Blended Learning Model as an Effort to Increase Product Innovation of Mathematics Learning Devices

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Abstract This study aimedat seeing the improvement of product innovations of mathematics learning devices in the 21st century of 2013 curriculum through blended learning model. The method used was descriptive quantitative. The instruments were portfolio assessment and student'sresponse questionnaire. The results of the improvementanalysis innovation portfolio of mathematics learning devices such as syllabus and lesson plan were shown from Normalized Gain (N-Gain) scores and the analysis of learning activity responses of a Likert scale. The results of this study were (1) the average post-test score of the lesson plan innovation results in an N-Gain score of 0.76 with the criteria of the improvement "high" so that the lesson plan can be used as an example for other teachers; (2) the average post-test score of syllabus development innovation results in an N-Gain score of 0.71 with the criteria of the improvement "high" so that the syllabus development can be used as an example for other teachers; (3) the learning response resulted from the questionnaire score of 85.91%, it showed that the blended learning model gave a very strong response toward learning; (4) the innovation product from this research were the lesson plan and syllabus development.So blended learning model increase product innovation of mathematics learning devices.

Keywords: Blended Learning, Product innovation, Learning Devices

1 Introduction

The development of science and technology has a significant impact on various sectors and multi-sectors. These developments have an impact on education. The reality is that when education is linked to technology, it makes a positive contribution to its use, and it shows that education needs technological assistance. One of them is computer and internet media which then led to e-learning as an IT-based learning media. E-learning is expected to "turn on" learning to make it more interesting and enjoyable[1].

The problem faced by many mathematics teachers was the lack of innovation in utilizing information technology in the learning process. Other problems found in the field in the preparation of learning deviceswere; (1) the teachers have not made his own learning device but they used the learning devices made by other teachers or copied from a book; (2) school limitations in the process of increasing human resources through training or workshops so that teachers found difficulities in preparingthe learning devices; (3) teachers have not mastered and used various innovative cooperative learning models. Innovative learning devices are a set of updated learning activity plans to achieve learning goals that help children's learning process and outcomes towards a better direction[2].The problems felt by teachers have implications for mathematics students at the fourth semester in the subject of Mathematics Learning Planning at UniversitasMuhammadiyah Cirebon (UMC), in the learning process students felt that it was less challenging, especially in the use of IT. The understanding of making learning devices based on the 2013 curriculum was still low. The limited time allocation of teaching and learning activities makes the lack of information and practice of students in making learning devices. The constructing of learning devices that do not yet have innovation means that they still cannot develop the 21st century revision of K-13 learning devices. The material, content and assignments delivered to the students were very limited because the time allocation was only 2 credits which was equivalent to 100 minutes. Mathematics Learning Planning courses become one of the important subjects in the concept of professionalism of mathematics pre-service teacher, because the students are required to

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be able to make learning tools (syllabus development, effective weeks, annual programs, semester programs, lesson Plan of KTSP and K-13) then simulate the results of its products as an effort in preparing for teaching practice at school (PPL). Students' innovation and creativity which were still lack in the preparing the learning devices required a thoroughness and patience so that it needed a good effort in the learning process that was giving unlimited time in making the innovative the creativity preparing students' mathematics learning device products.

- **Solution**

The use of learning models supported by IT as an effort to refresh the learning process provides a new atmosphere that is not monotonous and has a broad scope of time allocation and unlimited in understanding the material, tasks and discussion. The existence of technology that continues to grow rapidly allows people to interact and meet the need for information almost unlimited. The limitations of time, distance, speed, capacity, etc. can be solved by technology. The number of internet users in 2017 has reached 143.26 million people or 54.68 percent of the total population of Indonesia. This number shows an increase of 10.56 million people from the survey results in 2016. Thus was announced the Indonesian Internet Service Providers Association (APJII) after conducting a survey of penetration and behavior of internet users in Indonesia [3]. This provides a great opportunity to change in various sectors of life, including education. By utilizing technology, time constraints on classroom learning can be solved. One of the sulotution is to combine classroom learning with online learning, which refers as blended learning.One of learning models that has implemented by teachers was aimed to make the students easy to comprehend the lesson as explained by EduviewsTM, he limited blended learning as learning practice which combined teaching method from face to face meeting then online learning[4]. "*Blended learning is a formal education program in which a student is engaged in active learning in part online where they have some control over the time, place, and pace and in part at a brick-and-mortar location away from home*"[5]. This is reinforced by Tucker's statement that blended learning is learning where a student is actively involved in online learning both face to face or in different locations or face to face indirectly.Blended Learning is a combination of online and face-to-face meeting in an integrated learning activity [6].Blended learning model is a learning model that combines face-to-face and online learning by information and communication technology devices.

