Development of assessment instruments to measure quality of MOOC-Platform in engineering mathematics 1 course

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Abstract. Industry Revolutionary Era 4.0 requires changes in the organization of learning. Learning is implemented without any concept of time and space. Engineering Mathematics 1 Course has developed MOOC Platform. The aim of this research is to develop assessment instrument and to measure quality of the platform. This assessment instrument is developed by using Plomp Model. Plomp Model consists of five phases, they are; the design phase; the construction phase; test, evaluation, and revision phase; the implementation phase. There are 20 items in this assessment instrument. The 20 items were divided in three indicators. Validation has done by 3 experts. Then the instruments were given to 100 students. Results from this research consist of 8 items which are valid and reliable. Value of reliability is questionable.

1. Introduction

George Siemens organized a course at the University of prince Edward Island. It was the first MOOC which articulated by Manager of Web Communications and Innovations in a Course organized. MOOC (Massive Open Online Course) is a massive open learning system in the form of an online course to allow participants enjoy unlimited and it can be accessed via the web [1]. In Australia advanced technology gives some influences on the way people create, share, use, and develop information in society [2]. Moreover, in developed countries have implemented learning Massive Open Online Courses (MOOC) for a long time, where learning in Indonesia also continue to evolve in the direction of MOOC. That is occurred because Indonesia has a large population, and to encourage equitable education and training to the community. Besides the Industrial Revolution Era 4.0 require changes in learning systems into blended learning [3]. In Blended learning, students get experience in outdoor education and learning time management [4].

Mathematics Engineering 1 Course is a subject in Mechanical Engineering Program Study. The teaching and learning processes in Engineering Mathematics 1 course still use direct learning in the whole meeting. Then it need to develop MOOC Platform especially in vectors, functions, differential, and applications differential. Results of this research, 98% of students use the Internet as a medium of learning, 82% of students study materials or task via youtube or video, 59% of students study the teaching material to the article as a pdf or word, as much as 72% of students prefer to online learning than traditional learning, and 51% students believe online learning is more effective and efficient [5]. Moreover Engineering Mathematics 1 course will change in MOOC for some topics. The change of course began with the development process of the learning device includes planning in Lesson Plans, MOOC-Platform, and assessment instruments.

Learning device is a set of teaching preparation tools which includes Lesson Plan, instructional media, until the process of assessment of learning through questions [6-7]. There are some useful
things when developing a learning device, they are purpose of learning, teaching materials, teaching methods. Then it was developed methods or learning strategies, tools or media in teaching, learning and evaluation resources [8]. One of the learning device that is a lesson plan. Lesson Plan is the responsibility of educators to improve the quality of learning [9]. Development of the device first MOOC-based learning is the development of lesson plans. Development of this lesson plan refers to several things: the level of difficulty of understanding the material at state Polytechnic students and interactive learning model. The difficultiest topics of Mathematics Engineering 1 Course is vectors, matrices, differential, and application of differential. The MOOC-Platform developed must be able to improve the quality of learning on difficult topics.

MOOC is shortened from Massive Open Online Course. Every word has meaning which can used for indicator quality of MOOC-Platform. The word “Massive” means the large number of user who use this online educational platform. Then the word “Open” represents anyone can participant in the course on the platform. The second O is Online. It means online teaching through the internet, and Course means the participant can learn topics of MOOC [10]. In addition, the credibility of presentation in MOOC is also positively correlated to student confidence in MOOC [11]. So the credibility of presentation is also an important factor in determining the quality of the MOOC. Measurement of the quality of MOOC especially the MOOC platform is very important, such as instructional design and available technology [12].

2. Research Method
This research method uses Plomp Model [13-14]. Plomp Model has chosen for this research because it can be used to develop some of the learning device.

2.1. Preliminary investigation phase
In this phase, it gives information about the lecturers still teach with direct learning. Then MOOC-Platform has being develop in this year. It facilitate interaction between students and lectures. Moreover, in this phase is to set boundaries, namely the development of the development of assessment instruments to measure the quality of MOOC-Platform. The assessment instruments must be developed in accordance with the aim of making MOOC in Engineering Mathematics 1 Course.

