

Developing The Teaching Module Of Initial Values And Boundary Problems For Students Of Mathematics Education Program

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Abstract

This research was a developing research based on Tessmer's stages, but until at Small Group stage only, which were: Self Evaluation, Expert Review, One-to-One Evaluation, and Small Group. This research was held at Mathematics Education Programme of FKIP Unsri in Indralaya and in Palembang as well. The aim of this research was to produce a teaching module of the course, Masalah Nilai Awal dan Syarat Batas, which was valid and practical. At the end of the research the teaching module was finally produced.

Key Words: Initial values and boundary problems

I. INTRODUCTION

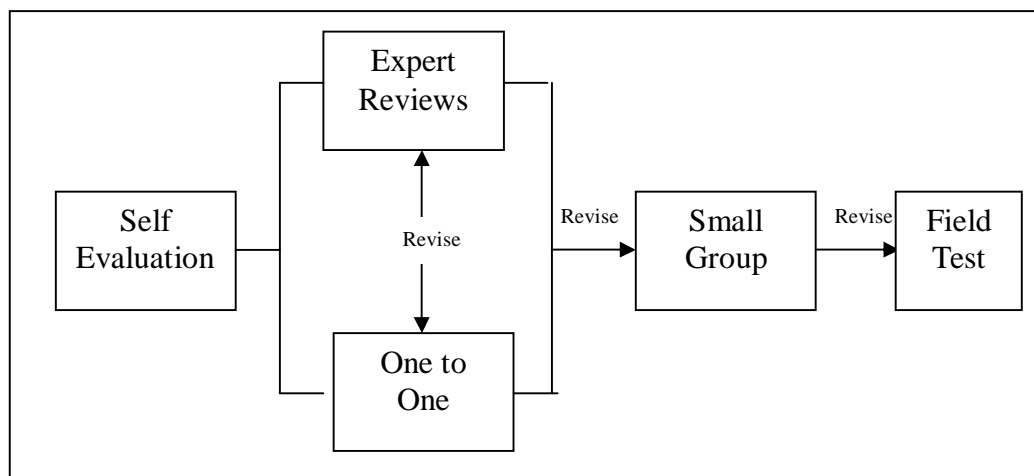
The government has already decided the minimum standard achievements of education for every education level, which are (1) standard of contents, (2) standard of competency of graduations, (3) standard of process, (4) standard of educators, (5) standard of facilities, (6) standard of management, (7) standard of funding, and (8) standard of evaluation of education. At a university level, the standard of process requires lectures to develop syllabus and lesson plans. One important element of syllabus is a teaching module, which means that a lecture is supposed to develop teaching modules as the source of teaching and learning activities. A teaching module would be better if it is appropriate to characteristic of learners in order to achieve optimal aims of teaching and learning.

Masalah Nilai Awal dan Syarat Batas (Initial Value and Boundary Problems) is a compulsory course for students of mathematics education program. The reason of developing a teaching module of the course was because the source of teaching and learning of the course was only an English text book, but not all topics was used in lesson plans, and the use of the text book was not effective enough. The aims of developing the teaching module were to provide an alternative teaching material, which is suitable for curriculum and student's needs, and also appropriate to characteristic and

social neighbourhood of learners; and also to help lectures to teach. Meanwhile the benefit of developing the teaching material were (1) availability of alternatives of teaching source; (2) richness of references of the teaching module; (3) improvement of lecturer's skill in writing a teaching material; (4) growth of teaching-learning communication which is effective to help students more confident and independent. A teaching module at least should consist of lists of instructions to use, targets of competency, contents, supporting information, exercise questions. A good teaching module should display its contents by an elegant structure of language, and illustrations.

II. RESEARCH METHOD

This research was a kind of development research with evaluation using formative research to produce a teaching module of a course, Masalah Nilai Awal dan Syarat Batas, to use in teaching students of mathematics education program at FKIP Unsri. Tessmer's steps were used in this research.



Picture 1. Tessmer's Steps.