The study conducted by Dziuban, Hartman, danMoskal found that blended learning have a potency to increase student's achievement and decrease the number of drop out student, it was compared to the whole online learning [7]. It also states that blended learning model is better than face-to-face meeting. The research of Wen-Shan Tseng et al entitled "Effect ofIntegrating Blended Teaching into Mathematics Learning for Junior High School Students" was found positive and statistically significant toward student learning desire, their learning process and method, maths belief, and total score for learning mathematics. So that blended learning is significantly effective than traditional learning and it is recommended to use by education practitioners and teachers [8].Research by Supandi et al entitled "Design of Blended Learning for Learning in High School (SMA)" concluded that the design of high school mathematics learning tools namely lesson Plan and Student Worksheet based on Blended e-learning provides opportunities for students to think broadly by doing creative practice questions including authenticity work, flexibility [9]. Utami's research revealed that the blended learning model was effectively used in Vocational High Schools [10]. Innovative learning tools in Subtheme 4 refers to the 2013 Curriculum for Class, students with the Generative Model and Problem Based Learning (PBL) learning model produce excellent quality learning tools [1].Based on the results of relevant researches and preliminary studies on mathematics education students, it is sufficient to strengthen the researcher to conduct this research, but efforts must be made for improvement by other researchers in order to achieve the expected learning goals. Thus researchers interested to conduct the research by using blended learning models as an effort to improve innovative products of learning devices as a result of mathematics learning planning courses.

2 Methodology

Referring to the challenges presented and the research objectives to be achieved, the research method used in this study useddescriptive research under quantitative approach with the aim of describing the findingsas the result of the research. The reason to use quantitative wasto enable researchers to take notes, and process data involving numbers or scores from questionnaires as instruments in quantitative research to be analyzed.. This method was used to improve student learning after the assessment of the Midterm Exam in constructing the products of mathematics learning device between the students who were given and those who were not given blended leraning model as the treatment.

Population is the area of generalization of the number and characteristics of research subjects/ objects [11] and according to Arikunto, Sthe population is the whole subject of research [12]. The population used in this study was UniversitasMuhammadiyah Cirebon (UMC) mathematics education students. Sampling technique is a sampling technique in a study [11]. The technique used is nonprobability sampling with saturated sampling type. Saturated sampling is a sampling technique when all members of the population are used as samples [11]. In this study the population used was the fourth semester of the mathematics education study program at UMC, which consisted of 11 students. According to Arikunto if the total population is less than 100 people, then the total sample is taken, but if the population is greater than 100 people, then it can be taken 10-15% or 20-25% of the total population [12]. Another reason for taking this sample technique is because the population is relatively small or small, namely as many as 11 students so that saturated sampling is used as a technique in data collection in this study.

Data collection technique was by preparing research instruments. The instruments used were portfolio guidelines (study or syllabus analysis and lesson plans) and questionnaires. Portfolio guidelines were prepared in accordance with the analysis indicators of learning tools which were then analyzed as results of Pre-Test and post-test data. Hypothesis testing used in this study was a test using the normalized gain test to see the improvement before and after learning has done.

$$\langle g \rangle \frac{\langle s\ post \rangle - \langle s\ pre \rangle}{\langle s\ max \rangle - \langle s\ pre \rangle}$$

Source: Meltzer[13]
abbreviation:
<g> = normalized gain t
<S post> = post test score
<S pre> = pretest score
<S max> = total score
Agreed Criteria based on the N-Gain test can be determined with indicators such as at Table 1.