2.2. Design phase
From the information obtained in the phase of preliminary investigations, the assessment instruments must be developed to measure quality platform. The development of assessment instrument consist of three indicators namely display quality, ease of use, and the effect of using MOOC for students.

2.3 Construction phase
Some of the activities carried out in this phase are described as follows.

2.3.1 Creating a validation sheet for assessment instruments. Validator validation sheet made in 3 validation. They are construct validity, content validity, and face validity. The validation process was done by 3 validators. The validator comes from other universities who understand the development of learning tools of MOOC-Platform in Engineering Mathematics 1 Course.

2.3.2 Develop a questionnaire as assessment instruments. This stage is to develop a questionnaire filled out by the students. The questionnaire consisted of three indicators. They are display quality, ease of use, and the effect of using MOOC. Then indicators of display quality have three sub indicators. Moreover, sub indicator in ease of use is accessibility and material convenience. Afterwards, the effect of using MOOC indicator become efficiency and learning motivation. The questionnaire was designed by likert scale in positive or negative sentences. It is consist of four answers. In the positive sentence is given 1 for strongly disagree, 2 for disagree, 3 for agree, and 4 for strongly agree. Other, in the negative sentence is given 1 for strongly agree, 2 for agree, 3 for disagree, and 4 for strongly disagree [15].
2.4 Test, Evaluation, Revision Phase
Test, evaluation, and revision phase is the continuation of the construction phase. Some of the activities carried out in this phase are as follows:

2.4.1 Validate the questionnaire. Perform validation provided the validation sheet to expert / lecturer in Mathematics Education Department in Science and Mathematics and Education Faculty. There are 3 experts. It validated the questionnaire which devided in three validation.

2.4.2 Perform analysis validation sheet. Analyzing the data obtained from the validation result sheet to the experts (mathematics and mathematics education faculty). This was followed by revising the questionnaire.

2.4.3 Perform analysis questionnaire. Questionnaire have been distributed in students. Then it was analyzed in the validity and reliability at first [16]. Analyzing data from questionnaires was distributed 2 times at one hundred students in three program study. They are Manufacturing Ship Engineering, and Livestock Products Processing Technology Program, Management Bussiness Tourism Program.

Interval of Reliability
\[ \alpha = \left[ \frac{n}{n-1} \right] \left[ 1 - \frac{\sum_{i=1}^{n} \sigma_i^2}{\sigma_X^2} \right] \]  \hspace{1cm} (1)

where \( \alpha \) is a lower-bound estimate of the true reliability, \( n \) is the number of items in test \( X \), \( \sigma_X \) is the observed score variance of test \( X \), and \( \sigma_i \) is the variance of item \( i \). The criteria of interpreting an internal consistency reliability coefficient of an instrument are presented in Table 1.

| \( \alpha \) | Interpretation |
|------------|---------------|
| \( \alpha < 0.5 \) | Unacceptable |
| \( 0.5 \leq \alpha < 0.6 \) | Poor |
| \( 0.6 \leq \alpha < 0.7 \) | Questionable |
| \( 0.7 \leq \alpha < 0.8 \) | Acceptable |
| \( 0.8 \leq \alpha < 0.9 \) | Good |
| \( \alpha \geq 0.9 \) | Excellent |

2.5 Implementation phase
Conclusions from the evaluation and revision were done, so it get a questionnaire which can be used measure the MOOC-Platform of Engineering Mathematics 1 Course. Online Platform of Engineering Mathematics 1 Course must be valid and reliable or it must be fixed.

3. Results and Discussion

3.1 Design Phase
The process of attention to several things. The first is to design a validation instrument for experts consisting of 4 questions. Each question reflects contract validation, content validation, and face validation. Then the second step describes indicators into sub-indicators. Each sub indicator is then given a clue as a measure. The division of indicators can be seen in Table 1.
Table 2. Sub Indicators of Each Indicators

| Indicator               | Sub Indicator       | Addition  |
|------------------------|---------------------|-----------|
| Display Quality        | Picture             | Design    |
|                        | Sound               | Tutor     |
|                        | Illustration        | Media     |
| Ease of Use            | Accessibility       | Open      |
|                        | Material Convenience| Structural|
| Effect of Using MOOC   | Efficiency          | Time      |
|                        | Learning Motivation | Learning Interest |

3.2 Result of Construction Phase

In Construction Phase, after the classification of clue of each sub indicator, it will make sentence of the sub indicator. It is needed to be undertaken distributing questionnaires to students, learners can provide input to the MOOC-Platform assessment instruments in Engineering Mathematics 1. Distribution of the questionnaire subindicators and point statement can be seen in Table 3.

