
Implementation Of Learning First Order Differential Equations By Using Students' Worksheet

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Abstract: This study aims to analyze the implementation of learning first order differential equations by using students' worksheet. These variables which have been examined in this study consist of (1) students' activities during learning process, (2) students' response about students' worksheet, and (3) students' opinion about implementation of learning first order differential equations by using students' worksheet. The subjects of this study were students of Department of Mathematics Education FKIP Universitas Riau who studied differential equations course in odd semester of 2019/2020. Data was collected through (1) observed the students' activities during learning process, (2) filled in students' response questionnaires, and (3) interviewed these six students. From the data analysis obtained information that (1) students' activities during learning process by using students' worksheet was excellent, marked by students had great enthusiasm for studying first order differential equations, discussing in groups, solving the problems were given, etc., (2) the students' response about students' worksheet were excellent, marked by students' worksheet can used as learning resource, students' worksheet is very helpful for understanding materials, solving problems, etc., and (3) these students proposed in order that the lecturer used students' worksheet as additional learning resources in learning differential equations.

Keywords: students' worksheet; first order differential equations

1. Introduction

One of the branch of applied mathematics is differential equations. Bronson (2006) stated that Differential equations are among the linchpins of modern mathematics which, along with matrices, are essential for analyzing and solving complex problems in engineering, the natural sciences, economics, and even business. The emergence of low-cost, high-speed computers has spawned new techniques for solving differential equations, which allows problem solvers to model and solve complex problems based on systems of differential equations.

One of the courses in applied mathematics is differential equations. The differential equations is an advanced course and must be studied by students of Department of Mathematics Education FKIP Universitas Riau. There are three prerequisite courses from Differential Equations, namely Differential Calculus, Integral Calculus, and Multivariable Calculus. Budi Utomo (2009) stated that differential equations course aim to develop students' ability to understand various concept of differential equations and their solutions and use them to solve real problems that arise in other disciplines. In the curriculum of Department of Mathematics Education FKIP Universitas Riau (2014), it is stated that the differential equations course provides a solid basis for solving mathematical models that appear in other disciplines. In this course, there are four major topics are discussed, namely (1) the fundamental aspects of differential equations, (2) first order differential equations, (3) second order linear differential equations, and (4) higher order linear differential equations (Department of Mathematics Education FKIP Universitas Riau, 2014, revised).

One of the topics presented in the differential equations course is "First Order Differential Equations". Bronson (2006) classified that differential equations covering six sub topics, namely (1) standart equations form and differential equations form, (2) linear differential equations, (3) bernoulli differential equations, (4) homogeneous differential equations, (5) separable differential equations, and (6)) exact differential equations. Boyce (2008) stated that First Order Differential Equations covering nine sub topics, namely (1) linear differential equations: method of integrating factors, (2) separable differential equations, (3) modeling with first order differential equations, (4) differences between linear and nonlinear first order homogeneous differential equations, (5) autonomous differential equations and population dynamics, (6) exact differential equations and integrating factors, (7) numerical approximations: euler's method, (8) the existence and uniqueness theorem, and (9) first order differential equations. In the curriculum of Department of Mathematics Education FKIP Universitas Riau (2014), it is stated that the differential equations covering eight sub topics, namely (1) Separable Differential Equations, (2) First Order Homogeneous Differential Equations, (3) First Order Nonhomogen Differential Equations, (4) Exact Differential Equations, (5) Non-exact Differential Equations, (6) First Order Linear Differential Equations, (7) Reduction of Differential Equations into First Order Linear Differential Equations, and (8) Bernoulli Differential Equations. Referring to the learning material above, and the experience of researchers as a lecturer who teaching differential equations course, in general students have difficulties in determining the completion of first order differential equations, especially choosing the right method for solving differential equations according to their type and shape. This is caused by the low understanding ability of students and the lack of Indonesian language literature. The impact of these problems are not optimal learning and low student achievement on the topic of first order differential equations.

