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Design and Evaluation of a Guided Discovery-Based Calculus Module on Derivatives with Islamic Values Integration

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ABSTRACT

Purpose of the study: This study aims to develop and evaluate a guided discovery-based calculus module on derivatives integrated with Islamic values to support students' conceptual understanding, independent learning, and spiritual awareness in higher education mathematics learning.

Methodology: This study employed a Research and Development (R&D) method using the 4D model (define, design, develop, disseminate). Data were collected through questionnaires, validation sheets, and documentation. Instruments included expert validation sheets and student response questionnaires. Data were analyzed using descriptive quantitative and qualitative techniques with a Likert scale (1–4).

Main Findings: Results show that the module achieved valid criteria across material, media, and Islamic values aspects after revision. Material validation increased to 3.75, media design to 3.8, and Islamic values to 4.0. Limited trial results indicated an average score of 3.56, categorized as very attractive. These findings confirm that the module is feasible and well-received by students.

Novelty/Originality of this study: This study presents an integrative calculus module combining guided discovery learning with Islamic values on derivative topics. It simultaneously addresses cognitive and spiritual aspects within a single instructional design. This approach provides a holistic learning resource and contributes to advancing mathematics education by integrating pedagogical strategy and value-based learning.

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1. INTRODUCTION

Calculus is a fundamental subject in mathematics education that plays an essential role in developing students' analytical thinking and problem-solving skills. Core concepts in calculus, such as limits, continuity, derivatives, and integrals, are interconnected and form the basis for advanced mathematical learning [1], [2]. Among these topics, derivatives serve as a crucial foundation for understanding higher-level courses, including integral calculus and differential equations. A strong conceptual understanding of derivatives is therefore necessary for students to succeed in subsequent mathematical studies [3], [4]. Consequently, effective learning resources are required to support students in mastering these fundamental concepts.

Despite its importance, many students experience difficulties in understanding calculus concepts, particularly derivatives. Learning materials commonly used in lectures are often limited to textbooks and presentation slides that are not sufficiently interactive or student-centered [5], [6]. The language used in textbooks

is frequently considered complex and less communicative, making it difficult for students to grasp the material. In addition, the learning process tends to be teacher-centered, where students rely heavily on explanations from lecturers [7]. As a result, students' motivation, participation, and independent learning abilities remain relatively low.

Previous studies have shown that the development of instructional materials can improve students' learning outcomes and engagement. The use of guided discovery approaches has been proven effective in encouraging students to actively construct their own understanding [8]. Furthermore, research on module-based learning indicates that well-designed modules can enhance students' independence and conceptual comprehension [9]. Several studies have also integrated Islamic values into learning materials, showing positive impacts on both cognitive and affective domains [10], [11]. However, these studies generally focus on either instructional approach or value integration separately.

There is still limited research that combines guided discovery approaches with the integration of Islamic values in calculus learning materials, particularly on derivative topics. Most existing studies develop modules without incorporating a structured learning approach, or they apply guided discovery without integrating religious values. In addition, previous developments are often focused on different mathematical topics or educational levels [12], [13]. This lack of integration creates a gap in providing comprehensive learning materials that address both cognitive understanding and spiritual development. Therefore, a more holistic approach is needed to bridge this gap in mathematics education.

The development of an appropriate learning module is essential to improve the quality of calculus instruction. A module designed with a guided discovery approach can encourage students to actively explore concepts and build their own understanding [14], [15]. Integrating Islamic values into the module can also support the development of students' character and spiritual awareness. Such integration is important in creating a balance between knowledge acquisition and moral development [16]. Therefore, the development of an Islamic-integrated calculus module is considered highly relevant and necessary.

This study offers novelty by developing a calculus module on derivatives that integrates Islamic values within a guided discovery framework. Unlike previous studies, this research combines instructional design and value integration in a single product. The module is specifically designed to promote independent learning, conceptual understanding, and spiritual awareness simultaneously. In addition, the study evaluates the feasibility of the developed module through systematic validation and testing. Thus, this research contributes to the advancement of mathematics education by providing an innovative and integrative learning resource.

2. RESEARCH METHOD

2.1 Research Design

This study applied a Research and Development (R&D) approach to design and evaluate a calculus module on derivatives integrated with Islamic values using a guided discovery approach [17], [18]. The development process adopted the 4D model, which consists of define, design, develop, and disseminate stages [19]. The define stage focused on identifying learning needs through questionnaires and literature analysis related to calculus instruction [20]. The design stage involved structuring the module content, learning activities, and integration of Islamic values within the guided discovery framework. The develop and disseminate stages aimed to validate, revise, test, and distribute the final module for broader educational use.