Table 1.Normalized Gain Criteria

Heading level	Example
$0,7 \leq g$	High
$0,3 \leq g < 0,7$	Medium
$g < 0,3$	Low

The analysis of learning results responses using a scale that refers to the name of the LikertRensis, which publishes a report that explains its use, the Likert Scale. Sugiyono argues that the Likert scale is used to measure the attitudes, opinions, and perceptions of a person or group of people about social phenomena. [11]. The answers to each instrument item that uses a Likert scale have a positive gradation. The ordinal scales according to Sugiyono "The ordinal scale is a measurement scale that not only states the category, but also states the measured construct rating [14]. There are five scoring categories on the Likert scale as follows:

Table 2.Likert Scale Questionnaire Score

No	Information	Score
1	Strongly Agree (SA)	5
2	Agree (A)	4

3	Undecided (U)	3
4	Disagree (D)	2
5	Strongly Disagree (SD)	1

Based on Table 2 above, the questionnaire scoring questionnaire is explained with a Likert scale. The score used to determine the interpretation obtained from each aspect measured. According to Riduwan, the questionnaire interpretation is as follows: Table 3 [15]:

Table 3.Questionnaire Scale Interpretation

No	Percentage	Interpretation
1	0% - 20%	Very weak
2	20% - 40%	Weak
3	40% - 60%	Fair
4	60% - 80%	Strong
5	80% - 100%	Very Strong

3 Findings and Discussion

a. ***Blended Learning model as the improvement of product innovation of Mathematics learning devices***

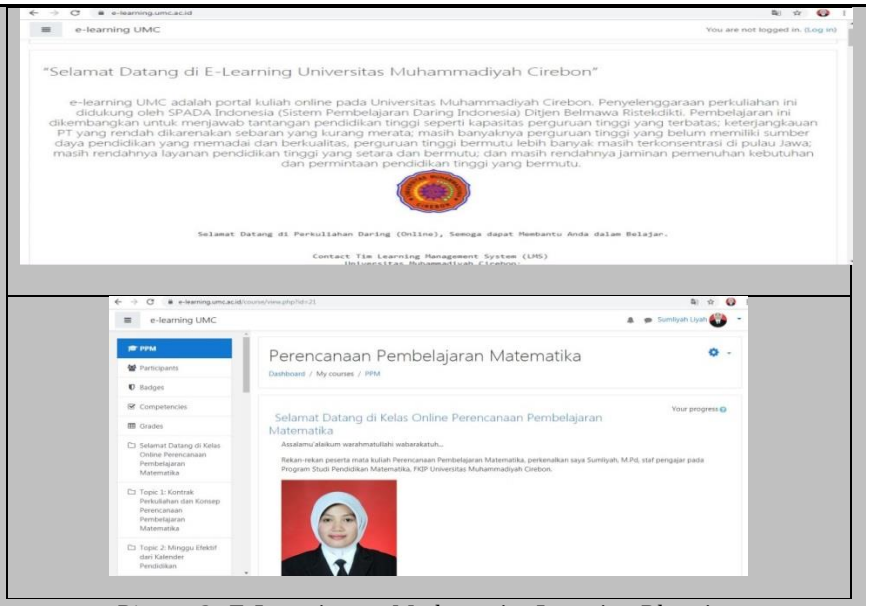
The term blended learning has long been popular and used by teachers in developed countries to support innovative learning, in Indonesia, Blended learning as a learning model at the school level has not been popular among educators so it is still not widely used in learning. One of the causes is due to several factors, including learning support facilities and there are still not many studies that discuss Blended learning in detail from theory to application. The application of blended learning at schools and universities often experiences misconceptions because traditional face-to-face learning in classrooms using technology media is often regarded as blended learning.

Kurtusstates that blended learning is a mixture of various learning strategies and delivery methods that will optimize the learning experience for its users [16]. Implementation of this strategy allows the use of online learning resources, especially those based on web / blog, without leaving face-to-face activities [17]. From the above definition, blended learning places more emphasis on combining / uniting conventional learning models (face-to-face) with e-learning models[18].

Midterm exam results become a very clear view, because of limit time in class and lecture meetings, in each meeting have an impact on the results obtained. Mathematics planning courses require in applying and practicing because as mathematics student teacher requires to be able to create or arrange applicable learning devices according to curriculum demands. One of the right learning methods to overcome these problems is that through blended learning model presents effective learning innovations[19]. Time limitations will not be a problem because there is a lot of space and time that students use to study, discuss and complete assignments. The following Table 4 illustrates the learning activities of blended learning:

Table 4.*Blended Learning activity*

Steps	**The Implemetation of Blended Learning The innovation of learning devices**
1. Creatingan Account	Account was created by the development team. The account created were the account of lecturers supporting online courses and online student participants for 11 students with their registration number as username and password each.