The curriculum applications have the different learning approach, as well as in the curriculum 2014 of Department of Mathematics Education FKIP Universitas Riau. Generally, we know the curriculum 2014 is identical with the scientific approach on its learning process. In scientific approach, the lecturers do the learning steps in accordance with the scientific approach. The scientific approach on mathematics learning can be defined as learning which is designed, so that the students construct concepts, laws and principles actively through the stages of observing, asking, reasoning, trying and concluding the problems.

To further optimize learning in order to improve students' understanding abilities and relevan with curriculum 2014 of Department of Mathematics Education FKIP Universitas Riau, researchers feel the need to supplement textbooks with students' worksheets. Hendro Darmodjo and Jenny R.E. Kaligis in Endang Widjajanti (2008) states that the student's worksheet is a sheet that contains guidelines for students as a support in increasing students' activities in the learning process. Endang Widjajanti (2008), states that students' worksheet is one of the learning resources that can be developed by the teacher as a facilitator in learning activities. Therefore, researchers use students' worksheet in learning first order differential equations. This study aims to analyze the implementation of learning differential equations by using students' worksheet, consist of

(1) students' activities during learning process, (2) students' response about students' worksheet, and (3) students' opinion about implementation of learning first order differential equations by using students' worksheet

According to Andi Prastowo (2011), students' worksheet is printed instructional materials in the form of sheet of paper containing materials, summaries and directive implementation of learning task that must be done by the students, which refer to the basic competencies that must be achieved. Every teacher in providing Students' worksheet must consider several requirements of the preparation of students' worksheet so that the basic competencies that must be mastered by the students can be achieved. Therefore, the teachers will be able to compile the good students' worksheet if they have the

enough skill. Additionally, Dwicahyono (2014) suggested that the structure of the Students' worksheet in general, namely: (1) the title, subject, semester, place; (2) instructions to learn; (3) the competence to be achieved; (4) indicator; (5) supporting information; (6) the task and work step; and (7) assessment. In this research, the structure of the students' worksheet are (1) the title of subject, (2) the sub-competence to be achieved (3) instruction to learn (4) teaching materials understanding concept, (5) conclusion, and (6) problem solving task.

2. Methodology

2.1 Variable and subject of research

This research is a descriptive research mixing up quantitative and qualitative. These three variables which have been examined in this study consist of (1) the students' activities during learning process by using students' worksheet, (2) students' response about students' worksheet, and (3) students' opinion about implementation of learning first order differential equations by using students' worksheet. The subjects of this study were students of Department of Mathematics Education FKIP Universitas Riau who studied the differential equations course in odd semester of academic year 2019/2020 which amounted of 40 students.

2.2 Instrument of Data Collection

To collect data about students' activities during learning process by using students' worksheet was used observation sheet covering six sub aspects, namely (1) the implementation of group discussions, (2) the groups' skills to understanding concept, (3) the groups' skills to get conclusion, (4) the groups' skills to solve problems, (5) the groups' skills to present their work, and (6) the groups' skills in responding the result of presentation. Data was collected by observer using a Likert scale (4: excellent, 3: good, 2: average, 1: Poor) supplemented with comments and suggestions by observers.

To collect data of students' response about students' worksheet was used students' response questionnaires covering four sub aspects (1) clarity of language and sentence of students' worksheet, (2) ease of using students' worksheet, (3) user confidence, and (4) user satisfaction. The questionnaire was distributed to the students, and they are expected to respond it by choosing one of the possible choices (4: excellent, 3: good, 2: average, 1: Poor) supplemented with comments and suggestions by observers.

To collect data of students' opinion about implementation of learning first order differential equations by using students' worksheet was used guideline for interview covering (1) user satisfaction, and (2) user expectation.

2.3 Technique of Data Collection

Accordance with the research objectives, there are three technique to collect data in this research namely:

- a. Technical observation to collect data of students' activities during learning process by using students' worksheet.
- b. Technical questionnaire to collect data of students' response about students' worksheet.
- c. Technical interview to collect data of students' opinion about implementation of learning first order differential equations by using students' worksheet.

2.4 Technique of Data Analysis

The data were collected then analyzed using by quantitative descriptive analysis and narrative descriptive analysis. The following are assessment criteria of students' activities during learning process by using students' worksheet, and assessment criteria of students' response about students' worksheet on the topic of first order differential equations.

