Developing Learning Module Based On Differentiated Instruction

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Abstract

This study aims at developing learning modules based on a differentiated instruction for the Department of Informatics, Universitas Darussalam Gontor. This material is about equalities and inequalities of absolute value. This research is a development research adopting Borg and Gall development procedures limited to 7 stages namely information collecting, planning, development, preliminary field testing, revisions, main field testing, and revisions of a product as suggested by main field test result. The development of this product uses a differentiated instruction approach based on differences in student ability levels. Expert validation was carried out by 5 mathematicians (mathematics lecturers). The results of the expert validation indicate that the module is feasible to use in which its score is 84%. The practicality and effectiveness were assessed by the observer using some instruments including a lesson plan, feasibility observation sheet, student's questionnaire. The product testing was conducted in calculus subject for the Department of Informatics. The score of the student response on the questionnaire was 82.67% which mean student responses are positive and modules were feasible to use for Calculus course. The product feasibility and student response show that the module based on differentiated instruction is valid and feasible to use as teaching aid in Calculus course.

Keywords: *development , differentiated instruction, a learning module*

Introduction

Education works as a means for character building and gives considerable contribution for the development of a country. No doubt that human resource is a key role in the achievement of a good education. Many developing countries have established and well-structured education system by giving a major investment in it. However, this accomplishment cannot be achieved if several factors have not been met. It is not only determined by the learning process but also the learning method as well. Furthermore, one of the most substantial factors in learning method is the teaching materials.

As mentioned before, the teaching materials are quite complex. There are several substances that support the learning process as well. One of them is called module. A module is systematically composed by some contents, methods, and evaluations. A well-composed module must be able to facilitate the student comprehension according to the student learning level.

There are several definitions about module prior to this research. A module is a printed learning material about which the student doing self-learning (Susilo, Siswandari, & Bandi, 2016). This self-learning style is the characteristic of a module as well according to (Lasmiyati & Harta, 2014). Consisting of a well-planned experience learning, module is designed to assist the student understanding of a lesson and its evaluation. (Tjiptiany, As'ari, & Muksar, 2016) proposed a learning module based on inquiry approach. It was stated that the proposed module accommodated the teacher and student to display their ideas. In addition to that, the module enabled the student to improve their skills by solving the problems by dealing with the evaluation and competency test materials independently. In order to achieve that purpose, the module was adapted to the students characteristics.

Module is a structured program based on a relevant qualification framework. When composing this module, it is highly required a student-centered learning approach. In addition, this composition did not only focus on the content and model but also on the learning quality.

Learning Calculus is quite demanding especially for the student of the department of informatics. In recent observations, the learning activities barely reach the learning purpose. This is occurred because of the teaching material that unable to accommodate by differentiating the students learning level capabilities.

Universitas Darussalam Gontor is an Islamic boarding university in which more than 80 % of the students come from Darussalam Gontor Islamic Boarding School. In an Islamic boarding school, the majority of the lessons are non-scientific. Obviously, when the students start learning in a department, in which based on science, they barely under stand the content of a science course. For instance, in a math course, every student faces a difficult circumstance. In a recent

survey conducted by the Department of Informatics Universitas Darussalam Gontor resulted that the mathematical ability of the students are classified into three levels, such as: low, middle, and high. In the learning process, the low-level students tend to be passive and barely understand the given materials. By this condition, the gap between high-level and low-level students was getting higher for the learning results. Based on this outcome, a comprehensive module is developed to optimize the student math learning performances.

The differences in which every student has affected significantly on the student achievement. The students are able to discover a creative and innovative way to solve a problem. Furthermore, this learning style has taught them a lifetime learning. This research is intended to develop a learning module based on differentiated instruction (DI) for the Calculus course particularly in the topic of equality and inequality of the absolute value. DI is a learning approach about which the material instructions, processes,and evaluation are set to be distinguished to each student according to their learning level.

The curriculum, content, and purpose of a course is delivered equally to every student. However, their learning end point, the deep of understanding is unique as well as the instructed assignment. When teachers differentiate instruction according to student existing interest, such students are motivated to connect what is being taught with things they already value (Joseph, Thomas, Simonette, & Ramsook, 2013).

In DI method, the student thinking competency is crucial. It must be stimulated throughout all learning activities in which incorporate both deductive and inductive reinvention. For example: a peer group discussion of the same level students can be helpful to enhance this ability. Finally, the evaluation is given at the end of the discussion.

