial yang jelas; (2) luaran pembelajaran berupa media pembelajaran matematika dengan aplikasi berbasis *Android*.

Kata kunci: LMS, Action Research, Pandemi

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Introduction

Nobody wants a pandemic situation and there are no prior predictions that Covid-19 will become a pandemic. Like a scorching heat in broad daylight and then it rains, people will seek shelter as much as they can, or even surrender to the situation and get soaked. According to Murphy (2020), Covid-19 pandemic has changed social structures. Application of social distancing has caused a shift in learning patterns. Covid-19 pandemic requires changes in learning patterns that have been carried out face-to-face then it shifts to distance learning. Khalaf (2018) states that traditional/face-to-face learning is strongly influenced by the role of teachers so that problems begins to emerge in the absence of direct mentoring by the teacher. Students, who are not accustomed to being independent, will find it difficult to develop their potential.

Learning in the classroom is not possible because if the teaching and learning process is carried out in schools, it will have the potential to spread the virus and many students and teachers will be infected. Data submitted by Pusparisa (2020), there are at least 68,729,037 students studying at home at the moment.

An effort that can be used in distance learning systems during this pandemic is to use the internet in the learning process and face-to-face learning process shifts into e-Learning. According to Naidu (2006), e-Learning generally refers to deliberate use of information and network communication technology in the learning process. Several terms refer to the same concept; they are online learning, distributed learning and web-based learning. Basically, e-Learning is an educational process that utilizes information and communication technology to mediate learning activities both simultaneously and asynchronously. E-Learning carried out in this discussion is e-Learning which functions as a substitute which can be described that students fully carry out teaching and learning process with teachers via internet.

Although there is a projection of internet users in Indonesia that continues to increase from year to year, the projected data related to internet users cannot be used as a benchmark. Covid-19 pandemic caused impact from economic perspective also hampered access to the internet. It is clear that the Covid-19 pandemic can affect the level of data accuracy of internet users' projection in Indonesia. However, the data presented by Jayani (2019), that in 2019 alone, the number of internet users in Indonesia is projected to grow 12.6% compared to 2018, which is 107.2 million users. It can be used as initial indication. Initial indication shows that there is a potential for Indonesian population to be literate in information technology. Yet the emerged problem is that the growth of internet users should ideally be accompanied by a good internet connection speed. In fact, the growth of internet users has not been matched by the speed of internet connection.

Data presented by Widowati (2019), when compared to neighboring countries in ASEAN, Indonesia is only superior to Cambodia and Myanmar. Meanwhile, Indonesia's internet connection speed when compared to countries around the world is in 112^{th} position with the average file download speed of 17.02 Mbps as of May 2019. For the average file upload speed, which is 10.44. Mbps, Indonesia is ranked 123 in the world. In fact, Mtebe (2015) states that the circumstance for implementing an LMS (Learning Management System) must have internet capacity at least with a bandwidth of 20Mbps.

Yustika, Subagyo and Iswati (2019) reveal other facts found that a literature review shows the discontinuation of students from online lectures is caused by several factors such as gap which is a lack of communication between students and tutors, in this case the teachers. The term gap is used here to denote a disconnected relationship between students, teachers, and facilitators/administrators of online classes. This means that the communication network between the participants and the virtual teachers is not as connected and reliable as it should be.

Allen, Rowan and Singh (2020) also convey the obstacles related to online learning, especially during Covid-19 Pandemic, teachers and teacher educators are forced by circumstances to make a transition. They still have to work professionally to adapt to online learning. There are many complex problems encountered, both on the part of teachers and teacher educators as well as students and university student learners. From the teachers and teacher educators, suddenly they are required to be able to master the software, to move the material to the online space and to shift the face-to-face learning process to online learning room. Likewise students and university student learners, in terms of early age and university students' age, they must be familiar with gadgets. They are prone to radiation and gadget addiction. Monitoring the learning process becomes difficult. The feedback given does not immediately get a response from them. There is a situation like this that is called a struggle to adapt to the so-called "new normal" through time of great uncertainty.

The new normal process in a very uncertain time must be supported by all components related to the learning process. Xiao (2018) emphasizes that distance learning in LMS needs a system approach. As the focus in this study, so that universities as educational institutions are possible to independently create their own LMS. But in fact, when Covid-19 pandemic began to break out, not all universities could immediately organize an LMS system independently. There is a time lag that must be passed, because there must be stages of creation, socialization and training. However, Elfaki, Abdulraheem & Abdulrahim (2019) state that the introduction of multimedia and internet technology in learning at many universities has been means to increase accessibility and quality of delivery and learning among teachers. Furthermore, Shawar & Sadi (2010) suggest that LMS should not be only in business domain but also to be involved in broad areas such as: cognitive science, organizational knowledge, informational scientific, document management and support system decision.