Tessmer's steps can classify in to steps, which are:

1) Self Evaluation

This step consists of analysis and design steps. Analysis step is the first starting point in development research. In this step the researcher analyzed the curriculum, contents, and literatures, which should appropriate to the curriculum of mathematics education program of FKIP Unsri. Students' characteristic was also analyzed in this step. The products of this step were

syllabus, lesson plans and instruments of evaluation. Meanwhile in the design step, the products were a prototype of the teaching module, which was designed and focused based on three characteristics which were contents, construction, and language use.

2) Developing step

This step consists of two steps, which are formative evaluating step and revising step of the teaching-module draft. Langkah perbaikan ini sudah terintegrasi dalam setiap tahap pada langkah evaluasi formatif.

In this research the formative evaluating step was only until small group step. In the expert review step, validations included contents, construction, and language use. Validation of contents was to see appropriateness of the contents to the aims of teaching. Validation of construction was to investigate the suitability of content design with the instruments of evaluation, and validation of language use was to check the correctness of language use in the teaching module.

In the One-to-One evaluation, a first draft of the teaching module was tested to two students. The students were asked to read the module, to answer the questions, and also to give critics and comments the module. In the small group step, the second prototype of the teaching module was tested in a small group of students (5 students in a group). The results of testing steps were analyzed to find problems occurred when students dealt with the module, then the findings could be used to revise the prototype to make it better.

III. RESULT

The process of formative evaluation in this research consists of self evaluation, expert review, one-to-one, and small group, which are described below.

(1) Self Evaluation

In this step the researcher did some steps, which are:

Problem Identification; The researcher found the problem which was “how to develop an effective and practical teaching module of a course, initial value and boundary problems, for students of mathematics education. After that, the researcher did some preparations, in which the researcher analyzed the curriculum of the course. Based on the result of analysis, it was identified that the standard of

competency of the course was that students understand mathematics model of real problems in ordinary-differential-equations with initial values and also can solve real problem of simple mathematics models in partial differential equations with initial values and boundaries.

Draft Module Design; The first thing the researcher did in this step was identifying the aims of course. After that, the researcher analyzed contents of the course. The next step was choosing and developing the topics after the competency standard was already decided. The last step was building up the draft of teaching module.

The product of self evaluation was the first draft design of teaching module, which is described in the table below.

Table 1. Description of the first draft of the teaching module

Cover
Cover of the module was designed by displaying the title of the course, and the name of institute of FKIP, Universitas Sriwijaya, and the year 2011.
Modul 1
The title of Modul 1 is Solusi Persamaan Diferensial dengan Deret Pangkat. The basic competency in the modul 1 is that students are supposed to understand power series and be able to determine solutions of differential equations by using power series. In Modul 1 there are explanations about power series, examples of questions of power series with the answers, and also questions for practicing.
Modul 2
The title of Modul 2 is Persamaan Diferensial. The basic competency of modul 2 is that students are supposed to understand Legendre equations, to be able to determine Legendre polinom, and also to be able to find solutions of differential equations. Explanations of contents in modul 2 include Legendre equations, Legendre polinom, Ortogonality of Legendre polinom, Normality of Legendre polinom, and also Legendre series, followed by an example and 4 questions for practicing.
Modul 3
The title of Modul 3 is Deret Fourier, which contains explanation of a method to find values of a_0 , a_n , and b_n , and follows an example and 11 exercising questions. The basic competency of Modul 3 is that students are supposed to

understand Sine and Cosine Fourier series.
Modul 4
The title of Modul 4 is Transformasi Laplace. The basic competency of this module is that students are supposed to understand Laplace transformation and to be able to determine its invers. In this module, there are explanations about the benefit of Laplace transformation, definition of Laplace transformation, examples of determining Laplace transformation, table of Laplace transformation of some functions, and also a subtopic, invers of transformation, which follow by some examples and questions for practicing.
Modul 5
The title of Modul 5 is solusi persamaan diferensial dengan transformasi Laplace. The basic competency of Modul 5 is that students are supposed to be able to find solutions of differential equations by Laplace transformation. The differential equations discussed in this module are the second orde with initial values. There are one example and 5 questions.
Modul 6
The title of Modul 6 is solusi sistem persamaan diferensial dengan transformasi Laplace. The basic competency of Modul 5 is that students are supposed to be able to determine solutions of differential-equation systems by Laplace transformation. Modul 5 consists of explanations about the method and technique to solve differential-equation systems, which follow by an example and 3 questions for practicing.
Modul 7
The title of Modul 7 is transformasi Laplace dari fungsi tangga. The basic competency of Modul 7 is that students are supposed to be able to find Laplace transformation for stairs functions. In this module there is general explanation about Laplace transformation for stairs functions, which follows by two examples and 5 questions.