In this decade, many research studies have been conducted in the topic of DI. Having a research on student as a subject, six years later, (Borja, Soto, & Sanchez, 2015) studied the understanding of lecturer on using the DI method. The result showed that the DI method has considerable impact on the student learning progress. (Ditasona, 2017) stated that learning using DI approach is able to

improve the student mathematical logic ability. In another research, (Iskandar, 2016) mentioned that DI is significantly influencing the increase of the mathematical problem solving ability as well.

In this research, the DI approach can bring positive learning experience to students. Instead of being treated equally on learning to a particular course, the students are set into a certain learning level environment. By this condition, the students are able to optimize their learning skill. However, the DI concept is not that simple. Skilful teachers, well-planned materials, and implementation play important roles in order to achieve the learning purposes (Dixon, Yssel, McConnell, & Hardin, 2014).

Research Methods

This research may be categorized as a research and development (R&D) where the developed product is learning module based on DI. The development of this module used Borg and Gall development procedures limited to 7 stages. These stages are organized as follows: (1) Literature study and information gathering which include student capability analysis, concept analysis, and arrangement of the material concept map. (2) Planning which includes determining the learning tool for development and selecting the module format. (3) Development which include developing the learning tool, composing the research instruments, and the expert validation sheets. (4) First implementation was conducted using a questionnaire for low-scale subjects, about 10 students, to measure the module feasibility and readability. (5) Second implementation was the revision of the first implementation. (6) Field implementation was conducted in order to implement the lesson plan. (7) And the last one was the revision of the field implementation.

Expert validation is using a validation sheet to determine the feasibility of the module that develops. Questions in the validation sheet were about format, illustration, language, and content. The validation data is analyzed both quantitatively and qualitatively. The qualitative data are recommendation, comments, and critics in writing taken from the expert teams. And the quantitative data are validated scores and responses from students. The score assessment

consisted of five categories: very bad (1 score), bad (2 score), quite good (3 score), good (4 score), and very good (5 score). A learning tool is considered as valid when each result belongs to a category which has score greater than or equal to 3.

This DI steps are consisted as follows: before delivering a lecture, a pretest is conducted in order to determine the student learning level. The pretest results are categorized into three groups: low, mid, and high. The classification of student learning level was determined based on the average value and standard deviation from the pretest results. Each level is limited by maximum and minimum threshold. The minimum is formulated as:

$$b_{min} = X \quad \frac{1}{2} SD \tag{1}$$

and the maximum value is formulated as:

$$b_{max} = \acute{X} + \frac{1}{2} SD \tag{2}$$

where b_{min}, b_{max} are minimum and maximum threshold respectively. $\bar{X}$ and SD are the average score and standard deviation respectively.

Once the minimum and maximum value are determined, the intervals for classification are determined as in Table 1.

Table 1. First Trial Student Level Classification

No	Interval	Categories
1	$x < b_{min}$	Low
2	$b_{min} \leq x \leq b_{maks}$	Middle
3	$x > b_{maks}$	High

where x is the student pretest score.

The practicality aspect of using module is using questionnaire response (QR). These used five Likert's scale. The QR consist four indicators, namely readability, interest, renew ability, and relevance to students' abilities. The QR was analyzed using quantitative descriptive analysis in the average form and grouped for each indicator. To find out the quality of modules in each indicator and overall percentage conversion is done into qualitative data with a scale of five. Changing the percentage score to scale five is based on table 2.

Table 2. The Percentage Score to Scale Five

Score Range	Categories
0 – 1	Very Less
1,01 – 2	Less
2,01 – 3	enough
3,01 – 4	Good
4,01 – 5	Very Good

The average score obtained by each indicator is concluded descriptively to describe the feasibility of the module. Modules are said to be feasible if each indicator includes a good or very good category. In addition, the feasibility of the module is also determined by the average score of the total questionnaire that was considered positive when percentages that are greater than 80%.

Result and Discussion

In this research, a learning module based on student learning level using DI has been proposed for the Equality and Inequality Absolute Value topic in Calculus course. The learning level is based on the student pretest results. The pretest is conducted prior to the module development for understanding the student characteristics. The first-stage average result of the student capability is 71.64 with the standard deviation equals to 13.96. From these values, it can be determined the maximum and minimum threshold for each interval. The maximum and minimum values are 64.65 and 78.60 respectively. The classification results are shown in Table 3.

Table 3. First-stage Student Capability Categories

Interval	Categories	N(S)
$x < 64{,}65$	Low	7
$65{,}65 \leq x \leq 78{,}60$	Mid	7
$x > 78{,}60$	High	10

where x is the score and N(S) is the number of students.

