



DEVELOPING MATHEMATICS CONTENT KNOWLEDGE TEST IN LMS MOODLE

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ABSTRACT

The development of the effective and efficient test for measuring mathematics content knowledge for pre-service teacher is very necessary. This study is a development research, which is purposed to produce the development products of mathematics online content knowledge test for pre-service mathematics teachers, developed in Moodle. Respondents are 100 mathematics college final-year students (pre-service teacher) at Institut Agama Islam Negeri Syekh Nurjati Cirebon, in Province of Central Java, Indonesia. The results of this study are: 1) Moodle with its distinctive features in test development and management has been able easily to fulfill the need to develop and conduct the online tests of mathematics content knowledge. 2) The moodle provides features to develop random questions, feedback, grading, summary, timers, report the results of test, recordings, export and if needed even up to item analysis available.

Keyword: Moodle, Content Knowledge, Online Test

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1. INTRODUCTION

One of the successful learning of pre-service mathematics teacher students can be seen from student mastery of all the material taught by the lecturer and student completeness when given a test or assessment in learning. The test in this case serves as a tool to measure the cognitive abilities of mathematics student knowledge content and also simultaneously measure the success of teaching programs for pre-service mathematics teachers.

The role of the test as an important part from the learning process to measure mathematics in student knowledge content cannot be underestimated. Preparation, development, presentation up to the processing of test results and assessments requires special attention and a lot of time-consuming so that it is often a separate obstacle for lecturers in improving the quality of learning.

Therefore, the right solution is needed for these problems in order to obtain an effective and efficient mathematical test for both the preparation by the lecturer and its use by students.

One alternative in overcoming the problem of math tests is to develop mathematical tests in based *e-learning* using internet technology. The development based on *e-learning* offers a variety of alternatives to the preparation of tests and presentations online. Various features of excellence are offered, ranging from various types of tests, ease of compiling question and answer material, question bank, import of material and images, setting the time limit for the execution of questions, to scrambling questions and answers to avoid cheating by test participants.

One of the development of math tests *online* based *e-learning* is the making of test products with the help of software called the Moodle Learning Management System (LMS). *Moodle* is an application used to develop *e-learning* online. *Moodle*, a name that stands for *Modular Object Oriented Dynamic Learning Environment*, is a software for creating questions, quizzes, or online tests. In its use, this software is very familiar and easy to operate so it does not require programming language skills to operate it. With *moodle*, researchers can arrange various forms of questions and have different levels, ranging from the form of *multiple choice questions*, true/false, matching, filling in in the blank and others.

Content knowledge is one of the important aspects of competence that must be mastered by the teacher. Kilian (2018) asserts that CK is a prerequisite for teaching. Dreher, et. al (2018) explain that content knowledge (CK) is a teacher's knowledge of the subject matter that they must learn or teach.

According to Beckmann (2010), the material that mathematics teachers in secondary schools must master includes numbers and their operations, geometry and measurements, algebra and number theory, statistics and probability, introduction to calculus, discrete mathematics, and history of mathematics. Tay, et. al (2017), assert that the mathematical content that professional mathematics teachers must master includes numbers and their operations, functions, algebra, calculus, geometry, statistics and probability, and discrete mathematics.

Every pre-service teacher student needs to be tested first for their mastery of *content knowledge* according to their field of expertise. The problem is that until now there are still limited availability of knowledge content assessment instruments in almost all subject areas. At present there are indeed pedagogical competency test instruments, but these instruments tend to measure pedagogic competence in general, not yet associated with content knowledge of certain material.

This study aims to produce the development products of *mathematics online content knowledge test* for pre-service mathematics teachers. The development of content knowledge is needed given the importance of content knowledge for pre-service mathematics teachers before becoming a real math teacher. This is in line with the statement of (Ball, Thames, & Phelps 2008; Rowland & Ruthven, 2011) which says that content knowledge is one of the key competencies for mathematics teachers. The inability of mathematics teachers in terms of content knowledge can inhibit the knowledge transfer process to students. While online content knowledge development is in line with the development and transformation of digital-based education that is currently growing. The content knowledge online test developed in this study is expected to be useful for college mathematics teacher training in order to map the readiness of pre-service graduates before entering the real world of work as a teacher.