2.2 Participants and Data Collection

The participants in this study were undergraduate students from UIN Raden Intan Lampung, Universitas Lampung, and Institut Teknologi Sumatera involved in the limited trial phase. Data were collected in the form of quantitative and qualitative data using questionnaires, validation sheets, and documentation [21]. The instruments included expert validation sheets covering material, media design, and Islamic value integration aspects. In addition, student response questionnaires were used to measure the attractiveness and usability of the developed module. Data collection techniques involved pre-research questionnaires, expert validation, and limited trials to obtain comprehensive evaluation results.

2.3 Data Analysis Technique

Data analysis was conducted using descriptive quantitative and qualitative techniques to evaluate the feasibility and effectiveness of the module [22]. Quantitative data were obtained from Likert-scale assessments ranging from 1 (very poor) to 4 (very good). The average score was calculated to determine the validity and attractiveness levels of the module. The results were then categorized into specific criteria to interpret the quality of the product. Qualitative data in the form of suggestions and feedback from experts were used to revise and improve the module before final implementation.

Table 1. Validation Criteria

Average Score Range	Category
3.26 – 4.00	Very Valid
2.51 – 3.25	Valid
1.76 – 2.50	Less Valid
1.00 – 1.75	Invalid

3. RESULTS AND DISCUSSION

3.1 Development Results

This study produced a calculus module on derivatives developed using a guided discovery approach integrated with Islamic values. The development process followed the 4D model, consisting of define, design, develop, and disseminate stages. In the define stage, it was found that students tended to be passive and the existing teaching materials did not support independent learning or the integration of Islamic values. The design stage resulted in a module structure containing learning materials, guided discovery activities, and the integration of Qur'anic verses and Islamic reflections. The initial prototype of the developed module before revision is presented in Figure 1.

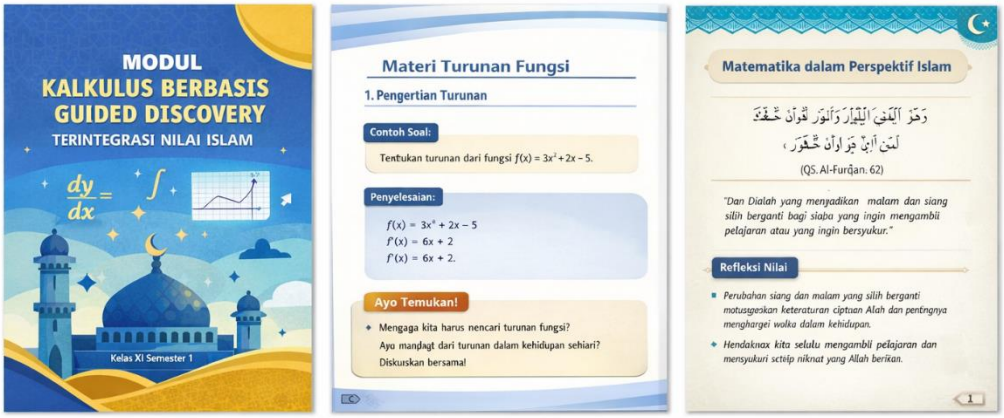

Figure 1: Initial Prototype of the Guided Discovery-Based Calculus Module Integrated with Islamic Values

3.2 Validation Results

3.2.1 Material Expert Validation

The results of material expert validation showed an improvement in the quality of the module from the first stage to the second stage after revision. In the initial stage, the average scores for content quality, guided discovery, and language aspects were categorized as fairly valid. After revisions based on expert suggestions, the scores increased to the valid category with averages above 3.6. This indicates that the content is conceptually accurate, systematically presented, and supports guided discovery learning. Therefore, the module is considered feasible in terms of content.

Table 2. Material Expert Validation Results

Aspect	Stage 1	Stage 2	Criteria
Content Quality	3.12	3.75	Valid
Guided Discovery	3.21	3.78	Valid
Language	3.25	3.62	Valid

3.2.2 Media/Design Expert Validation

The media/design expert validation results showed significant improvement, particularly in the visual aspects of the module. In the first stage, the cover and content design were categorized as not valid and less valid. After revisions, including improvements in layout, typography, and cover design, the scores increased to the valid category with averages above 3.3. This demonstrates that the module meets the criteria of visual quality,

readability, and instructional design suitability. Thus, the module is considered feasible in terms of media and design.

