Developing Islamic-Nuanced Linear Algebra Module with Guided-Inquiry approach in the Matrix Material

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Abstract. This research aims to develop and find out the feasibility of Islamic-Nuanced Linear Algebra Module with Guided-Inquiry approach in the Matrix Material. The research method is Research and Development (R & D) with the 4D model. The stages start with defining, designing, developing, dissemination. Validation was done by the material experts, Islamic experts, and media experts. Product testing was done through limited trials. Based on the results of the material expert validation, it obtained an average score of 3.6, Islamic experts obtained an average score of 4 and media experts obtained an average score of 3.7. Thus, the product is declared valid to be used after validating the results of the product and testing it to the student. Student responses were used to find out the feasibility of the product which obtained an average score of 3.4 with the highly attractive criteria.

1. Introduction

Education is a necessity of life and essential for humans because education can develop the potential within through the learning process to meet the needs of life [1-2]. Through education, the potential possessed since birth can be developed in accordance with the self-potential respectively. Mathematics is a very important science to learn because mathematics is the parent of all knowledge [3]. Mathematics always contains the concepts, principles, and abstractions. Understanding the concept must be strong before understanding the principles [4]. Mathematics learning needs an emphasis on understanding the concepts of the material [5].

Linear algebra is one of the subjects taught in the Mathematics Education Department of Tarbiyah and Teacher training faculty of Raden Intan State Islamic University Lampung. Linear algebra itself has many sections of material, for example, the matrix. A matrix is an arrangement of numbers or functions arranged in rows and columns and flanked by two square brackets [6]. Linear algebra is an important part of mathematics learning in Higher Education that need to be mastered by the students because it is quite widely used on other materials such as linear programming and calculus [7]. But, in fact, there are still many students who have difficulty understanding the concept of Linear Algebra. This is in accordance with the results of the questionnaire analysis of the students’ needs in several campuses, namely the Raden Intan State Islamic University Lampung, University of Lampung, and the Teknokrat University Indonesia.

The results of the questionnaire concluded that the students have difficulties in understanding the material as well as sample problems. One of the factors of the difficulty is the learning resources and the learning model which is not in accordance with the needs and characteristics of students [8-9]. Moreover, there has been no reference in the learning resources related to the verses of the Quran on the material [10]. The Quran already stated that all things were created mathematically based on the word of God in Surah Al-Qamar verse 49: Meaning: Indeed, we have created all things in its proper measure.
This verse describes that surely we have created everything according to its size. It says in the verse above, in terms of language, the phrase “proper measure” can mean a specific size or means the power. This means that all in this nature has been calculated thoroughly.

Based on these problems, it is necessary to develop a linear algebra learning courses module in accordance with the needs of students. According to Hamdani, the definition module is a tool or means of learning that contains the materials, methods, limitations of learning materials, instructions, learning activities, exercises, and evaluation that is systematic and interesting to achieve the expected competencies and can be used independently [11-12]. The module developed by the researchers is an Islamic-Nuanced Linear Algebra Module with Guided-Inquiry approach in the Matrix Material because researchers wanted to create a math module that does not only accentuate the aspect of mere intellectual but applying the values Islam that can be applied in everyday life.

The learning Model is also in accordance with the characteristics of students, for example, guided inquiry. Guided-inquiry is an effective way to create variations in the pattern of learning [13]. This is consistent with the statement stated by Opara and Oguzor, that in inquiry learning, the role of teacher only as students’ facilitator to find their own ideas for them to learn and develop a very deep science. Guided-inquiry learning problems are raised by mentors or teachers that involve skill process and scientific activity, in order to produce behavioral changes or learning outcomes. Through guided inquiry, the teacher must monitor class’ ideas and when students develop their ideas [14]. Piaget argued that the model of guided inquiry is a model that prepares learners on the situation to conduct their own experiments in the area to see what happens [15].