Bancheva (2010) explains that the application of e-Learning in universities requires teachers to spend a lot of time preparing material and students are also required to have self-discipline. Therefore, for students who have difficulty with time management, face-to-face method remains the main choice for them.

Murshidi (2017) states there is a new reality that students and educators must accept m-Learning in learning process so that the development of system and supporting product for m-Learning is a must. The attitude towards m-Learning technology is an important factor that helps determine whether students and educators are ready to use m-Learning. In line with the development of m-Learning, the focus of this research is also on e-Learning based on learning project. The project in question is an Android-based learning media. The problems rose in this study later on which will become a success indicator which also lies in the achievement of those products.

The importance in emerging the learning output focus as an indicator of research implementation is a basic thing in a digital knowledge society due to digital literacy. Output as an indicator of this research focuses on Android-based digital learning media. Digital literacy media plays an important role in the change and development of new learning (new normal). This is in line with the opinion of Liu et al. (2020) who states that digital literacy as the basis for learning models development is influenced by digital didactics.

Based on a review by Turnbull, Chugh and Luck (2020), it is found that there are no purely quantitative LMS studies in Australia. This can strengthen the method carried out in this study. Further exploration is needed in the implementation of the LMS with a descriptive review. The LMS referred to in this study is still limited to online learning (e-Learning), with common approaches, namely: e-books, videos, web or blogs, and social networks.

Method

This study uses Action Research method. Wardani & Wahirdit (2016) describe the Action Research method as a research conducted by teachers in their own class through reflection with the aim of improving their performance as teachers so that student learning outcomes are improved. The Action Research method is then adopted in this study in the context of online learning. The learning process is different, but the stages of the research are the same, through the plan-act-observe-reflect cycle, as it is seen in Figure 1.

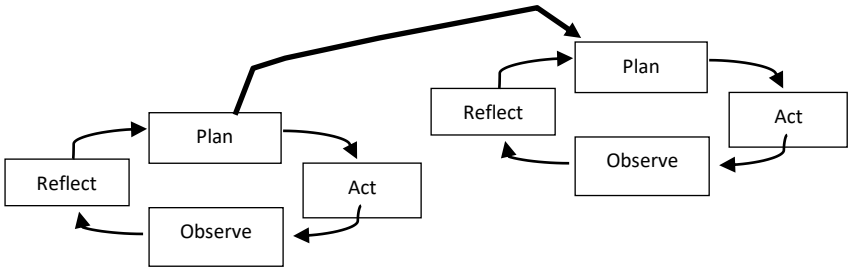

Figure 1. Action Research Cycle

The essence in implementing a research project involves iteration of the plan-act-observe-reflect cycle. The iteration of the cycle is important because it reflects the collaboration of processes and needs. The processes rest on the analysis of each reflection and the needs are the result of the process that becomes the output of learning. Gill and Johnson 2010 emphasize that in the learning process, teachers (lecturers) should encourage dialogue and participation although this may be a challenge because the participatory characteristics of each student (university student) are different.

Action Research is chosen because there are problems in the distance learning/online learning process during Covid-19 Pandemic so that the purpose of this research action is to find the right use of Learning Management System (LMS) implemented in online learning. Indicators of LMS selection is by considering the reflective analysis of each cycle in terms of its strengths and weaknesses. The class setting in Action Research is a lecture on ICT-based Mathematics learning media at PGRI Indraprasta University Jakarta in even semester of the 2019/2020 academic year. Selection of ICT-based Mathematics learning media course is because ICT itself has a very important role for teacher-candidate university students. This refers to the research of Tran, et. al. (2020) which states that a teacher must be equipped with good ICT skills, as a basis for developing e-Learning or digital literacy.

Steps in conducting this research follow the stages of each cycle, which is called plan-act-observe-reflect. Data collection is obtained by observation in online learning, questionnaires/assessments via Google Form and result project. In this study, the researcher is also the main instrument, because he is the executor of the online learning process through the LMS.

Result and Discussion

The results, which are obtained, are in the form of analysis result and description of the online learning process. Observation sheet is used to observe lecturer activities and student activities in each cycle. The presented data is also related to description of student abilities in each cycle and student response data (questionnaires) related to the learning environments, convenience factors, easily available facilities, economic factors and students' abilities to receive materials and tutorials.

