

Guided Discovery Approach in the Development of Calculus Modules on Derivative Material with Islamic Nuance and Environmental Insight

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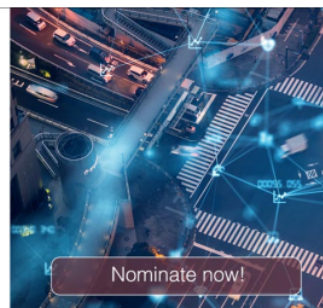
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2 Guided Discovery Approach in the Development of Calculus Modules on Derivative Material with Islamic Nuance and Environmental Insight

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²⁴**Abstract.** The development of teaching materials in the form of modules needs to be developed in calculus courses to help students understand derivative materials. This development aims to determine the development and feasibility of the developed module, namely calculus modules on derivative material with Islamic nuance and environmental insight. The method used in this research is Research and Development (R&D) using the 4D model proposed by Thiagajaran. The steps taken are to Define, Design, Development, and Disseminate. Based on the results of the research, the results of the validation by the material experts, media experts, and Islamic religious and environment experts are deemed valid. Based on small-scale testing on the product's attractiveness, the module is declared as very attractive. Thus, based on the assessment of validators and small-scale trials, the developed module is declared as feasible.

1. Introduction

Calculus I course is the basis of mathematics education courses. Calculus 1 discusses the derivative material or differential calculus which is important in calculus [1] In the process of lecturing, learning resources used in explaining the derivative materials have not provided an opportunity for students to build their understanding independently and there is no Islamic nuanced book containing excerpts from Quran, especially related to the environmental sustainability as an alternative in innovation and transformation of education [2], Effective learning should be able to make students experience science and technology (IPTEK), faith and obedience (IMTAK), and environmental aspects equally [3].

The use of instructional media gives a good influence on the learning process, [4–6] Therefore, it is necessary to develop mathematics learning and teaching materials in the form of modules, because modules are independent teaching materials that can facilitate students to understand the material and achieve the desired goal [7–11]. In developing the right learning tools, a good approach must be chosen [9]. One of the right approaches to overcome the tendency of students to memorize the learning and turn it into independent and active learning is to use the guided discovery approach [12] which is a method of discovery learning that the implementation is carried out by students based on the teachers' instructions in the form of guidance statements to find a concept [13–16].

Some previous research focuses on developing teaching materials and learning media such as modules, worksheets, learning videos, and e- Modules [4, 7, 17–37] calculus learning module has also been developed for the learning process [1, 38] Some of which are calculus modules developed on integral material to improve mathematical abilities, the development of variable calculus modules 1, the development of basic and advance calculus modules using Maple 14 [38–40]. Several studies have been

carried out using the guided discovery approach in developing a teaching material [8, 38, 41–43], and several studies have been carried out to develop Islamic-nuanced modules or integrated Islamic values [44–52]. However, no previous research has developed a special calculus module for derivative materials using the guided discovery approach with Islamic nuance and environmental insight.

Based on research that has been done before, the renewal in this study lays in the development of guided discovery approach calculus modules on derivative material with Islamic nuance and environmental insight. So, the purpose of this research is to find out how the development and feasibility of the guided discovery approach calculus modules on derivative material with Islamic nuance and environmental insight.

22 **Research Methods**

The type of research used is R & D (Research and Development) [53] which is used to produce certain products, as well as testing the effectiveness of the products [54]. The procedures of development of this study are the four-stage model (4D) proposed by Thiagarajan et al. that consist of the Define, Design, Develop, and Dissemination stages [55, 56]

Instruments used in collecting the data were validation sheets and questionnaires. The types of data used are qualitative data and quantitative data [57]. The data collecting techniques in this study are questionnaires distributed to respondents which then the respondents respond to the list of questions [4]. The qualitative descriptive analysis technique is a technique used in this study which describes the results of product development. It consists of expert validation data analysis and product trial data analysis. The validation data for the validity test is quantitative. The quantitative data based on a Likert scale [58]. Assessment can be done by calculating the average score:

$$\bar{x} = \frac{\sum_{i=1}^n \bar{x}_i}{n} \text{ with } \bar{x}_i = \frac{\sum_{i=1}^n x_i}{n_i}$$

Description:

\bar{x} = Total average score

n = Number of validators

\bar{x}_i = Average score of each criterion

x_i = Score of each criterion

n_i = number of criteria

The results of the score rating of each validator are then converted to determine the validity and feasibility of the module. The average feasibility analysis criteria are shown in Table.1 [59]

11 **Table 1.** Expert Validation Criteria (modified)

Score Quality	Feasibility Criteria	Description
$3,26 < \bar{x} \leq 4,00$	Valid	No. Revision
$2,51 < \bar{x} \leq 3,26$	Quite Valid	Partial Revisin
$1,76 < \bar{x} \leq 2,51$	Less Valid	Partial Revision and & Reexamining the Material
$1,00 \leq \bar{x} \leq 1,76$	Invalid	Total Revision

The results of each student are calculated and then converted to determine attractiveness. Converting the score into this assessment question can be seen in Table 2.

