

Preliminary Analysis Developing Learning Materials of Ordinary Differential Equation Based on Discovery Learning

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Abstract—Student's understanding on Ordinary Differential Equations lecture are low. It can be seen on previous examination held. They are not familiar in interaction of constructing the concept. They just listen what the lecturer told. Anticipating this condition, we use Discovery Learning model. In this research we create learning materials on Ordinary Differential Equation lecture using discovery learning approach. It develop using Plomp model with 3 phases, they are front-end analysis/preliminary research, development/prototype phase and assessment phase. In this article we just tells the student's difficulties on Ordinary Differential Equation lecture. Based on the preliminary analysis, we found that there are 3 component support it, they are: 1) learning process, 2) lecture material, and 3) learning resources.

Keywords—ordinary differential equation, discovery learning, development research.

I. INTRODUCTION

Ordinary Differential Equation is a core subject for Mathematics Education program in FMIPA UNP. Students are upcoming teacher for the future. They have to have four competencies: pedagogical competency, personality competency, social competency and professional competency to support their professional task. Pedagogical competency directly related to student's (teacher's candidate) ability on practical teaching in the classroom. It shows the teacher's ability on helping students understanding the lesson better. Pedagogical competence related to how to teach and giving a learning which educate and discuss. It requires teacher to accommodate the lesson. Mathematical learning approach encourage students to understand mathematics better than before to success on the lesson.

Based on Kurikulum 2013, students are accused to be able in: (1) mathematical communication; (2) mathematical reasoning; (3) mathematical problem solving; (4) mathematical connections; and (5) positive attitudes towards mathematics.

One of the ways to increasing that ability and skill is increasing understanding on the topic discussed. So that, an upcoming mathematics teacher have to have a good understanding during his/her study in the university. One of them is Ordinary Differential Equation. This course teach students teacher to solve the equation contains differential of a function. Differential of a function have be discussed on Calculus course. Calculus is an essential course on mathematics in the university [1]. Calculus material are really needed in the developing science and technology. Many applications of science need calculus. So, every students need calculus. Because of that, attention to learning and teaching calculus increase drastically [1].

But, we find many students reach problem on Calculus subject [1]. Cipra and Peterson told that drop out rate on Calculus really high because weak skill and student's understanding. Indeed, Selden and Mason, the best student on Calculus can't solve non-routine problems properly [2]. It cause many factors, i.e. pedagogical aspect, reading resource, content and prerequisite materials.

The problems above gives misconception on students. For derivative material, Ubuz told that in general the mistake students do on differential are about: (a) differential on a fixed point which result a function of a derivatives, (b) tangent equation is first order derivatives, (c) derivatives on a fixed point is tangent, and (d) derivatives on a fixed point is the value of tangent equation on that point. It occur because (a) lack of differentiate of a concept in different context or different concept on similar situations, (b) incompatibility expansion of a specific case to general case, and (c) lack of understanding on representation of a graph [3].

Effect of this difficulties makes students also difficult to understand the Ordinary Differential Equation materials. Besides that, teaching materials used before cannot construct their knowledge yet. For that reason, we design a learning materials like lesson plan and student's worksheet based on discovery learning.

Hamalik told that discovery learning is a learning process which focused on mental intellectual of students on solving

the problem, so that they reach the concept in the daily life. More deep, Mulyasa told that discovery is a learning strategy which focus on experience without depend on the theories in the textbook [4].

Discovery that we want can be done by guidance [5]. This learning require a creative teacher so that the students can construct their knowledge themselves. Teacher is a mentor and give the students chance to learn actively. This condition change the teaching process, from teacher oriented to student oriented.

Designing a discovery learning have to pay attention on: 1) students activity to study themselves, 2) final result have to find by students themselves, 3) prerequisites needed have been owned by students and 4) teacher can direct and advise, not tell the truth [5].

Ministry of education on Permendiknas No 58 year 2014, tells the steps on operate the discovery learning model: 1) formulate the problem that will be given to the students, 2) based on data from the teacher, students arrange, process, organize, and analyses the data, 3) students arrange their prediction based on his/her analysis, 4) if needed, the student's prediction are checked by the teacher, 5) if find a certainty about prediction, students are directed to make a verbal prediction, and 6) after students find the solution, teacher has been prepare an exercise or additional problem to check whether the discovery is right or not. Steps for application discovery learning model in the class: 1) Stimulation, 2) Problem statement, 3) Data collection, 4) Data processing, 5) Verification, and 6) Generalization.

In the Stimulation stage students are faced with something that causes confusion, then continues to not give generalization, so that the desire arises to investigate itself. In addition the teacher can start learning activities by asking questions, encouraging reading books, and other learning activities that lead to problem solving preparation.