The determination of the lecture project is carried out by discussion. Discussions in the ICT-based math learning media lecture formulate learning objectives to create a simple math learning application based on Android using the Sketch ware application on a Smartphone. The initial material, that is presented, is to make a simple mathematics learning application development plan by making a blue print of the application development plan.

Researcher conducted a preliminary research by conducting a survey (interview) in the first week of March 2020. The survey was carried out before the determination of distance learning by the DKI Jakarta Provincial Government.

The first interview conducted by researchers was to determine students' initial ability in making simple Android-based Mathematics learning applications. Data of questionnaire result is presented in Table 1.

Table 1. Result of First Interview

No	Questions	Students Response (%)	
		Yes	No
1	Is ICT based learning media important?	91,67	8,33
2	Have you ever made a simple android based application?	3,33	96,67
3	Are you able to make plans to develop a simple android-based math learning application?	33,33	66,67
4	Are you able to make a simple android based math learning application?	25,00	75,00

Data in Table 1 shows that students have realized from the start the importance of ICT-based learning media. However, the majority of students have never made a simple Android application, moreover an application that is used as a learning medium. In fact, the majority of students answered that they could not give explanation just for planning to develop application-based mathematics learning media.

Then, situation changed when lectures shifted from practicum based lectures in computer lab into online-based distance lectures. The difficulty that occurs was that lectures did not run normally in face-to-face lectures so that students practically did not receive direct guidance. (2nd week of March 2020).

Referring to the initial analysis of students' abilities (Table 1 Data), it becomes the basis for making lesson plans in this Action Research. The design of using LMS in the first cycle is made as ideal as possible to approach the face-to-face teaching and learning process in class. Action Research uses 3 cycles and then it can be described in stages for each cycle.

The faced basic problem is that students need an appropriate Learning Management System model to implement distance learning. Therefore, in fact the reflection of each cycle is essentially to analyze how the implementation of the LMS is executed. The expected solution with effective and efficient learning criteria/indicators in terms of comfort zones, easily accessible facilities, economic factors and supporting the improvement of students' abilities to receive lessons is needed.

Description of Cycle 1 Implementation

At the planning stage, the researcher must make an online class first. In cycle 1, the researcher collaborates with classrooms in the Schoology and ZOOM Meetings. Preparation is done by making the Sketch ware application module, lecture attendance and planning an assessment

Implementation of online learning is carried out with Schoology and ZOOM Meetings. The use of Schoology assists in the delivery of Sketch ware application modules, attendances, feedbacks, questionnaires and assignments using/given through Schoology basic. Meanwhile, the virtual face-to-face process and explanation of the application design use the ZOOM Meeting

Referring to the observations that have been done, online learning is active and interesting. The first impression from the implementation of online learning turned out that students gave a positive impression. The discussion process was interesting and students also seemed to show the progress of the project they were working on by experimenting with the tools in Sketch ware. In the ZOOM Meeting, it can be monitored the conditions of the online class. Moreover, the atmosphere is lively and fun.

In determining the sustainability of the cycle, then it should refer to the reflection that is carried out. Researcher conducted an analysis of student responses in online lectures. Reflections on Cycle 1, the advantages of using Schoology and ZOOM Meeting made the discussion went well. The

tutorials provided by researcher related to tools in Sketch ware could be directly practiced by students with direct instructions as well. Students can be well monitored, in terms of activeness, especially through ZOOM Meeting by activating microphone sound and video call. Meanwhile, the disadvantages of using Schoology and ZOOM Meeting are that they are more vulnerable to being constrained by the quality of the internet network. Students feel that the use of Schoology must go through adaptation and it is not yet fully proficient. Especially for the ZOOM Meeting, it must be with a good internet network quality so that the video and sound quality is not intermittent. If the video and sound quality is not good enough, students cannot play back the video from previous time duration. Not to mention that if you use ZOOM Meeting which is not yet PRO, there is limited time duration. The use of the ZOOM Meeting also received complaints from students due to the high cost that had to be prepared.

Based on the reflection of the implementation of Cycle 1, the researcher decided to proceed to Cycle 2. Cycle 2 was carried out by changing the implementation of online lectures which replaced the ZOOM Meeting with the delivery of material via YouTube Channel. Schoology is still maintained because even though students complain that they have to take time to adapt, the use of Schoology is still considered effective. Basically, Schoology is able to support the delivery of material, presentation and feedback.

