Development of multiple intelligences-based teaching material to improve student’s high order thinking skill

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Abstract. This research was development research that used ADDIE design (analyze, design, develop, implementation, and evaluate). The study aimed to develop teaching material based on multiple intelligences to improve multiple intelligence and higher-order thinking skills. The characteristics of teaching material developed the insertion of multiple intelligences, namely linguistic, logical-mathematical, visual-spatial, kinesthetic, musical, interpersonal, intrapersonal, and naturalist intelligence. The sample research was students of class X in one of the high schools in Juntinyuat-Indramayu. The results showed that: 1) the feasibility of teaching material based on multiple intelligences have an average score of 2.75 with proper status; 2) the results of the readability test of teaching material showed a reading rate of 82.1% in the high category; 3) interpersonal intelligence was the dominant intelligence by students in both classes, the improvement of multiple intelligences in the moderate category in the treatment class and the low category in the comparison class; 4) improvement of higher-order thinking skills in the moderate category in the treatment class and the low category in the comparison class; 5) Positive student responses to teaching material are 80.8% with strong categories.

1. Introduction

Good learning is one that can facilitate students to develop their intelligence and their potential in the cognitive, affective, and psychomotor realms [1] in accordance with educational goals. A need for the development of teaching material that builds up intelligence and potential of students so that each student has the opportunity to succeed in the future of its intelligence to maximize results.

The concept of multiple intelligence is very closely related to the current curriculum, namely 2013 Curriculum, it is that the results of the study show that the 2013 curriculum contains the development of multiple intelligence dimensions that can be seen from three things, namely the development of competencies, namely core competencies, the approach used is scientific approach, and in the scoring system that is authentic assessment [2]. The 2013 Curriculum is a competency-based curriculum, therefore curriculum development is directed towards achieving the formulated competencies. One effort to reach the curriculum is to develop multiple intelligences in learning and teaching material that students can use independently.
Facts on the field show that teaching materials in schools have not demanded students into all the core competency domains expected in the 2013 Curriculum. In addition, existing teaching material still dominate the development of competencies in the cognitive domain alone. One of them is multiple intelligences based learning or multiple intelligence is one of the means to achieve the expected competencies. The expected competencies may be achieved well because students have guidance in the form of teaching material that guide students when studying in class and independent learning.

The differences in intelligence of each individual student not only can show the contents of intelligence but also on the learning styles of students receiving learning [3, 4] and the processing of information obtained. The more types of intelligence that develop, the students will quickly adapt to the environment, how to learn accordingly, how to understand the material [4, 5] and finally can have higher-order thinking skills. The concept of multiple intelligences is the concept of different intelligence according to the development of intelligence possessed by each individual, so that not only certain intelligences are developed, but other intelligences also need to be developed so that students can have skills in learning and his prowess dup [6].

2. Methods

This study aims to obtain a product in the form of multiple intelligences based on Vertebrate material for high school students and testing their effectiveness. This study used ADDIE (Figure 1) that uses five stages in its development [7]. Here is presented Chart 1 stages of research and development with the design ADDIE. The sample of this research is multiple intelligence and higher-order thinking skills of students class X in one of the high schools in Juntinyuat taken from two classes. Both classes will be used as treatment classes and comparison classes. Sample selection is done by cluster random sampling method.

![ADDIE Model](image)

Figure 1. ADDIE Model

3. Result and Discussion

3.1 The Feasibility of Teaching Material

The feasibility of teaching material developed refers to feasibility teaching materials based on the Badan Standar Nasional Pendidikan (BSNP). Feasibility of teaching materials seen from the results of questionnaires validation teaching material that has been filled by a validator by attaching product teaching material. A summary of the results of the assessment of the feasibility of teaching is presented in Table 1.
Table 1. The results of the assessment of the feasibility of teaching materials by the validator

| No. | Validator       | Score | Average score | Status  | Percentage | Criteria  |
|-----|-----------------|-------|---------------|---------|------------|-----------|
| 1   | Validator 1     | 117   | 2.8           | Worthy  | 70.6       | Strong    |
| 2   | Validator 2     | 112   | 2.7           | Worthy  | 67.4       | Strong    |
| *   | Maximum Gain    | 168   | 4             | Worthy  | 100        | Very strong |
|     | Average         | 114.5 | 2.75          | Worthy  | 69         | Strong    |

*Questionnaire items = 42 statements

Based on Table 1, it is known that the average score obtained is 2.75, based on the assessment criteria of BNSP by looking at the profiles of the two components then set to a worthy status. While the average percentage of the feasibility of teaching material is 69% with strong criteria. Based on these results, the teaching materials that have been developed can already be implemented.