After stimulation, the next step is the Problem statement, the teacher gives the opportunity for students to identify as many agenda issues as possible relevant to the lesson material. At this stage the teacher gives students the opportunity to identify and analyze the problems they face.

When exploration takes place the teacher also provides opportunities for students to collect as much information as relevant (Data collection). Students are given the opportunity to gather various relevant information, read literature, observe objects, interview with resource persons, it conduct their own trials and so on. Students learn actively to find something related to the problems faced, thus students accidentally connect problems with the knowledge they have.

Data processing is an activity of processing data and information that has been obtained by students both through interviews, observation, and so on, then interpreted. All information resulting from reading, interviewing, observing, etc., are all processed, randomized, classified, tabulated, even if necessary to be calculated in a certain way and interpreted at a certain level of trust [6]. Data processing is also called coding / categorization which functions as concept formation.

At the Verification stage, students conduct a careful examination to prove whether or not the forecast is determined by alternative findings. Based on the results of

the processing and interpretation, or the available information, the statements or forecasts that have been formulated earlier are then checked, whether answered or not, whether proven or not.

Generalization / drawing conclusions is the process of drawing a conclusion that can be used as a general principle and applies to all the same events or problems, taking into account the results of verification. Based on the results of the verification, the principles underlying the generalization were formulated. After drawing conclusions students must pay attention to the generalization process that emphasizes the importance of mastering the lessons on the broad meanings and principles or principles that underlie one's experience, as well as the importance of the regulatory process and generalization of those experiences.

With this learning model, students are faced with situations where students are free to investigate and draw conclusions. The teacher acts as a guide, the teacher helps students to use the ideas, concepts, and skills they have and learn in advance to acquire new knowledge. In this paper we will describe the difficulties experienced by students in Ordinary Differential Equations lecture.

II. METHOD

This research is a development research with the aim of creating a valid, practical and effective lecture device. The work steps carried out consist of four stages, namely 1) the initial assessment stage, 2) the design stage, 3) the realization /construction stage and 4) the evaluation and revision stages.

At the Initial Assessment stage an analysis of mathematics learning, analysis of learning theories and curriculum analysis and student analysis was carried out. At the design stage, the device design and design of research instruments are carried out which include the preparation of learning plans, media selection, selection of learning device formats, and instrument design. During the evaluation and revision stages an evaluation of the validated devices was carried out. If the device is not valid, then it is revised based on the suggestions and comments given by the validator. The revised device is then re-validated. If the device is still not valid, revisions will be made based on validator suggestions and comments, then re-validated, and so on until a valid, practical and efficient device is obtained.

III. RESULTS AND DISCUSSION

From the results of the study there are several difficulties experienced by students in learning the Ordinary Differential Equation lecture. These difficulties are viewed from several aspects, namely: 1) the most dominant general difficulties experienced by students, 2) difficulties encountered in terms of the learning process, 3) difficulties encountered in terms of lecture material, and 4) difficulties encountered in terms of source books.

The most dominant difficulties experienced by students are 1) understanding the material given because it is too much and solid (40%), 2) deriving the formula and applying it to the problem because there are several calculus concepts and the interrelationships between the forgotten material (35%), 3) understanding the subject matter during the discussion and told to learn by themselves (15%), 4)

difficulties in the learning process and focusing on the mind (10%).

Difficulties experienced by students in terms of the learning process are 1) less conducive learning atmosphere because learning is only focused on a few people (20%), 2) difficult to understand the words in the source book and understand the explanation of friends when the discussion (45%), 3) because the learning process using the screen infocus is small (10%), and 4) because the material explanation is not detailed (25%).

Difficulties experienced by students in terms of material are 1) examples of the questions given are different from the exam questions, and the repair exam questions are more difficult (15%), 2) due to solid material often forget about using the right formula in solving the problem (60%) , 3) lack of understanding with supporting prerequisite material (15%), and 4) difficult to understand book language (10%). The difficulty experienced in terms of the source book is the elaboration of the formulas in the source book is incomplete and poorly understood.

Some improvement suggestions that the students put forward are: 1) In order to complete the facilities and infrastructure such as projectors that are used too small so that they are less clear and air conditioned, 2) to pay attention to all students in the learning process, 3) the concepts taught are truly understood by students so that it does not cause confusion for students in applying the formula to the problem, 4) the lecturer should better explain the handouts that have been given, 5) the repair test should be easier than the first exam questions, 6) the submission of material should not be done with group presentations, but

explained by the lecturer 7) learning methods should be more varied and give more examples of the problem.

VI. CONCLUSION

The conclusion of this study is that students still experience difficulties in learning the Ordinary Differential Equation courses. Difficulties experienced consist of several aspects, namely: 1) learning process, 2) lecture material, and 3) source book. Lecturers should prepare more varied teaching materials so that the learning process can run well.

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