Based on the results of previous studies, research was conducted to develop a math module with the strategy of problem-solving to measure the level of mathematical creative thinking abilities of students [1], design and development of physics module based on learning style and appropriate technology by employing isman instructional design model [16], the development of a group guidance module for student self- development based on gestalt theory [17], development of e-module based on problem based Learning (PBL) on heat and temperature to improve student’s science process skill [18], develop learning media (module) - assisted geogebra the subject of the derivative [19], mengembankan modul pembelajaran IPA SMP pada materi tekanan berbasis keterampilan proses science [20], develop module bilingual picture-based quantum learning on the material opportunities [21], developing mathematical modules based on the learning model of problem based learning the subject matter of trigonometry [22] and develop the module a mathematical approach to science, technology, engineering, and mathematics (STEM) on the material of quadrilateral [23]. The difference with the products developed by researchers develops module courses of linear algebra in the material matrix of the nuances of Islam with a guided inquiry approach.

Further research designing teaching material course of linear algebra to develop mathematical creative-thinking abilities [24] and develop teaching materials courses linear algebra-based open-ended [25]. The difference with the products developed by researchers is that the researchers develop an Islamic-Nuanced Linear Algebra Module with Guided-Inquiry approach in the Matrix Material that aims to determine the verses of the Qur'an related to the matrix material that so that it can be applied in everyday life.

Further research developed a learning module of science integrated with Islamic values for students with visual disability [12], develop the ability of the mathematical connection through the electronic-interactive textbook (BAEI) integrated with Islamic values [26], develop LKPD discussion activity integrated with Islamic values in the pictorial riddle on the fractional material [27]. The difference between the products developed by researchers is that the language and the material are easy to understand and be adapted to the characteristics of the students.

Subsequent research developed the students worksheets with a guided-inquiry approach to optimize the critical-thinking skills of learners [14], the development of student worksheets based on guided inquiry by class and laboratory activity for reaction rate material at the 11th grade in high school [28], develop LKS practicum-based guided inquiry on the subject of buffer solution [29] and developing worksheets based on a guided inquiry approach in cooperative learning on the material of heat [30]. The difference with the products developed by researchers is that the researchers developed Islamic-Nuanced Linear Algebra Module with Guided-Inquiry approach in the Matrix.
Based on several previous studies, researchers concluded to provide an alternative to creating a module featuring the process skills aspects so that students can understand the material and do the exercises given by the lecturer. The research aims to produce an Islamic-Nuanced Linear Algebra Module with Guided-Inquiry approach in the Matrix Material.

2. Research Methods

This research used Research and Development method. This study used 4-D model proposed by Thiagarajan Semmel, and Semmel (2014). The Researchers used the model with reference to the previous studies[17, 28–34]. This Model consists of four stages of development, namely define, design, development, and dissemination [35]. The steps of the research and development are shown in figure 1 [29,36]:

![Define → Design → Development → Dissemination](image)

Figure 1. Research and Development according to Thiagarajan (1974)

The first stage, namely the define phase with the purpose to establish and define the terms of learning. After the define phase, the next stage is the design stage with the aim to set up a prototype learning device. Furthermore, the third stage is the stage of development with the aim to produce learning tools revised based on input from experts. While the last stage is the stage of dissemination, this stage is the stage of use of the device that has been developed on a wider scale [35].

Researchers concluded using a model 4D with four stages but in the context of product development, the stage of dissemination is done by means of the socialization of learning resources or teaching materials through the distribution of a limited trial. The distribution is intended to obtain responses, feedback to the learning resources or teaching materials that have been developed. The type of data used in the implementation of this research using quantitative data and qualitative data. Data analysis techniques in this research using qualitative descriptive analysis technique which presents the results of product development.

The Data obtained through the instrument of the test were analyzed using qualitative descriptive statistics. This analysis is meant to describe the characteristics of the data obtained through expert validation and field trials. Data of validation experts covers the materials, the suitability of the material with the Basic Competence, Competence Standard, the Indicators of Achievement, learning objectives, completeness of the materials of Islamic values, the content of Al-Qur'an and its interpretation, the relationship between the mathematical content with the Islamic values and the accuracy of the score. To determine the attractiveness, the product was tested through field trials by the students. To calculate the assessment score, the following formula was used [37]:

$$\bar{x} = \frac{\sum_i x_i}{n}$$

Description:

- $\bar{x}_i$: the score of the questionnaire
- $\bar{x}$: average score
- $\bar{x}_i$: the score of the questionnaire
- $n$: number of students who fill out the questionnaire