2 RESEARCH METHOD

This research uses a development method with the aim of producing development products *mathematics online content knowledge test* for preservice mathematics teachers. The test development phase in this study includes: 1) preparation of questions, consisting of determining objectives, analyzing competency of pre-service teachers, compiling grids, compiling questions, expert review, and post-review revisions, 2) uploading questions online, 3) test trials and 4) analysis of results. The experts involved in the study of this matter were mathematical education experts (3 people) and experts on instrument development (2 people). The subjects of the trial were the seventh semester students of the 100 mathematics teacher candidates at IAIN Syekh Nurjati Cirebon. The results of the test data conducted at the trial stage are then downloaded from the presentation features available on moodle.

Preparation and development of the problem of *content knowledge* in this study using the moodle application. The feature in *moodle* used in compiling questions is Quiz. Quiz can be in the form of exercises or tests in *moodle*. There are several types of quizzes in moodle, including quizzes matching, short essays, free essays, multiple choices and true-false. (Riyanto, 2012: 51). In this study, the type of quiz presented is multiple choice by arranging the appearance of questions and answers randomly, duration of access and length of time spent on quiz work.

3. RESULTS AND DISCUSSION

Result of the study are presented based on the purpose of the research which is to produce development products in the form of *mathematics content knowledge test* online for pre-service mathematics teacher. The test to measure *mathematics content knowledge* is based on competency standards that must be mastered by pre-service mathematics teacher students, including in Table 1. Based on the competency target, 25 multiple choice questions were then made. Details of competencies and number of items are presented in Table 1.

Table 1. Competencies and Number of Items.

No	Competencies	Number of Items
1.	Using numbers, relationships between numbers, various number systems and number theory.	4
2.	Using mathematical logic	2
3.	Using the concept of geometry.	2
4.	Using statistical concepts and probabilities.	3
5.	Using pattern and function	3
6.	Using algebraic concept.	5
7.	Using the concepts of calculus and analytic geometry	1
9.	Using trigonometry concept	2
10.	Using the concepts of vectors and matrices.	1
11.	Using the concept of set	1
12.	Using social arithmetic	1
Total		25

After the question is made, the question is then reviewed by pure mathematicians (1 person), experts mathematics education (2 people) and instrument development experts (2 people). Review was carried out on all three aspects of material, construction, and language. The experts were asked to give views on the items that had been made, and provide input. After the questions are reviewed by competent and improved experts based on their inputs, the questions are then uploaded online through moodle. The making of questions in moodle includes several stages, starting with making course as quiz, followed by making questions that will be stored in the question bank, and make the question settings as needed. These are shown in Figure 1 to Figure 7.

▼ Timing

Open the quiz 3 December 2018 13 24 Enable

Close the quiz 31 December 2018 13 24 Enable

Time limit 60 minutes Enable

When time expires Open attempts are submitted automatically

Submission grace period 1 days Enable

Figure 1 Timing of quiz moodle

Sets the time interval for participants to take the test / test and takes the length of time the exam takes place.

▼ Grade

Grade category Uncategorised

Grade to pass 7

Attempts allowed Unlimited

Grading method Highest grade

Figure 2 The Grade Setting

Set the minimum grade limit, set the number of times the participant can take the test / set, the biggest, smallest or average score.

▼ Layout

New page Every question

Navigation method Free

[Show less...](#)

Figure 3 Layout question settings

Set display, whether all questions are displayed on one page or several questions appear on one page. Navigation method to allow you to return to the previous question or not be allowed.

▼ Question behaviour

Shuffle within questions Yes

How questions behave Deferred feedback

Allow redo within an attempt No

Each attempt builds on the last No

[Show less...](#)

Figure 4 Question behavior settings for a test

Figure 5 Settings Review options quiz

Review options test results, whether the system provides feedback when the test takes place was complete. Bringing up the key and discussion of the test, or after the test. Allow feedback when the test takes place or wait until it's finished.