Table 2. Criteria for the attractiveness (modified)

9	Score Quality	Feasibility Criteria
	$3,26 < \bar{x} \leq 4,00$	Very Attractive
	$2,51 < \bar{x} \leq 3,26$	Attractive
	$1,76 < \bar{x} \leq 2,51$	Less Attractive
	$1,00 \leq \bar{x} \leq 1,76$	Unattractive

19 3. Results and Discussion

The main result of this research and development is a guided discovery approach calculus module on derivative materials with Islamic nuance and environmental insight. The procedures of development of this study are the four-stage model (4D) proposed by Thiagarajan et al. that consists of the Define, Design, Develop, and Disseminate stages [55]. Here is a description of the results of the module development:

25 3.1 Define Stage

The activity at this stage contains the analysis or collection of activities to define and establish the learning needs related to the product that will be developed.

3.1.1 The initial and final analysis. The researcher analyzed a questionnaire regarding teaching materials used in the study of calculus courses at several tertiary institutions in Lampung, namely UIN Raden Intan Lampung, Unila, and Teknokrat. Based on the questionnaire that has been distributed, many problems were found during the learning. The students are less active in the learning process. The teaching and learning activities only took place in one direction. There were no teaching materials that have Islamic nuances or related to Islamic values, as well as the environment. It can be concluded that a teaching material in the form of a module with the guided discovery approach is needed.

3.1.2 Analysis of calculus textbooks, specifically on derivative materials. Based on questionnaires that have been distributed, the book commonly used in the process of the calculus was Calculus (9rd Edition) by Dale Varberg, Edwin Purcell, and Steve Rigdon. The book was analyzed and used as a reference for the preparation of the module development.

3.1.3 Literature analysis. The literature related to the development of the modules used was calculus books on derivative material and sources of Islamic and environmental information obtained from science mathematics books, journals, and sources from the internet.

3.2 Design Stage

The activities in the design stage are:

3.2.1 Product selection. From the results of the analysis that has been carried out at the define stages, the product to be developed is in the form of a guided discovery approach calculus module with Islamic nuance and environmental insight because such modules are assessed as an effective learning resource and according to the needs.

3.2.2 The choice of format, the format developed by the researcher was adjusted to the learning of mathematics in the derived material by including the steps of the guided discovery and by taking into account the requirements of the preparation of the appropriate module. For the format setting and writing style, the authors developed it themselves.

3.2.3 Initial Design. It is the initial product design before the product is revised. The initially-designed module was a module that will be assessed by the validator. The draft overview of the module can be seen in Figure 1.

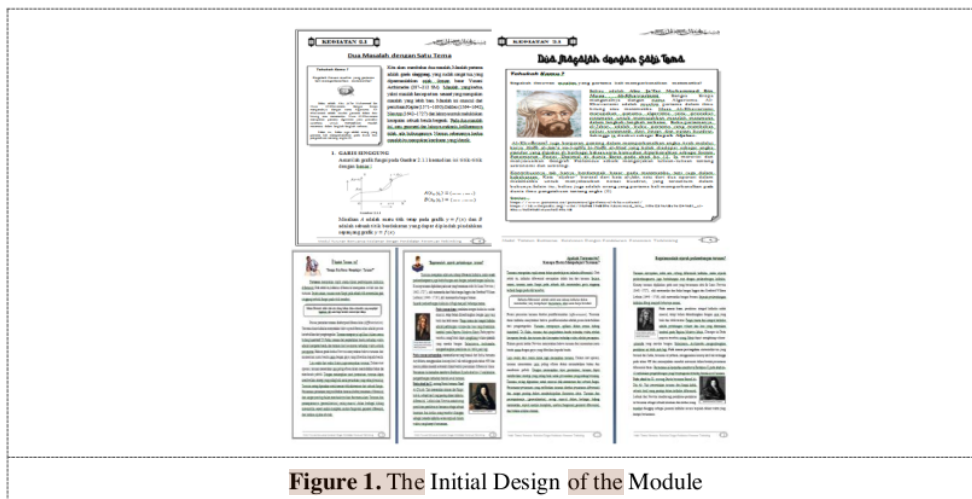


Figure 1. The Initial Design of the Module

3.3 Develop Stage

The activity at this stage followed the designs that have been made in the design stage, the revised draft based on the comments and advice from the experts, and the small-scale trial. This module was validated by validators who are experts in their fields, namely material experts, media/design experts, and experts in Islamic values.