Questionnaire validation experts associated in terms of materials, the suitability of the material with the Basic Competence, Competence Standard, the Indicators of Achievement, learning objectives, completeness of the materials, the content of Al-Qur'an and its interpretation, the relationship between the content of mathematics with the Islamic values as well as the accuracy of the scoring. The questionnaire has 4 choices of answers. Assessment scores for each answer choice can be seen in Table 1.

| Score | Answer Options | Feasibility |
|-------|----------------|-------------|
| 4     | Excellent      |             |
| 3     | Good           |             |
| 2     | Poor           |             |
| 1     | Very poor      |             |
The results of the assessment score of validation by the experts can be seen in Table 2.

| The Quality Score | Feasibility Criteria | Description                  |
|-------------------|----------------------|------------------------------|
| 3.26 ≤ x ≤ 4.00  | Valid                | No revision                  |
| 2.51 ≤ x ≤ 3.26  | Quite valid          | The revision of the part     |
| 1.76 ≤ x ≤ 2.51  | Less valid           | The revision of the part and review the material |
| 1.00 ≤ x ≤ 1.76  | Not valid            | Total Revision               |

Questionnaire responses to the attractiveness of the product can be seen in Table 3.

| Score | Criteria |
|-------|----------|
| 4     | Excellent |
| 3     | Good      |
| 2     | Poor      |
| 1     | Very poor |

The results of the assessment scores from each student can be seen in Table 4.

| Score          | The Attractiveness Criteria |
|----------------|----------------------------|
| 3.26 ≤ x ≤ 4.00| Very interesting           |
| 2.51 ≤ x ≤ 3.26| Interesting               |
| 1.76 ≤ x ≤ 2.51| Less interesting           |
| 1.00 ≤ x ≤ 1.76| Uninteresting             |

3. The Results of Research and Discussion

Define phase includes four steps as follows [29]:

1. Front-End Analysis
   - Needs analysis refers to the existing conditions in the field. This analysis is needed to determine whether the source of learning indeed need to be developed or not.

2. Concept Analysis
   - The results of the concept analysis are in the form of 6 systematic and relevant sections based on the syllabus, namely: matrix, matrix operations, elementary row operations, determinant, matrix inverse and matrix rank.

3. Task Analysis
   - Researchers analyze the main tasks that must be mastered by students so that the students can achieve the minimum competencies.

4. Specifying Instructional Objectives
   - This stage is the formulation of the previous analysis to determine the behavior of the object of research.

After define stage, the next stage is the design stage. There are four steps that will be done at this stage, namely [29, 34, 39]:

1. Constructing Criterion-Referenced Test
   - The results of the analysis in the preparation stage obtained as follows:
     1.1 The learning activities in the form of the matrix material with Islamic nuances
     1.2 Examples of questions using the guided-inquiry approach.
     1.3 Answer keys for every item.
2. The Selection of Learning Resources
   Learning resources are in the form of a module which aims to facilitate in the learning process. The module is very relevant and has not been used subject universities.

3. Format Selection
   The module is adjusted to the syllabus. This module uses the B5 paper size, 1.5 scale spacing, Calibri, Cambria, Times New Roman, and Bernard MT Condensed font, the material of the matrix and symbols of Mathematics are made through the application of the Wolfram Mathematica 7 and the program Equation, as well as verses of the Qur'an through the Add-Ins program.

4. Initial Design
   The draft of the initial product development module consists of a front cover and back cover, inner cover (page of team development module), preface, list of contents, learning activities in the form of the material, examples of questions using a guided inquiry approach, exercises, bibliography, and answer key.

   The next is the development stage (development) with the following stages:

1. Validation
   The developed module was validated at the initial stage by the experts. The criteria of expertise are those who are experienced in their field, have at least a magister degree or are currently studying in postgraduate school.

1.1 Validation by the Material Expert
   The results of the validation by a material expert in stage 1 increased compared to the material expert validation in stage 2. The score of the content quality aspect in stage 1 obtained an average score of 2.7 with the moderate criteria and in stage 2, the obtained average score was 3.6 with the valid criteria. Aspects of guided inquiry in stage 1 obtained an average score of 2.2 with the least valid criteria and at stage 2, the average score of guided-inquiry obtained 3.7 with the valid criteria.
   The language aspect in stage 1 obtained an average score of 2.7 with the moderate criteria and at stage 2, the average language score obtained was 3.6 with the valid criteria. The data can be seen in figure 2.