Tabel 1. Assessment Criteria of Students' Activities and Students' Responses

Value Range	Criteria
$3,3 < N \leq 4,0$	Excellent
$2,7 < N \leq 3,3$	Good
$2,0 < N \leq 2,7$	Average
$1 \leq N \leq 2,0$	Poor

(Modified Murniasih, 2014)

3. Result and Discussion

3.1 Students' Activities During Learning Process By Using Students' Worksheet

As explained in the research methodology, students' activities during learning process by using students' worksheet consisted of six sub aspects. Following are the results of data analisys for each sub-aspect

Table 2. Students' Activities During Learning Process By Using Students' Worksheet

No	Sub Aspect	Everage	Criteria
1	Implementation of group discussion	3,6	Excellent
2	Groups' skill to understanding concept	3,6	Excellent
3	Groups' skill to get conclusion	3,4	Excellent
4	Groups' skill to solve problems	3,0	good
5	Groups' skill to present their work	3,2	good
6	Groups' skills to respond the result of presentation	3,3	Excellent
	Average	3,35	Excellent

(modified Sa'dun Akbar, 2013)

Based on table 2, it can be seen that implementation of learning first order differential equations by using students' worksheet is excellent. Students had great enthusiasm for studying first order differential equations, discussing in groups, and solving the problems were given. Students had great enthusiasm to present their work in front of the class, and to respond the result of presentation.

3.2 Students' Response about Students' Worksheet

The next results of research are data of students' response about students' worksheet on the topic of first order differential equations, as presented in table 3 below.

Table 3. Students' Response about Students' Worksheet

No	Sub Aspect	Everage	Kriteria
1	Clarity of language and sentences	3,63	Excellent
2	Ease of using students' worksheet	3,48	Excellent
3	User confidence	3,53	Excellent
4	User satisfaction	3,54	Excellent
	Average	3,545	Excellent

(modified Sa'dun Akbar, 2013)

From table 3 above it can be seen that the average of students' response about students' worksheet that have been developed and used in learning first order differential equations is excellent Next, the following are the comment of students in filling out the questionnaire, including:

- a. Clarity of language and sentences
 - 1) The language of students' worksheet is easy to understand.
 - 2) The writing of students' worksheet can be read clearly.
 - 3) Directions of students' worksheet can be explained clearly
- b. Ease of using students' worksheet.
 - 1) Students' worksheet activities are clearly regulated.
 - 2) Empty space is large enough but dots (.....) should be removed.
- c. User confidence.
 - 1) Students' worksheet can used as learning resource.
 - 2) Students' worksheet is very helpful for understanding materials.
 - 3) Using students' worksheet can increase interaction between students and interaction between students and lecturers.
 - 4) Using students' worksheet can increase autosuggestion of students.
- d. User satisfaction.
 - 1) Students' worksheet can increase spirit of learning.
 - 2) Students' worksheet create serious learning with a little relaxed

Students suggest are (1) the questions of problem solving must be extended from easy problems to difficult problems, (2) empty spaces do not use dots (.....) so student writing is unlimited, and (3) maintain learning using students' worksheet.

3.3 Students' Opinion About Implementation Of Learning By Using Students' Worksheet

Based on interviews with students obtained information that (1) students' worksheet can be used as additional learning resources, (2) problems to understanding concepts are relatively easy, but all questions of problem solving including the difficult category. Therefore students suggest in order to (1) the questions of problem solving must be extended from easy problems to difficult problems, (2) Put forward the prerequisite material in students' worksheet, (3) The group's discussion must be permanent and heterogeneous based on ability, and (4) students proposed in order that the lecturer used students' worksheet as additional learning resources in learning differential equations course.

4. Conclusions

Based on the results of research and discussion, it can be concluded that (1) the implementation of learning first order differential equations by using students' worksheet is excellent, and (2) students' response about students' worksheet are also excellent. Therefore it is suggested that the use of students' worksheet can be maintained and extended for learning other topics.

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