Implementing Google Apps for Education as Learning Management System in Math Education

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Abstract. This study aims to find the effectiveness of math education using Google Apps for Education (GAFE) as learning management system to improve mathematical communication skill primary school preservice teacher. This research used quasi-experimental approach, utilizing the control group pre-test – post-test design of two group of primary school preservice teachers at UPI Kampus Purwakarta. The result of this study showed that mathematical communication skill of primary school preservice teacher in the experiment group is better than the control group. This is because the primary school preservice teacher in the experiment group used GAFE as a tool to communicate their idea. The students can communicate their idea because they have read the learning material on the learning management system using GAFE. All in all, it can be concluded that the communication tool is very important, beside the learning material, and also the options to choose the learning model to achieve the better result.

1. Introduction

Out of the many mathematical skills that must be mastered by students as stated in the objectives of the 2006 Indonesian Curriculum (KTSP), mathematical communication skill is one of the skills that is expected to be obtained after students learn mathematics [1]. This also corresponds to Wichlet that communication is a vital skill in mathematics [2], and NCTM which state that mathematical communication is a way of sharing ideas and clarifying understanding. Through communication, ideas become objects of reflection, refinement, discussion, and amendment [3]. Mathematical communication skill include: 1) understand math concepts, explains the relationship between concepts, and apply the concepts or algorithms in a flexible manner, accurate, efficient, and precise in problem solving; 2) Using the pattern and nature of the reasoning, mathematical manipulation in making generalizations, compile evidence or explain ideas and mathematical statement; 3) Solve problems that include the skill to understand the problem, devised a mathematical model, solve the model and interpret the obtained solution; 4) Communicate ideas with symbols, tables, diagrams, or other media to explain the situation or problem; 5) Have respect for mathematics in life, which has a curiosity, attention and interest in studying mathematics, as well as a tenacious attitude and confidence in problem solving [1].

Several studies and efforts have been conducted to develop students' mathematical communication skills related to the use of models and media such as [4], [5], [6], [7], only few with regard to the use of technology. However, University has a very high dependency on the use of ICT in many aspects, both in the terms of the learning process as well as in management education. Utilization of ICT in
learning has become a primary need for students and teachers, so that the availability and the selection of appropriate tools to be used will also facilitate the process of education in the University. The availability of online learning for students should be a main concern. In addition, ICT will provide the online learning process with learning resources that can be accessed anytime and anywhere. ICT also develop a university quality in providing infrastructure by the use of technology in learning. Google Apps for Education (GAFE) is an information technology solution that can be used by schools/colleges so that the entire academic community can communicate and collaborate. Students and lecturers can share ideas more quickly and effectively in obtaining information, creating documents, spreadsheets, presentations, and collaborating with each other in real time.

This research uses Google Site as one of the features provided by GAFE. Google site on Google Apps and other support tools, had a possibility to develop a learning management system, because GAFE could provide learning materials, assignments, discussion forums, quizzes and others. This study analyze and design a learning management system for math education as a case to implement online learning that provide by Google Apps for Educations

1.1 Learning Management System
Learning Management System (LMS) is needed to support online learning. The LMS should meet some requirement such as: possibility for administrators, teachers and students to register on curriculum; provide a link between curriculum and instructional administration on learning content; supporting virtual learning; provide for various analyzes and measurements, as well as group or sole progress tracking; administering tests, assessments and reports; administrative system; management of capabilities so that an organization can measure learning needs and identify development needs[8],

There are few things that must be considered when developing LMS [9] that can be reviewed by these following factors: 1) User and availability: This factor can be seen from the speed of internet connection required; Special system requirements on client; The use of web browser; Other functional requirements on LMS; Documentation and help for users; 2) Usability: Some of the important things on this factor include the user interface, and the most important thing in the interface is the navigation that should be easy to learn and use, has a consistent structure and tailored to the general habits of the users: Presence of site-map; the availability of search function; help functions and language options; 3) Learning environment: The learning environment factors has several functions for teachers and students and divided into a communication environment where teachers and students are not simultaneously learning (asynchronously) and in real time (synchronous); Distribution environment, ie in what form/learning format distributed to the user; test environment, ie how many types of tests/tests that can be done; the interaction environment, which is the possibility for participants to influence the environment.

A focus on LMS development to support student learning in higher education institution should paid attention to the theoretical, pedagogical and technological problems because most of problems reported concerning LMS, center on underutilization of interactive features and the low level of student engagement of the system [10]

This study implemented GAFE as LMS using flipped classroom model because GAFE offers embedded features that promote collaboration and exchange of information. The integration of the various tools comprised in the Google Apps portfolio offers a powerful framework that ranges from basic communication to video streaming tools. Flipping a classroom becomes much simpler when these features are present. [11]

2. Experimental Method
This study was implemented from July - December 2014 at UPI Kampus Purwakarta. This study used a quasi-experimental approach and the Control Group Pre-test – Post-test Design [12]. The first group of subjects as the experimental group use the LMS that developed by using GAFE and the second group as a control group use conventional learning as the control group. In order to obtain the
necessary data, this study used research instruments such as achievement test of mathematical communication skill, the format of observations during the learning process, and student journal.