From the pre-test results, it was known that the students of Informatics Department can be classified into three categories: high, mid, and low. According to these categories, three type modules are proposed. Each module represents each level categories. For a convenient use, the low, mid, and high modules were

labelled as 01, 02, and 03 respectively. Thus, the students will not aware of this classification.

Materials and curriculum are arranged equal for every student level. However, the depth of materials was unique. The depth, in this term, refers to the question difficulty, learning activity, and learning evaluation. The proposed modules are validated by five mathematics educator experts. The validation covers four aspects in learning tool: format, illustration, language, and content.

Table 4. Validation Score Summary

Aspects	Score	Categories
Format	4	Good
Illustration	5	Very Good
Language	4	Good
Content	4	Good
Average Score	**4.2**	Good

As shown in Table 4, the average score of all categories is equals to 4.2. In other words, if the maximum score of 5 then the average score is equals to 84% as well. Therefore, the proposed modules satisfy the feasibility study for all scoring aspects with the mark as good. The further step is the field implementation.

The product experiment was tested twice: the first and field implementation. The first test is carried out with 10 students in semester 3 who have taken the Calculus class. The students were asked to read and learn the modules. The first trial was not delivered in a class. However, the students was prepared to read and self-learn the module. This process was observed by the researcher. Assuming that the students, who have passed the calculus class, have understanding in the selected topic. In this first trial, the module was assessed from the aspects of readability and message acceptance.

Then, they filled the QR. The QR consist four indicator, namely satisfaction, renewability, attention, and relevance to skills with five categories. The results of the analysis of student responses to modules are presented in table 5.

Table 5. Result of the Analysis of Student Responses

Student Respon Indicator	Score	Categories
Satisfaction	4.1	Very Good
Renewability	4.18	Very Good
Attention	4.15	Very Good
Relevance to Skills	4.1	Very Good
Average Score	4.13	Very Good

It is known from the first test that the total average QR score is 4.13 which mean that it is in a very good category. On the four indicators shows that the average score of each indicator includes a very good category. The percentage of the average questionnaire response was 82.67%, which mean student responses are positive and modules were feasible to use for Calculus course. In spite of the fact that the result was good, there is a mistake. It is the mistyped words in the module type 01 learning activity 3 in the question guide. Hence, the module 01 is revised. Once the first work done, the next step is the field implementation. There are two components in this test. The researcher acted as the lecturer while the colleague as the observer. Different from the first test, the respondents are the students from semester 1 who are on-going taking the Calculus course. In order to conduct this test, a learning method called Team Assisted Individualism was incorporated.

In addition, an observation is used to see the practically and effectiveness the module. The observation sheet for learning implementation is used with the intention of measuring the effectiveness and delivery of the module. The student activities were monitored by using student activity observation sheet. Given the observation sheet results, all of the learning steps have been accomplished and complied with the lesson plan (RPP). In addition to that, the score from the observation sheet is 84 % means that the students are interested in using the module based on DI.

After the lesson was delivered, all of the students are asked to fill the QR about the DI module. The result is remarkable. With the 85.06% of average score, which mean student responses are positive and modules were feasible to use for Calculus course. Put it differently, the students are positive with the DI module.

According to the students, this module can be referred as a learning material for Calculus.

Based on the both validation and field experiments results, it can be drawn into conclusion that the proposed DI module is feasible enough for the Calculus teaching materials. This learning tool is expected to accommodate the students' needs as a reference. The level capability of every student is unique. Having considered the distinction, a learning approach must be developed. The DI does not solely mean to treat all students equally. Instead, by giving them an adaptive learning which is related to the learning level. As an illustration, the high-level students are given the harder task than other levels.

Conclusion

In this research, a learning module based on DI has been developed. In addition to that, a learning tool, which compatible with the proposed module, has been developed as well. Both learning tool and module have been approved as valid and feasible for implementation because of the expert team validation. The questionnaire results, from the first and field trial results, showed that the students felt about this module is new and easy. The students were interested in learning Calculus by using this DI module as well. According to students, this module can be used as reference in Calculus and accommodates them to solve question independently.

In future work, there are some recommendations that must be considered: (1) Highly recommended to the lecturer to utilize this module as their reference in Calculus course. (2) Since this current research scope is solely taken place in department of informatics of Universitas Darussalam Gontor, hoping that this module can be applied to other universities as well.

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