3.3.1 Material Expert Validation

The validation results increased from stage 1 to stage 2. The score of the quantity of the content aspects in stage 1 is 3.12 with the moderately valid criteria and in stage 2 with the average score of 3.75 with the valid criteria. The guided discovery approach score in stage 1 is 3.21 with the moderately valid category and then increased in stage 2 with an average score of 3.78 with the valid criteria. The average score of language aspects in stage 1 is 3.25 with the moderately valid criteria and then increased in stage 2 with an average score of 3.62 with the valid category. A comparison of the results of the validation stages 1 and 2 can be seen in Figure 2.

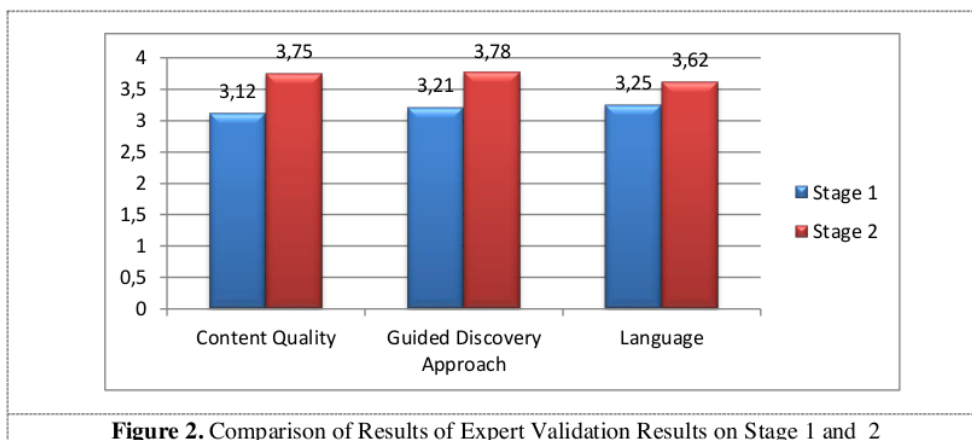


Figure 2. Comparison of Results of Expert Validation Results on Stage 1 and 2

Based on Figure 2, there is an increase in the score of the three aspects from stage 1 to stage 2, the value in the aspect of content quality increased by 0.63, the value in the aspect of guided discovery increased by 0.57, and the value in the aspect of language increased by 0.37

3.4 Validation of Media / Design Expert

There are some improvements in the module based on the media/design experts' validation on stage 1 and 2. The scores obtained on the module's size aspect of the module remain the same which is 3.5 within the valid category. The average score for the cover design in stage 1 is 1.5 within the invalid category and the score increased in stage 2 with an average score of 3.3 with a valid category. The average score for content design aspects in stage 1 is 2.25 within a less valid category and it increased in stage 2 with an average score of 3.8 within the valid category. The comparison of the results of validation on stages 1 and 2 can be seen in Figure 3.

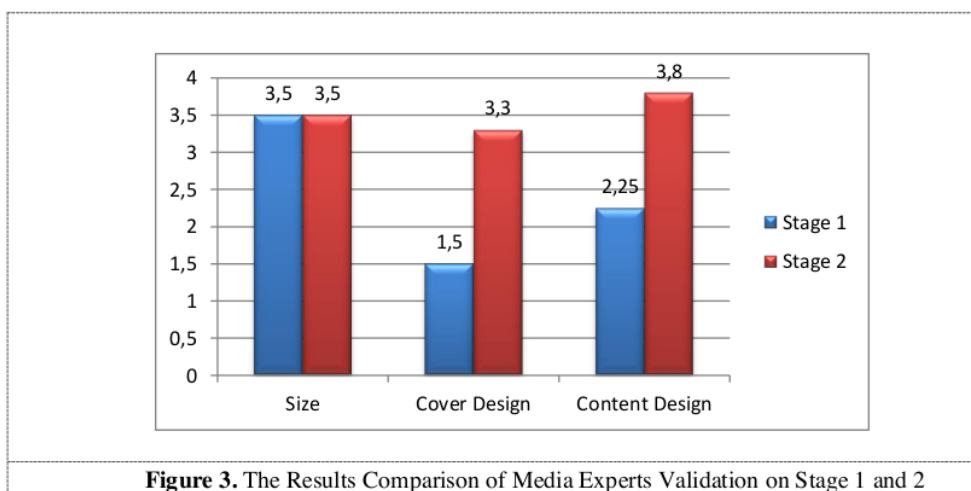


Figure 3. The Results Comparison of Media Experts Validation on Stage 1 and 2

Based on Figure 3, there is an increase in the score of the cover design aspect and the content design aspect. For the module size aspect, there was no increase. The score in the cover design aspect increased by 1.8 and content design aspect increased by 1.55