   ![](image)

   **Figure 2** The Comparison Chart of the Average Validation Results by Material Expert in Stage 1 and Stage 2

   Based on figure 2, there is an increase in all three aspects of the assessment in stage 1 to the assessment in stage 2. The average score increased by 0.9; the average score of the guided-inquiry aspect increased by 1.5 and the average score of the language aspect increased by 1.2.

1.2 Validation by Religious Expert
   The results of the assessment validation by religious experts in stage 1 were better than stage 2. The average score for the content quality aspect stage 1 obtained an average score of 2.7 with the moderate criteria and at stage 2 the average score obtained an average score of 4 with valid criteria. The material emphasis aspect in stage 1 obtained an average score of 4 with valid criteria and at stage 2 the average score obtained was 4 with valid criteria. The material emphasis aspect in stage 1 obtained an average score of 2.2 with the low validity criteria and at stage 2 the average score obtained was 4 with the valid criteria. The data can be seen in figure 3.

   ![](image)

   **Figure 3** The Comparison Chart of the Average Validation Results by Religious Expert in Stage 1 and Stage 2
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Based on figure 3, there is an increase in the aspect of the quality of the content and material emphasis. The language aspect remained the same. The score on the content quality aspect increased by 0.8 and the score on emphasis aspect of the material increased by 1.8.

1.3 Validation by Media Expert

The results of the validation by Media expert in stage 2 were better than stage 2. The score for the size aspect in stage 1 obtained an average score of 3 with moderate criteria while in stage 2 obtained an average score of 4 with the valid criteria. The cover design Aspects in stage 1 obtained an average score of 2.3 with the valid criteria and in stage 2 obtained the average score of 3.3 with the valid criteria. While the media experts on the design aspects in stage 1 obtained an average score of 3 with moderate criteria and in phase 2, the average score obtained was 4 with the valid criteria. The data can be seen in figure 4.

Based on figure 4, there is an increase in all aspects of the assessment of stage 1 to the assessment of stage 2 by 1.0 point.

2. The Revision of the Product

After the product design was validated through the assessment by the experts, researchers made revisions to the design of the products based on the inputs.

3. Product Trials

The limited trial to test the attractiveness of the product was conducted to 20 students. The students seemed happy and enthusiastic about using this module. The material and sample problems are presented contextually so that students could easily understand the material. The score of trials can be seen in figure 5.
Based on the results of the responses of the students, the module is in the highly attractive criteria with an average score of 3.4. This means that the module developed by the researchers has a criterion validity and attractive to be used as a learning resource in the learning process.

4. Revision
The module was declared very attractive so do not need to redo the trials. Furthermore, the module can be used as a learning resource in the learning process.

5. Learning Resources Validation
The module was declared very attractive so do not need to redo the trials. The module can be used as a learning resource in the learning process.

The final stage is the dissemination stage. The researchers disseminate the products developed online on the following website address http://pspm.tarbiyah.radenintan.ac.id.

Based on previous research, has done some research that developed the module linear algebra, some of which are e-modules the algebra-oriented problem solving to improve critical thinking skills of students [40-41], the module linear algebra elementary nuanced constructivism assisted the ICT [42-43], teaching materials linear algebra to develop mathematical creative thinking abilities [44-45]. Based on previous research, the novelty of this research lies in the development of the that provide insight into new knowledge, both in terms of mathematics and the interconnectedness between the matrix material with Islamic values. The exercises can make learning interesting and effective if used independently or in groups so that students can understand the problems. The module contains verses of the Qur'an and information about the figure of Muslim scientists to motivate the students in learning.

4. Conclusion and Suggestions
The developed product is declared valid through the expert validation with an average score of 3.6 by material experts, 3.7 by the Islamic experts and 3.7 by media experts. The response from the students obtained an average score of 3.4 with the Very Interesting criteria. It can be concluded that this module is said to meet the criteria of valid/feasible to use in the learning process.

Based on the results obtained, it is suggested to develop the next module with the more extensive material. The developed product still has many shortcomings in the manufacture or development so that the module can then be developed further in order to motivate and increase the students’ interest in the learning activity.

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