Table 3. Item Division of Student Questionnaire Based Sub Indicators

| Sub Indicator       | Item number |
|---------------------|-------------|
| Picture             | 1, 5        |
| Sound               | 2, 4        |
| Illustration        | 7, 10       |
| Accessibility       | 3, 6, 12, 16|
| Material Convenience| 8, 9, 14, 15, 17, 20|
| Efficiency          | 18, 19      |
| Learning Motivation | 11, 13      |

3.3 Test, Evaluation and Revision Phase

Assessment Instruments validation process were performed by 3 experts with two validation. After the first validation, it was repaired then it do a second validation. Construct validity is to degree to which an instruments measures the trait or theoretical construct that it is intended to measure [17]. Content validity represents propriety of content and face validity represent estimation regarding the clarity of the purpose of an instrument [18]. Average validation in Assessment Instrument performed by 3 experts in each aspect can be seen in Table 4.

Table 4. Average Value Expert Validation Results I and II

| Aspect         | Average Value Validation I | Average Value Validation II |
|----------------|----------------------------|----------------------------|
| Construct Validity | 3,33                       | 4                          |
| Content Validity    | 3,33                       | 3,67                       |
| Face Validity       | 2,67                       | 3                          |

Table 4 showed the questionnaire is very good in validity construct, good in content validity, and enough good in face validity. Afterwards the questionnaire were distributed to one hundred students. The aim of this step is measure the validity and reliability of questionnaire (assessment instruments) to measure quality MOOC-Platform. The invalid sentences will not used in the assessment instruments.
But it needs attention that the questionnaire must have all indicators that reflect the quality of the performance MOOC-paltform. The next step of development MOOC-platform assessment instrument is measure the reliability. Reliability refers to a measurement that supplies consistent result with equal values. It measures precision, repeatability, consistency and trustworthiness of a research [18]. The reliability was conducted by distributing questionnaires. The result of reliability questionnaires are illustrated by cronbach’s alpha value. Questionnaires were distributed to the three programs with the total number of students as many as 100 student. Then the reliable items were tested again in Readility Test. The result of Validity and Reliability can be seen in Table 5.

| Items | Cronbach ‘s Alpha if Item Deleted | Cronbach ‘s Alpha | Reliability | Sub Indicator |
|-------|---------------------------------|------------------|-------------|---------------|
| Number 1 | 0.609 | 0.624 | Reliable | Picture |
| Number 4 | 0.620 | 0.624 | Reliable | Sound |
| Number 7 | 0.622 | 0.624 | Reliable | Illustration |
| Number 11 | 0.581 | 0.624 | Reliable | Learning Motivation |
| Number 12 | 0.568 | 0.624 | Reliable | Accessibillity |
| Number 13 | 0.573 | 0.624 | Reliable | Learning Motivation |
| Number 14 | 0.569 | 0.624 | Reliable | Material Convenience |
| Number 18 | 0.588 | 0.624 | Reliable | Efficiency |

In Table 5 can be seen all sentences are reliable. The Cronbach’s Alpha value is 0.624. The interpretation of its value is questionable. There are eight sentences in development assessment instruments to measure quality MOOC-Platform. They are number 1 in picture sub indicator, number 4 in sound sub indicator, number 7 in illustration sub indicator, number 11 in accessibility sub indicator, number 12 in accessibility sub indicator, number 14 in material convenience sub indicator, number 18 in efficiency sub indicator.

4. Conclusion
This research is the development research. The product is a assessment instruments to measure quality of MOOC Platform in Mathematics. In engineering Mathematics 1 Course, In creating the assessment instruments must be through validity and reliability test. There are 2 validity in this research from experts and from students. Moreover there are three reliability test which have value of Cronbach’s Alpha 0.624.

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