3.5 Expert Validation of Islamic Religious Values

There is an improvement in the aspects of religious value. The average score for the content quality in stage 1 is 2.99 within the moderately valid category and the score increased in stage 2 with an average score of 3.78 within the valid category. The average score for the language aspects in stage 1 is 3.78 within a valid category and it increased in stage 2 with an average score of 4 within the valid category. The average score for the emphasis aspect of the material in stage 1 is 3.25 within the moderately valid category and it increased in stage 2 with an average score of 4 with the valid criteria. The comparison of the validation results can be seen in Figure 4.

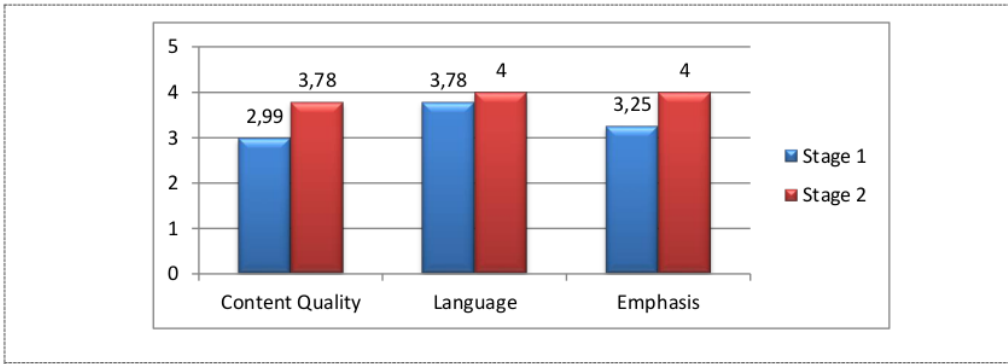


Figure 4. The Result Comparison of Islamic Expert Validation on Stage 1 and 2

Based on Figure 4, there is a score increase in the three aspects from stage 1 to stage 2. Based on the data, the scores of content quality aspects increased by 0.79, the score of the language aspect increased by 0.22, and the score of the material emphasis aspect increased by 0.75.

3.6 Small-scale Trial

In a small-scale trial, the module was distributed to the students to find out their responses toward the developed module. The students were mathematics students of UIN Raden Intan Lampung, Unila, and Teknokrat. They were asked to fill in the module attractiveness questionnaire. The results of the attractiveness trial data can be seen in Table 3.

Table 3. The Results of the Attractiveness Questionnaire

	1	2	3	4	5	6	7	8	9	10
$\sum x_i$	46	43	42	43	43	42	40	41	44	44
\bar{x}_i	3.8	3.5	3.5	3.5	3.5	3.5	3.3	3.4	3.6	3.6
\bar{x}	3,56									
Criteria	Very Attractive									

Based on the results of the students' responses, module attractiveness is in a very attractive category with an average score of 3.56.

3.7 Dissemination Stage

The next stage was to disseminate the developed product. The module can be accessed on the website at <https://pspm.tarbiyah.radenintan.ac.id>. This stage was done so that the product can be utilized and used in classroom learning. This research was limited to the deployment stage and no experiment was carried out on products developed due to time and cost limitations.

Based on the stages of development, the module is declared as valid and feasible to be used based on several stages of validation. A small-scale trial was conducted after the validation and revision to a limited number of students as users to get responses directly. The feasibility criteria in previous studies state that the feasibility can be known from the results of the validation of experts contained in the validation questionnaire based on the components assessed. The assessment of the validation questionnaire was then analyzed and calculated using the formula to produce a feasibility percentage which was then adjusted to the feasibility category based on the Likert scale percentage. After conducting the validation and revision stages, the module can be said to be feasible. The next step was the small-scale trial to find out their responses toward the module. The module met the validity criteria

of the validator and got a good response so it can be said that the module is feasible to be used as teaching material [60].