(2) **Expert Review**

In this step, the first design of the teaching module was validated by experts. The results of validation were suggestions and comments to the first design of the teaching module. Some suggestions and comments are (1) add introduction which consists of descriptions of benefits of learning using the module and explanations of important points of the essential topics, (2) add more examples in modul 1, (3) it is necessary to add explanations about how to determine solutions of differential equations by power series, etc.

Based on the suggestions and comments from the experts, the researcher made some revisions to the first design module, and the result was the prototype of the teaching module.

(3) *One-to-one Evaluation*

In this step, the first prototype, which consists of 7 modules, was distributed to 17 students of mathematics education program to read and to learn it, and every the same module was learned by two students. The researcher observed students to identified difficulties during learning the module. Some of the results of observation of one-to-one evaluation are described below. For Modul 1; add more examples which are similar to questions for practicing, because there was a question for practicing which asked the solution of differential equation $y' = \dots x^2 + \dots x + \dots$ but in the module 1 only y' in y form was explained. For the question $y' = y + 1$, students could answer it, even though the final answer was not completed in simple form. For the question $y' = xy$, students could answer it until determine recursive forms, even though the final answer was not completed.

For Modul 2; actually Modul was already systematic, but in the examples there was not information or clues for solving questions, which made students found difficult to answer the questions in Modul 2. For Modul 3; students did not really understand the last part of given examples.

$$f(x) = \begin{cases} 0, & -\pi < x < 0 \\ 1, & 0 < x < \frac{\pi}{2} \\ 0, & \frac{\pi}{2} < x < \pi \end{cases}$$

For the question above, students were able to determine a_0 , a_n , but got problem to find the value b_n .

For Modul 5; some students had already understood how to answer the questions, but still got problems in changing the form of invers transformation, because they did not understand yet what Laplace transformation is.

(4) *Small Group*

In this step, the second prototype was tested to 34 students, and every the same module was learned by 5 students, but Modul 7 was learned by 4 students, because 1 student was not able to present. The results of observation in small group were the difficulties which students faced within learning the second prototype. Some of problems are described below. For Modul 1; generally the module was good, but the explanation given in the module was still hard to be understood by students. Students suggested that it would be better if the main concepts of differential equations and some

examples of it were written also in the module, because it would help students to understand and to learn the main course. For Modul 2; from 5 students there were only 4 students whom were able to answer the question $f(x) = \begin{cases} 0, & -1 < x < 0 \\ x, & 0 < x < 1 \end{cases}$. However, students still got problems in drawing the sketch of the graph.

The result of small group was used to revise the second prototype of the teaching module. The product of revision was the third prototype of the teaching module, which was the final teaching module in this research.

IV. DISCUSSION

In this research, the teaching module of Initial values and Boundary Problems was developing through some steps, which were based on the Tessmer's formative evaluation. In every step, the teaching module had already passed the process of validation, revision, and evaluation, which was based on the suggestions and comments of experts and students. From the expert review, there were a lot comments and suggestion to make the teaching module towards to be better. Revisions of the contents, constructions, and language use dominated in developing steps

Observation of testing the prototype gave a lot of information that students still had problems in understanding the prototype of the teaching module. The difficulties which students faced when learning the teaching module were dominated by problems of understanding the content clearly. Overall, students still had problems in manipulating and simplifying algebraic expressions, for example, some students still did not understand why $f(t) = t^0 = 1$.

V. CONCLUSION AND SUGGESTION

From results of the research it is able to conclude that the teaching module of Initial Values and Boundary Problems has already passed through the developing process of Tessmer steps, even though it was only until at small group step. The teaching module is valid to use, because it was already reviewed by experts and already tested in process of One-to-One Evaluation dan Small Group.

Because this research was limited until Small Group step, the research suggests to whom may be interested to continue the developing the teaching module to next step which is Field Test to measure the practical aspect of the teaching module, and also to use the teaching module in teaching the course.

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