Figure 6 Random question settings

or random questions from available question banks. Admin can manage the number of questions that are randomized to be done by participants so that each participant does not get the same question.

Figure 7 Settings what to include in the report.

Student can take the test, have not tested, have already been tested and not taken the test.

Figure 8 Download Table data

Download all test results for various forms of file extensions such as CSV, Xlsx, HTML, Jones and OSS.

	First name / Surname	Email address	State	Started on	Completed	Time taken	Grade/10.00	Q.1 /0.40	Q.2 /0.40	Q.3 /0.40
	Rani Octav Review attempt	ranioctav24@gmail.com	Finished	18 December 2018 10:29 AM	18 December 2018 11:29 AM	1 hour	3.60	✗ 0.00	✗ 0.00	✗ 0.00
	Ika Ika Review attempt	ranioctav24@gmail.com	Finished	18 December 2018 10:30 AM	18 December 2018 11:30 AM	1 hour	3.60	✗ 0.00	✗ 0.00	✗ 0.00
	Yomi Rosmina Review attempt	yomirrosmina24@gmail.com	Finished	18 December 2018 10:30 AM	18 December 2018 11:30 AM	1 hour	4.00	✓ 0.40	✗ 0.00	✗ 0.00

Figure 9 Review attempts Displaying

The results of each participant's test, including the start time of the exam, the duration of the exam, the duration of the participant exam, the participant's ranking / score for each question for all participants displayed by moodle.

Response history				
Step	Time	Action	State	Marks
1	18/12/18, 10:30	Started	Not yet answered	
2	18/12/18, 10:40	Saved: 64	Answer saved	
3	18/12/18, 11:13	Saved: 48	Answer saved	
4	18/12/18, 11:30	Attempt finished	Incorrect	0.00

Figure 10 The response history question

Admin can find out student activities in answering test questions. Moodle records changes in student answers and their time. This data can be used for deepening problem analysis.

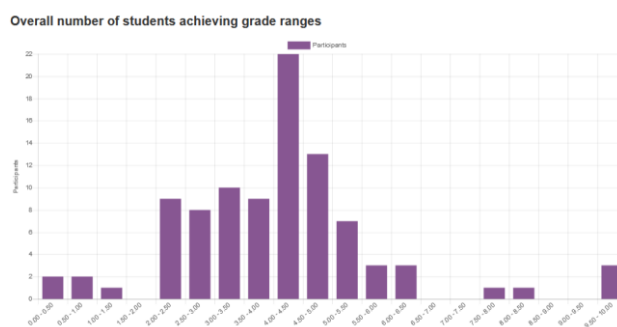


Figure 11 Histogram of graders '

Mode charts taken from participants' test results data. The admin can directly see the mode of the entire participant and analyze the desired.

3.1. Discussion

The preparation of *content knowledge online tests* e-learning based on moodle is one of excitement and breakthrough in the development of testing. The existence of computers as a technology product is utilized in connection with the emergence of e-learning models (Prawiradilaga, 2016: 1). The Moodle Team has put together a variety of facilities that allow us to create a variety of tests with ease, many of them automatically and with instant feedback, making Moodle Quiz to become a very useful tool.

This research has succeeded in compiling 25 items of mathematics content knowledge which are presented online using moodle. Based on the results of the study, it was found that moodle is an appropriate LMS used in the preparation and implementation of online tests. By using Moodle, we can implement that types of questions, such as calculated, embedded answer, essay, matching, multiple choice, numerical, short answer and true/false questions. (Paturusi, et.al, 2014: 12)

Moodle provides various forms of the question and can make the question settings as needed. This is in line with Dvorak (2011) statement which says that Moodle provides a way to set up the quiz content that asks the quiz maker to choose settings and make parameters so that students can interact with the quiz. The parameters consist of: timing, the grade setting, layout question settings, question behaviour settings, settings review options quiz, random question settings and settings what to include in the report.