Based on the results of the validation, the expert stated that the teaching material that has been developed has a decent category in terms of content, presentation, language, and graphics. Teaching material developed is teaching material made with the analysis process so that it matches the level of student development, uses language that is easily understood by students, writing is done systematically so students can connect between one subject and another, and use clear images and writing so students are more interested in reading teaching material.

Other characteristics that must be considered when making instructional materials are presenting interesting illustrations and examples to support reading exposure, the presence of feedback such as practice questions or assignments, material presented contextually such as providing examples relating to the student's environment, and using simple language. It is appropriate that by paying attention to the characteristics of making teaching materials, teaching materials are able to make students to learn independently and obtain completeness in the learning process [8].

### 3.2 The Readability of Teaching Material

The Readability of teaching material is one of the supporting data to ensure feasible to implement teaching material for the teaching material that can be understood or read well by the students. The readability of teaching material was tested using a cloze test. Based on the results, the average percentage of the value of reading level that is 82.1% that shows higher criteria. The readability test results of teaching material using the cloze test show that the discourse presented can be read and understood by students independently.

These results provide information that students can independently read the teaching material well. Good readability of teaching material is obtained because of the use of language that can be understood by students even though it does not lose its meaning such as the use of scientific terms in Biology. In addition, the consistency of writing is also very influential, as well as the existence of a glossary as an explanatory term that may not be understood by students, so that discourse is easily read and understood by students. It is in line that the criteria that must be considered in the teaching material discourse are the frequency of how often the word appears and its suitability with the level of student development [9].

### 3.3. Improvement Multiple Intelligence

Improvement students' multiple intelligence tests can be known after teaching material is implemented in learning. Data on increasing multiple intelligences were obtained from the results of multiple intelligence tests that were carried out at the beginning (pretest) and at the end (posttest) of learning in the treatment class and comparison class. Before conducting the multiple intelligence test, as the initial data and additional data, the multiple intelligence questionnaire, it was used to find out the dominant characteristics of the students. The results of the multiple intelligence questionnaire analysis are presented in Table 2.
Table 2. Results of multiple intelligence questionnaires

| No. | Intelligence              | Percentage (%) | Treatment class | Comparative class |
|-----|---------------------------|----------------|----------------|-------------------|
| 1   | Linguistics               | 0              | 4              |                   |
| 2   | Logical-mathematical      | 8              | 4              |                   |
| 3   | Visual-spatial            | 4              | 4              |                   |
| 4   | Kinesthetic               | 8              | 9              |                   |
| 5   | Musical                   | 8              | 4              |                   |
| 6   | Interpersonal             | 46             | 39             |                   |
| 7   | Intrapersonal             | 8              | 26             |                   |
| 8   | Naturalist                | 19             | 9              |                   |

Based on the results of the students' multiple intelligences questionnaire adapted from Armstrong in Table 2 shows that multiple intelligences of students are quite heterogeneous. Multiple intelligence that stands out both in the treatment class or comparison class is interpersonal intelligence, then intrapersonal intelligence in the comparison class, and naturalist intelligence in the treatment class. This informs that group activities or cooperation are the things most often done by students, so students are accustomed to communicating with others in solving problems or assignments cooperatively. In line with the research that high interpersonal intelligence is due to the usual learning activities that are carried out in groups either in discussions or other assignments [10].

Improvement multiple intelligence is assessed by different assessment tests and rubrics. Linguistic intelligence with reading tests, logical-mathematical intelligence with classification tests. Visual-spatial intelligence with drawing tests, kinesthetic intelligence with tests selecting tools and materials, musical intelligence with song lyric test, interpersonal intelligence with peer assessment, intrapersonal intelligence with self-assessment, and naturalist intelligence by testing observation skills. Based on the results of these tests it can be seen that students who have good logical-mathematical intelligence and students who have less logical-mathematical intelligence. It is seen from the classification test answers of students who have logical-mathematical intelligence are well marked by classifying animals into the right order and give reasons under the questions. While the classification test answers of students who have logical-mathematical intelligence are less marked by classifying animals is not right, even some animals that do not exist in the question are written down and do not give one reason whatever asked in the question. Summary of the results of the analysis of the average values of pre-test, post-test, and N-Gain students’ multiple intelligence can be seen in Table 3.

Table 3. The average value of pre-test, post-test, and N-Gain multiple intelligence

| Class       | Maximum Value | Average value | N-Gain | Criteria  |
|-------------|---------------|---------------|--------|-----------|
|             | Pretest       | Posttest      |        |           |
| Treatment   | 100           | 73.3          | 85.8   | 0.45      | Moderate  |
| Comparison  | 100           | 68.3          | 77.6   | 0.26      | Low       |

Table 3 shows that overall N-Gain is multiple intelligences the treatment class is 0.45 with moderate criteria and N-Gain multiple intelligence the comparison class is 0.26 with low criteria. In conclusion, the treatment class experienced a higher increase in multiple intelligences than the comparison class. Classroom treatment with multiple intelligences based teaching material is more effective than comparison classes with commonly used teaching material. Different tests of Mann-Whitney U nonparametric statistics were used in pre-test and post test data because the data were not normally distributed. Summary of different test results multiple intelligence is seen in Table 4.