The research procedure started by the identification of the problem to several classes of primary school pre service teacher level 2 UPI Kampus Purwakarta, then the activities carried out with details as follows: literature study, develop research instruments and instructional design; system development; testing system with black box testing; Implementation; data analysis and hypothesis testing of data that has been collected; building conclusions to obtain the expected goals. To obtain the necessary data, this research using the research instruments in the form of test and observation format during the learning process.

This study determine how GAFE implemented in the mathematic classroom to support the regular class and the effect of its implementation to pre service primary school teachers mathematical communication skill improvement.

3. Result and Discussion
The LMS design is made specifically for learning that is able to display and manage learning by two role of users, that is tutors and students. In general, the LMS is designed in accordance with the standard features of a distance learning. The LMS designed adjustable with a W3C consortium standard for a site and regard to the Best Practice Statement and the Default Delivery Context. The Implementation of LMS Mathematics Education develop by Google Site which was very easy to use, it is equipped with others features of GAFE such as Google Drive, Google Calendar, Google docs, etc. In general, there are no significant obstacles during the system deployment process with sufficient connection to the implementation environment.

The first step of this research is develop the instructional design, test instruments and observation guide and then develop a system process that deployed at http://www.supri.upi.edu, and the learning content entirely created using tools provided by GAFE such as Google Docs, Google Videos, and Google Slide.

![Figure 1. The LMS with a learning content sample development using google site and youtube videos](image)

After the completion of the learning content required deployed, the next step is to test this LMS with the black box testing scenarios. Black box testing is a term of testing a system by simply observing the results of execution through the data test and functional check of the system. Black box testing identical with the evaluation process from the point of view of the outside (interface) and its functionality without know what actually happened in the full process [12].
The Implementation of the learning process using GAFE as LMS conducted in accordance with a schedule. The learning steps in the experimental group using flipped classrooms as follow: 1) The students are required to learn independently at home about the learning materials, watch instructional videos or presentations provided by the LMS and communicate through google talk or email; 2) In the classroom, the students were divided into several heterogeneous groups; 3) The role of the lecturers during the learning activities is to facilitate the ongoing discussions with cooperative learning methods. In addition, teachers will also prepare some questions (questions) of the material; 4) Lecturer give quizzes / tests, as a facilitator in helping students in learning and problem solve problems related to the material using Google Form, Google Docs and Google Sheet.

In the learning process, students were given opportunity to communicate orally and in writing related course materials. Student activity is more dominant, debriefing and very active discussion conducted in this group because they already know and some have understood the material that will be discussed.

The learning process in the control group is using conventional design. The learning process is generally performed by the discussion method and debate. But in this class, although the opportunity has been given the widest possible to do a question and answer, discussion and reflection, student activity is still not as good as the experimental class

3.1 Learning Effect
The pretest data obtained by providing mathematics communication skill test to students in the experimental and control group. It aims to determine the initial student mathematics communication skill.

| Table 1. The score of student mathematics communication skill pre test |
|---------------------------------------------------------------|
| N     | Minimum | Maximum | Sum  | Mean  | Std. Deviation | Variance |
|-------|---------|---------|------|-------|----------------|----------|
| Experiment group | 40     | 2       | 12   | 210   | 5.25           | 2.968    | 8.808    |
| Control Group    | 38     | 2       | 12   | 200   | 5.26           | 3.142    | 9.875    |

From the data shown in table I the initial skill of student mathematical communication in learning mathematics has similarities, that was very lack. The mean different test of the pre-test data by U-test showed that there is no different mean between the experiment and control group pre-test score.

The post-test data obtained by providing mathematics communication skill test to students in the experimental and control group after using the GAFE as LMS in the experiment group and direct instruction in the control group, and the result showed in the table 2.

| Table 2. The score of student mathematics communication skill post test |
|---------------------------------------------------------------|
| N     | Minimum | Maximum | Sum  | Mean  | Std. Deviation | Variance |
|-------|---------|---------|------|-------|----------------|----------|
| Experiment group | 40     | 11      | 15   | 544   | 13.60          | 1.194    | 1.426    |
| Control Group    | 38     | 5       | 15   | 429   | 11.29          | 2.470    | 6.103    |

Table 2 shows that there is a different mean of post test score of student mathematical communication skill. The t-test used to test to the data show that there is a significant mean difference between the experiment and control group on the LoC 95%. So that the instructional using GAFE as LMS with flipped classroom model has a good effect on student mathematical communication skill. The student
mastery learning in the experimental group show that 100% primary school preservice teacher pass the exam with minimum C score, while the control group only 60.53%.

The pre-test, post-test data showed that there was a significant improvement of student mathematics communication skill in the experiment group. This was caused that the student in the experiment group has been given a new method of learning math using learning management system developed from GAFE. Students learn math individually from the LMS to learn the learning material repeated, and they can communicate, collaborate and sharing their documents needed using google mail and google talk to discuss with their friends. The students also communicate their idea, making a sentences or paragraphs to solve a problem together with graphs, symbols, tables using google docs and google sheet. The students were provided by the exercise so they can try to understand the concept, reasoning, and learn the pattern as the curriculum goals with google form. [1].

4. Conclusion
The availability of online learning for students in higher education (university) should be a priority because it can be accessed anytime, anywhere. In addition, LMS was the most frequently used tool in higher educational learning [10]. Beside the learning model and method, the result of this study shows that GAFE is one LMS that proves to be used in learning math and improve communication skills of primary school preservice teacher. Further research can be focused on other mathematical abilities with a wide range of development and materials.

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