Description of Cycle 2 Implementation

Cycle 2 begins with planning. The replacement of ZOOM Meeting with YouTube Channel requires researchers to prepare a YouTube Channel in advance. The YouTube channel used is Yogi Wiratomo. Next preparation is making video tutorials related to existing Sketchware tools. Then, tutorials related to tools in Sketchware are delivered through that channel.

At the online lecture implementation stage, it is same as in Cycle 1 but the delivery of tutorials or practice using Sketchware is done with the help of the YouTube Channel. Discussion process, attendance and assessment (feedback/questionnaire) are through Schoology.

The results of the observations show that discussions in Schoology take place unstructured. Student activity is less monitored. Researchers cannot know which students really listen from the start to finish and students who only need to attend lectures as lecture requirement or just do virtual presence. In fact, the detection of activeness by filling in the comments column on the YouTube Channel cannot be used as a benchmark for students who actually listen to videos from the start to finish or only post a comment.

The next stage is the implementation of reflection. Researcher found at least 2 deficiencies of collaboration between Schoology and YouTube Channel. The implementation of discussion in Schoology becomes less structured because even though they have used Schoology in Cycle 1, in fact students are still less familiar. The next weakness is related to virtual presence. Virtual presence cannot be a benchmark because, in Schoology, all students can attend without having to take full-time online lectures. YouTube Channel cannot control participation of students in full. However, YouTube Channel has its advantages. Tutorials via YouTube Channel are easy to understand. The videos in it can be played repeatedly even outside of online lecture schedules. Reflection in Cycle 2 results in the conclusion that the cycle should continue to Cycle 3.

Description of Cycle 3 Implementation

Referring to reflection in Cycle 2, planning in Cycle 3 is by choosing online learning via WhatsApp group and YouTube Channel is maintained to present Sketchware tutorial videos and to prepare Google Form as a presentation in this distance lecture (online lecture). It is clear that preparations are made by forming a WhatsApp group as their online class, then inviting all students to become members of the WhatsApp group. Researchers are the only admin in the WhatsApp group.

The basic implementation of online lectures then focuses on WhatsApp groups. WhatsApp group is very familiar to students, so that it is easy to use. The discussion process can also take place easily and it can be done via text message or can be done by voice message. Sending images can be easily done. Students can also send videos with a limited duration so that internet usage is thriftier. Researchers can send web addresses via WhatsApp group and sending Google Forms can also be done via WhatsApp group. WhatsApp groups with virtual face-to-face limitations can be dealt with certain tricks, for example by mentioning the student's name. If it does not respond to researchers' call for a long time, then it can be an assessment of the students' activeness. YouTube Channel remains a choice for virtual tutorials so that students can follow and carry out development related to products that are being worked on.

Observation of the implementation of Cycle 3 shows that the learning process is active and interesting. The atmosphere of class conditions is lively and fun. Discussions can take place in a structured and orderly manner. The class referred in Cycle 3 is through the WhatsApp group. Google Forms is an effective choice. Just like in the previous cycle, the tutorial on the YouTube Channel is easy to understand and students can follow steps in the video tutorial.

These reflections for Cycle 3 show that tutorials on Youtube Channel are easy to understand and students can follow and practice well. Discussions via WhatsApp groups can still be interesting and simple. The use of Google Form as a presentation, questionnaire and feedback (evaluation) is very effective and it does not take up time. The collaboration of the YouTube Channel, WhatsApp group, and Google Form can better adjust to network quality constraints, as well as save costs more economical. It is just that the learning process with collaboration like this cannot virtually take place face-to-face.

Based on the reflection of Cycle 3, the researcher made a stop cycle decision. The resulted collaboration has shown an LMS that met the criteria (indicators). The referred criteria are effective and efficient learning indicators in terms of comfort zones, easily accessible facilities, economic factors and supports for improving students' abilities to receive lessons. YouTube Channel video tutorials, with discussions using WhatsApp groups, attendance and tasks using Google Forms are the right collaboration as an LMS.

The next step in learning evaluation is to determine the ability of students in making Android-based designs for mathematics learning applications. Measurement of the ability to make designs is made in the form of assignments for students. From the observation of the product outputs, students can create and develop an Android-based mathematics learning application design. Figure 2 shows one of the application development designs in mathematics learning and indicates application process flow diagram that will be run later on.