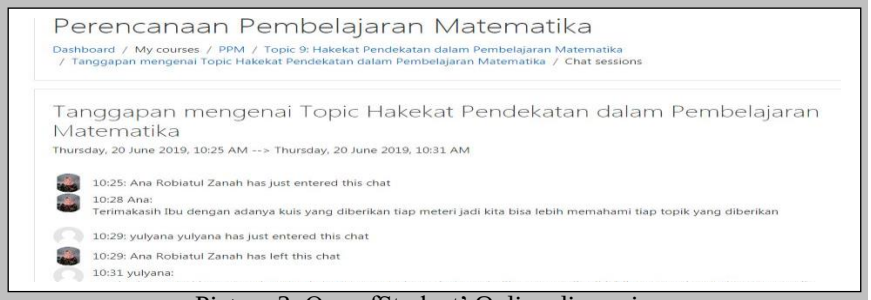
Picture 2: *E-Learning on Mathematics Learning Planning course*

2. Uploadinganddownloadingthe material

Material uploading was carried out by lecturers as facilitators of the online learning. The material uploaded was in the form of modules, presentation slides and learning videos. While downloading material was done by students as online participants, so students can learn the material that has or will be studied.

***3. Online*Discussion**

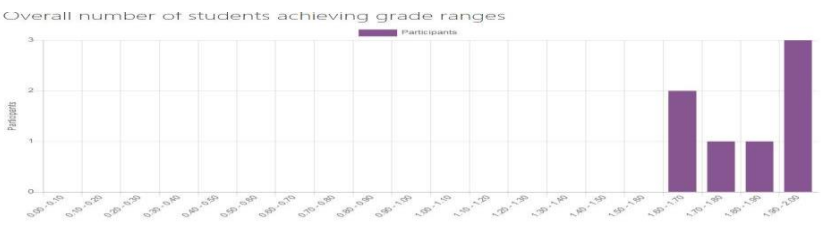
Online discussion involved the lecturers and online student participants. It used the discussion forum feature. In this activity, students were asked to actively discuss as if they were in direct conversation. In practice, students felt enthusiastic so that the discussion between lecturers and students ran actively and smoothly.



Picture 3: One ofStudent' Online discussion

3. Doing the quiz

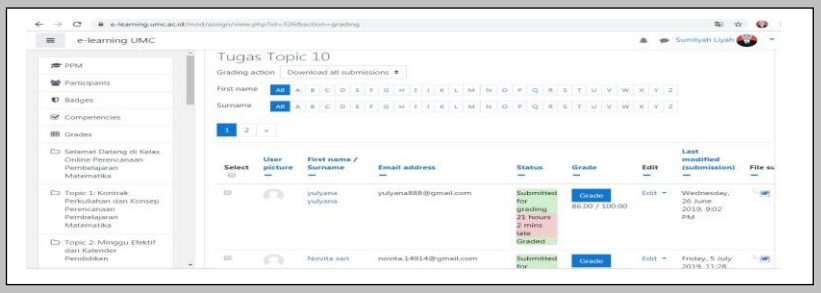
Quiz was done as an assessment of each final topic. Each online student must work on quiz individually. Forms of questions were made in the form of essay and completing. At the beginning of the quiz, online participants were not used to do it so that they got low score. But through the time, students began to get used to and the score obtained were getting better.



Picture 4: The Example of Students' Quiz Result

4. Doing the task

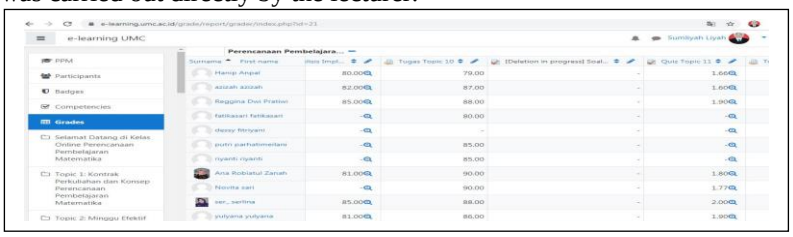
In addition to working on quiz, online student participants were assigned online task. The tasks were done individualy and grouply that must be submitted in the form of .doc, .pdf, and .ppt.



Picture 5: The Example of Students' Task Result

5. Assessing Task and Exam

Assessment was done to assess final task and exam (mid term test and final test), while the lecturer should recap the final results. Whereas mid term test and final test were held in a face-to-face meeting so that the assessment was carried out directly by the lecturer.