There is also research that says that the module's feasibility criteria that have been developed and assessed can be seen through the results of validation and the results of the small-scale trials. The assessment of product validation and the results of small-scale were analyzed to determine the module's feasibility [61]. There are also previous studies that explain that for the feasibility criteria of the product being developed, the product is fit to be used if it is in the valid/feasible category according to the criteria of feasibility based on the formula used. After the product has been declared as feasible according to the validators, to determine the feasibility of the product, a small-scale trial to investigate the product's feasibility was conducted to students as the users [62]. This research refers to some previous studies that have been presented. Then, based on the results of the validation of several validators who are experts in their fields, the assessment has been included in the valid criteria after a revision. In the small-scale trial, an average score of 3.56 was obtained within a very interesting category. It can be concluded that the module developed in this study is appropriate to be used in learning.

Based on research that has been done before, the development of calculus modules based on guided discovery has been carried out in lectures of variable calculus 1. The modules produced in previous studies have a moderately valid category both in terms of material, presentation, language and readability that is adjusted to the ability of students. The presentation of the material is clear so that the students have no difficulty in grasping the intent to be conveyed. The presentation of material raises the process of forming and understanding concepts because they are presented in clear and ordered stages. Besides, the presentation of material involved the students actively to discover concepts independently. Images are presented clearly with varying colors so that they can help students understand the concepts learned. The module presents the formulation of problems that will be the focus of students in making discoveries. The module also presents data that is needed by students to make discoveries related to the problems formulated. The modules have provided opportunities for students to construct conjectures (probability) [39]. Subsequent research has been carried out into the development of calculus modules with a guided discovery approach on integral calculus. The module can assist lecturers in realizing quality learning. The application of the module can condition the learning activities well, planned, independent, complete, and with clear results. The resulting calculus module is declared valid with minimum revision [38].

Guided Discovery Learning causes students to be directly involved in finding concepts or formulas, helping them to strengthen, and improving confidence in the process of discovery. Students also gain personal knowledge so that it can firmly remain in the souls of these students. Thus, it can arouse enthusiasm for learning so students have more strong motivation to learn [63]. Guided discovery learning requires teachers to design learning processes that actively involve students. In the beginning, the teacher gives a lot of guidance then regularly reduces the frequency to produce good investigation and the students' scientific knowledge can be increased. The advantage of discovery learning for students is that it emphasizes in presenting the results of their experiments. Students will be actively involved in discussions based on their learning styles [12]. This discovery learning model is ideal for science subjects and several studies have shown that this method is effective for improving students' learning outcomes [12, 64, 65]. With the skills acquired, students are motivated to be independent, think critically, and design experiments and research in ways that scientists do [66]. Students are allowed to see for themselves which ideas are more consistent with the evidence. Also, the ability to question, describe, propose, communicate, and conclude [67] can improve mastery skills in the learning process with discovery [53].

Some previous studies have developed calculus modules, some of which have developed calculus modules on integral material to be able to improve mathematical abilities [36] the development of calculus modules on multiple variables material [39] and the development of basic and advanced calculus modules using maple [40]. The renewal in this study lies in the development of calculus modules with the guided discovery approach on derivative materials. The module development is needed because many teaching materials do not provide an opportunity for students to find their understanding

independently [68] so the guided discovery approach is used in module development. Modules developed using the guided discovery approach are considered effective as an approach because students can find their understanding independently. The module developed in this study has an Islamic nuance supplemented by Islamic values in the form of Quranic verses. The mathematics explanation is presented by providing information from Muslim scientists. In addition to the Islamic values, this module also presents phenomena related to the environment such as environmental pollution, reforestation, and natural disasters caused by environmental factors. This module seeks to introduce Islamic references and the importance of preserving the environment in mathematics. However, this module has several drawbacks, namely, this module is not easy to use in institutions that are not Islamic-based because this module has an Islamic nuance. This module is developed only on derivative materials, and only uses one approach which is the guided discovery approach.

16 Conclusions and Recommendations 2

Based on the results of research and discussion, the guided discovery approach calculus modules on derivative material with Islamic nuance and environmental insight produced has been developed using the 4D model consisting of the define stage, the design stage, the development stage, and the distribution stage. Based on the results of the assessment, the module is declared as valid and feasible based on the validation conducted by the material experts, media design expert, religious and environmental values experts, as well as the attractiveness aspects which obtained an average score of 3.56 within the very attractive category.

Based on the conclusions of this study, several suggestions for future researchers can be proposed. It is hoped that the guided discovery approach calculus modules on derivative material with Islamic nuance and environmental insight can be further developed with a higher complexity or to develop an Islamic nuanced and environmentally friendly calculus module by using another approach.

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