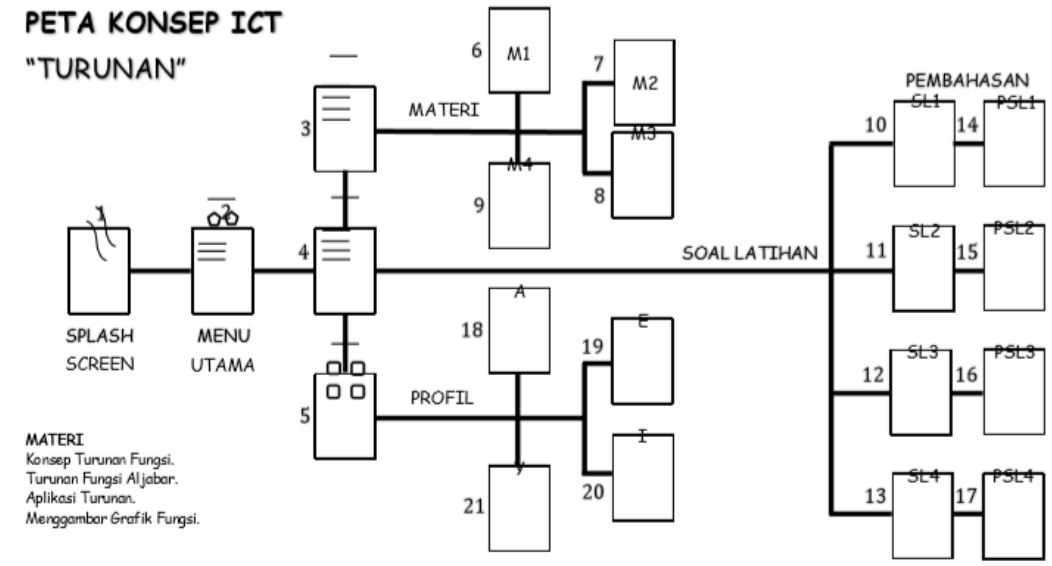

Figure 2. Example of a Mathematics Learning Application Design Created by Students.

Measuring the ability to create Android-based mathematics learning applications using Sketchware is made in the form of assignments for students. From observations, students can create and develop simple applications of Android-based mathematics learning media. Figure 3 shows the layout of the results of student products in designing, developing and making simple applications of Android-based mathematics learning media.

Mathematical knowledge and skill are necessary provisions for students' career in the future, even throughout their lifetime. In this research, ICT can play a vital role. This study has introduced a simple application of Android-based mathematics learning media that helps students motivate themselves to learn mathematics. The results of research by Saha, et. al (2020) ICT creates a significant positive attitude towards mathematics and helps to overcome mathematics anxiety.

Figure 3. Example of a Simple Android-Based Math Learning Application Made by Students

Learning environment analysis is conducted using a web-based questionnaire. This analysis aims to evaluate learning and to understand students' responses in the learning process. Students provide responses related to face-to-face learning to online learning

Table 2. Results of Learning Environment Analysis

Variable	Very often	Often	Often	Rarely	Never
Time Efficiency	14,60%	53,00%	27,00%	3,20%	2,20%
Receipt of Online Material	3,20%	19,50%	61,10%	11,90%	4,30%
Travel Efficiency	25,90%	46,00%	21,60%	4,30%	2,20%
Learning Flexibility	12,40%	49,20%	31,90%	4,30%	2,20%
Communication with Teacher	7%	35,20%	43,80%	12,40%	1,60%
Level of Boredom	13,50%	21,60%	49,20%	10,30%	5,40%

Data based on Table 3. shows that online distance learning has the ease of time efficiency, travel, and learning flexibility. The communication that is applied between lecturers and students is also going well. It is just that the level of boredom at the end of lecture is high because learning, assignments and communication are not done face-to-face.

In the end, the learning output is in the form of learning media with Android-based applications. The resulted learning media is an Android-based mathematics learning application using Sketchware. Android-based mathematics learning media by using the Sketchware application is one of the right alternatives in shifting print media literature to digital literature. This is in line with what Liu, et. al (2020) states. He states that digital media has an important role in the development of new learning.

Conclusion

The conclusion of this study is that distance learning during a pandemic should implement a simple and easily accessible application, within limited internet capacity and using clear tutorials. The use of applications that are simple and easy to use is more acceptable in the teaching and learning process in online classes. Discussion and communication in the online learning process can take place well using the WhatsApp group. Lectures that are based on online learning design with product outputs and with required practice, tutorials can be given via the YouTube Channel. The process of collecting data, questionnaires and evaluations can be circumvented by using the Google Form. Menawhile, the learning output is in the form of learning media with Android-based applications. The resulting learning media is an Android-based math learning application using Sketchware.

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