Picture 6: Students' Task Result

b. Product Innovation Improvement of Lesson Plan Device Test

N-gain test result was to determine pre-test and post-test improvement by using the normalized gain or n-gain test. The results of pre-test and post-test innovations in constructing and making the lesson plans are presented in table 5 as follows:

Table 5.The recapitulation of pre-test and post-test
Through Blended Learning model

No	Students	Pre-Test	Post-test	N-Gain Result	Interprestation
1	M-01	46	92.0	0.85	High
2	M-02	50	86.4	0.73	High
3	M-03	50	78.4	0.57	Medium
4	M-04	56	88.6	0.74	High
5	M-05	45	90.9	0.83	High
6	M-06	66	87.5	0.63	Medium
7	M-07	37	79.5	0.68	Medium
8	M-08	35	88.6	0.83	High
9	M-09	30	87.5	0.82	High
10	M-10	45	90.9	0.83	High
11	M-11	60	93.2	0.83	High
	Average	47.27	87.60	0.76	High
	Standard Deviation	4,75	10,5	0,09	

In the diagram above that the average of post-test was 87.60 and pre-test 47.27 so that a significant improvement was seen from the results of the pre-test and post-test portfolio. N-Gain obtained by students' post-test was 87.6 this shows that the learning device can be used as an example for other teachers with a standard deviation of 47.5. Whereas the pre-test was 47.3 which meant that there was a need for assisstingin constructing the learning devices with a standard deviation of 0.19. In general it can be seen that the average post-test score of N-Gain score of 0.76 with the criterion of improvement "high" in the class that has been given treatment was biggerthan in the untreated class of 40.3.

c. The Improvement of Silabus Development Innovation Test

N-gain test was to determine the results of pre-test and post-test improvement using the normalized gain or n-gain test. The results of the pre-test and post-test innovation syllabus development are presented in table 7 as follows:

Table 7. Pre-test and Post-Test Recapitulation of Silabus Development innovation Through Blended Learning Model

No	Students	Pre Test	Post test	N-Gain Result	Interpretation
1	M-01	30	90	0.86	High
2	M-02	35	70	0.54	Medium
3	M-03	50	95	0.90	High
4	M-04	56	80	0.55	Medium
5	M-05	55	90	0.78	High
6	M-06	66	80	0.41	Medium
7	M-07	65	90	0.71	High
8	M-08	54	80	0.57	Medium
9	M-09	34	90	0.85	High
10	M-10	40	90	0.83	High
11	M-11	43	90	0.82	High
	Average	48.00	85.91	0.71	High
	Standard Deviation	12.43	7.35	0.17	

Based on the picture above, the average post-test of syllabus development was 85.91 and pre-test 48.00 so that there was a significant improvement in the pre-test and post-test portfolio results. N-Gain results of students' posttest 85.91, it shows that the syllabus learning device can be used as an example for other teachers with a standard deviation of 47.5. Whereas the pre-test was 48.00 which meant that there was a need for assissting in constructing the syllabus learning devices with a standard deviation of 12.43. In general it can be seen that the acquisition of post-test score in the class that has been giventreatment produced N Gain bigger than 37.91 than the acquisition of N-Gain score of 0.71 with the criteria of high improvement than in the class that has not been given treatment.

d. The Analysis of Learning Response Questionnaire

Based on the results of the study, students who learn through blended learning model obtained a questionnaire score of 85.91%. The results illustrated that the learning model of blended learning provided a very strong and significant response to increase student responses. It means thatthe improvementof student response was triggered by the use of blended learning models. Based on the researchers' observations during the learning process, generally reflected the activity in accordance with the characteristics of blended learning model. Students who learn

by using blended learning model have better activities and innovations compared to students who learn conventionally. This is in contrast with the study conducted by Septina that the student of SMKN 7 yogyakarta felt hard to explain the use of e learning [20].

4 Conclusion

Based on the results of research and analysis of the learning portfolio innovation (syllabus and Lesson plan) it can be concluded that there was an improvement in the innovation product of learning devices. The results of the analysis of learning devicesreveal that there was the improvement of lesson plan innovation and syllabus development with high criteria and it was suitable to use and serve as a reference for teachers in developing learning devices and produce high learning responses from students as positive responses to innovative learning by using blended learning model.

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