One of the excellent parameters that can be explained is the arrangement of items both random questions and answers. This is in line with Bogdanovic's statement (2015: 7) which states that when creating a test, the Moodle option can be used to arrange random questions taken from the database. This study provides 25 items. Each test participant got a random question display that was different from the other test participants. This greatly minimizes cheating that can be done by participants.

Moodle also can provide the information about the student that take the test, have not tested, have already been tested and not taken the test. This can be an input to further investigate about the reasons students do so.

After the test, Moodle has the facility to see the test results that can be downloaded into the various forms of file extensions such as CSV, Xlsx, HTML, Jones and OSS. In addition, Admin can find out the student activities in answering test questions. Moodle records changes in student answers and their time. This data can be used for deepening problem analysis.

Result about the number of students who reach the range of mathematics content knowledge can be obtained in the form of bar charts. These charts present several ranges and frequencies of student exam scores. This is in line with Riyanto (2018:305) statement which says, in moodle, administrators can see the mode and score distribution of student exam results that are used as data as well as information needed.

Overall of the result, moodle has prepared a recapitulation of the answers and the results of the student examination. It will show the length of the exam, the date and time of starting the exam, the test score, and the results of scoring of each question and give a sign of the right and wrong answers. Administrators can easily monitor the results of tests conducted by all students. Administrators also easily save to a computer the results of an online evaluation recapitulation.

Additional result of the test participants directly as well as the answer statistics to find out how many students answered correctly, who answered certain options, and so on. It is in line with Singh (2015: 15) statements that moodle has a terrific facility for providing students rapid feedback on their performance and for measuring their understanding. An online gradereport can provide students' current information about their performances in course. Online grades can also help you comply with new privacy rules that prohibit posting grades with personal identifiers in public places.

Moodle's numerous facilities are very valuable for managing test results. They have been able easily to fulfill the need to develop and conduct the online tests of mathematics content knowledge for student pre-service mathematics teachers. Demands to design the quality tests, objective and avoid the cheating are fulfilled by arranging the types of questions, storing questions, processing time, setting the score level, layout the display of questions, and question behavior. The design of this test produces a quality test according to the conditions encountered and the characteristics of the tests needed. The implementation of the test is regulated automatically by the system in accordance with the design. The results are presented in full with a variety of analyzes that are very needed to assess students' abilities and for diagnostic needs as an effort to improve learning.

Transparency of the results and automatic calculation of valuations in moodle also have their own good value. The test participant can also directly know the results after the test is finished. This is in line with Henrick and Holland's view (2015: 2) that teacher can easily trace student progress through the content and activities of the course, and students can monitor their own progress, to where they understand and what has not been achieved. Students can find out how many items were answered correctly, how many items were answered incorrectly, and how many scores he could get. Shortly, moodle can make participants knowing the level of success or failure in taking the test.

The various advantages of moodle by offering convenience to users encourage an increase in wider use in the implementation of learning assessment. This is in line with Rice's view (2008: 192) which states that a moodle can be an effective combination of instruction and assessment. This is confirmed also with Danver (2016:774) which states that moodle proposes very sophisticated functionality in assesment and testing. It can make moodle as a comprehensive and powerful test management system that has no doubt about the ability, especially to measure the content knowledge of mathematics preservice teacher.

4. CONCLUSIONS AND SUGGESTIONS

The results of this study provide the following conclusions:

- a. Moodle with its distinctive features in test development and management has been able easily to fulfill the need to develop and conduct the online tests of mathematics content knowledge.
- b. The moodle provides *features to develop random questions, feedback, grading, summary, timers*, report the results of test, recordings, export and and if needed even up to item analysis available.

Based on these results further formulated some suggestions as follows:

- a. The form of questions in the moodle test to measure mathematics content knowledge can be changed to other forms, not just in multiple choices. It can be correct or false, match, or other forms of testing.
- b. There are still more facilities in moodle that can still be explored, both in the design, implementation, and reporting of test results, in addition to those used in this article. Use them to get more useful and optimal results.

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