Table 3. Media/Design Expert Validation Results

Aspect	Stage 1	Stage 2	Criteria
Module Size	3.5	3.5	Valid
Cover Design	1.5	3.3	Valid
Content Design	2.25	3.8	Valid

3.2.3 Islamic Values Expert Validation

The validation results from Islamic values experts indicated a notable improvement after revision. In the first stage, aspects such as content quality and emphasis on Islamic values were categorized as fairly valid. After revising the module by strengthening references and improving the integration of Islamic content with mathematical concepts, all aspects reached the valid category with scores up to 4.0. This suggests that the integration of Islamic values is appropriate, accurate, and relevant to the learning material. Therefore, the module is considered feasible from the perspective of Islamic values integration.

Table 4. Islamic Values Validation Results

Aspect	Stage 1	Stage 2	Criteria
Content Quality	2.99	3.78	Valid
Language	3.78	4.00	Valid
Emphasis on Values	3.25	4.00	Valid

3.3 Limited Trial Results

The limited trial was conducted to examine students' responses to the developed module, particularly in terms of attractiveness and usability. The trial involved 10 students from several universities who completed a response questionnaire. The results showed an average score of 3.56, which falls into the very attractive category. This indicates that the module successfully increases students' interest and engagement in learning. Therefore, the developed module is not only valid according to experts but also well-received by students.

Table 4. Limited Trial Results

Indicator	Score
Average Score	3.56
Criteria	Very Attractive

Results of this study indicate that the developed calculus module on derivatives based on a guided discovery approach integrated with Islamic values is valid and feasible for use in learning. Evidence for this can be seen from the improvement in validation scores across material, media, and Islamic values aspects after the revision process. The module fulfills criteria related to conceptual accuracy, systematic organization, and alignment with guided discovery principles. Integration of Islamic values has also been confirmed as appropriate and relevant to the mathematical content. Overall, the developed module successfully achieves its intended instructional design objectives.

Findings from the limited trial reveal that the module is highly attractive to students, as reflected in an average score of 3.56 categorized as very attractive. Such results indicate that student interest and engagement in learning calculus, especially derivatives, can be enhanced through the use of this module. Guided discovery activities embedded in the module encourage active participation and support students in constructing their own understanding. Inclusion of Islamic values further enriches the learning experience by adding meaningful and contextual elements. Consequently, the module supports both cognitive development and affective engagement.

These findings are in line with previous studies emphasizing the effectiveness of guided discovery approaches in improving conceptual understanding and student engagement [23]. Earlier research has demonstrated that well-structured modules can foster independent learning and strengthen problem-solving skills. Nevertheless, many studies tend to focus either on instructional strategies or on value integration separately [24]. This study addresses that limitation by combining both aspects into a unified instructional design [25], [26]. As a result, it provides additional empirical support for integrative approaches in mathematics education.

A key contribution of this study lies in integrating Islamic values within a guided discovery-based calculus module, particularly on derivative topics. Unlike earlier developments that lack structured discovery processes,

this module systematically guides students through conceptual exploration [27], [28]. Inclusion of Qur'anic verses and Islamic reflections introduces a meaningful connection between mathematical concepts and spiritual values. Such integration creates a more holistic learning resource that aligns with the context of Islamic higher education [29], [30]. This approach offers a distinct contribution to the development of innovative mathematics learning materials.

Implications of this study are relevant for educators and curriculum developers seeking to improve instructional quality. The module can be used as an alternative teaching resource that promotes active and student-centered learning [31], [32]. Lecturers are able to facilitate guided discovery processes more effectively while encouraging independent learning. Integration of Islamic values also contributes to character building and the development of students' spiritual awareness. In a broader context, this approach has the potential to be adapted for other mathematical topics and educational levels.

Several limitations should be considered when interpreting the findings of this study. Implementation was limited to a small number of participants during the trial phase. Focus on derivative material alone may restrict generalization to other areas of calculus [33]. In addition, the study did not include experimental testing to measure the direct impact on learning outcomes [34]. Constraints related to time and resources also influenced the scope of dissemination. Future research is therefore recommended to involve larger samples and experimental designs to further examine the effectiveness of the module.

4. CONCLUSION

This study successfully developed and evaluated a guided discovery-based calculus module on derivatives integrated with Islamic values, addressing the need for more interactive and meaningful learning resources as identified in the introduction. The results demonstrate that the module meets validity criteria across material, media, and Islamic values aspects, indicating its feasibility for implementation in higher education. In addition, findings from the limited trial reveal that the module is highly attractive to students and supports active engagement as well as independent learning. Integration of guided discovery and Islamic values not only enhances conceptual understanding but also contributes to students' spiritual and character development. These outcomes confirm the alignment between the initial research objectives and the results obtained, highlighting the effectiveness of an integrative instructional approach. Future research is recommended to expand the implementation on a larger scale, incorporate experimental designs to measure learning outcomes, and explore the application of this approach to other mathematical topics and educational contexts.

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