Table 4. Results of different test results of multiple intelligence

| Data       | Test             | Sig.  | Information   |
|------------|------------------|-------|---------------|
| Pre test   | Mann-Whitney U   | 0.258 | Not significantly |
| Post test  | Mann-Whitney U   | 0.022 | Significantly  |
Pre-test data the results of the multiple intelligence differential test in Table 6 show the probability value (Sig.) that is 0.258 > 0.05 which means that there is no significant difference in the data values of the pre-test class of treatment and the comparison class. Whereas post-test data the results of the multiple intelligence differential test in Table 6 show the probability value (Sig.) that is 0.022 < 0.05 which means there are significant differences of post test data value treatment class and comparison class. The existence of significant differences proves teaching materials based on multiple intelligences effective in increasing students' multiple intelligence.

Class treatment with multiple intelligences based teaching material has effectiveness in the moderate category towards increasing multiple intelligence and comparison classes with commonly used teaching material has effectiveness in the low category to increase multiple intelligence. According to what has stated [11] that intelligence is related to the individual's environmental development factors. So that the environmental factors in the form of multiple intelligences based teaching materials in which inserted activities to develop multiple intelligences make students do activities or learn with their learning styles or they find activities that are following their intelligence. This is closely related to the results of the tests obtained, which are increased.

Multiple intelligence must be applied in education to meet the needs of all students [12]. This is because the theory of multiple intelligences is a powerful tool that can help achieve its educational goals more effectively. The application of multiple intelligence theories in learning makes learning activities more attractive for both teachers and students so that they make a positive contribution to improving student performance itself [13]. Based on research findings [14] suggested that students should be facilitated not only in their learning but teaching materials also need to be facilitated for various intelligences that they may have to be developed.

Every intelligence is facilitated by different activities in multiple intelligences based teaching material. One of the activities in each intelligence is linguistic intelligence with discussion and reading activities, logical-mathematical intelligence with activities of classification and crossword, visual-spatial intelligence by drawing morphology of vertebrate and poster animals, kinaesthetic intelligence with practical activities, intelligence musical with activities to make song and video lyrics, interpersonal intelligence with peer assessment, intrapersonal intelligence with self-reflection, and intelligence of naturalist with direct observation activities. The following is presented in Figure 1 the work of students in the development of visual-spatial intelligence, namely the morphology of catfish and environmental care posters (frogs).

Each student has different intelligence, the dominant intelligence will lead in solving problems or ways of thinking and other intelligence will provide support. The more intelligence that developed it will be better for the students in understanding the lessons, absorb information, to solve the problem. This multiple intelligences based teaching material is one way that can be done to facilitate the development of multiple intelligence students both in learning or independently.

3.4 Improvement Higher-Order Thinking Skills
Higher-order thinking skills were measured using 25 multiple-choice tests. Summary of the results of the analysis of the average values of pre-test, posttest, and N-Gain higher order thinking skills can be seen in Table 5.

**Table 5.** The average value of the pretest, posttest, and N-Gain of higher order thinking skills

| Class      | Maximum Value | Average value | Criteria |
|------------|---------------|---------------|----------|
|            |               | Pre test      | Post test | N-Gain |
| Treatment  | 100           | 31.5          | 53.7     | 0.33   | Moderate |
| Comparison | 100           | 32.5          | 47.7     | 0.21   | Low      |

The results of the analysis in Table 5 show N-Gain higher order thinking skills the treatment class is 0.33 with moderate criteria and N-Gain Comparative class is 0.21 with low criteria. In conclusion, the treatment class experienced an increase in higher-order thinking skills higher than the comparison class. Different Mann-Whitney U nonparametric statistics test used in pretest data because data is not normally distributed. While the test is different statistics parametric T-Test is used in post test data.
because data is normally distributed. A summary of the results of the different tests of higher-order thinking skills seen in Table 6.

| Data   | Test             | Sig. | Information          |
|--------|------------------|------|----------------------|
| Pre test | Mann-Whitney U | 0.864 | Not significantly     |
| Post test | T-Test        | 0.117 | Not significantly     |

The pre-test and post-test data on the results of different tests of higher-order thinking skills in Table 6 show the probability value (Sig.) which is 0.864 and 0.117 > 0.05, which means there are no significant differences between the pre-test and post-test good value class or class treatment comparison. Classroom treatment with multiple intelligences based teaching materials is more effective than comparison classes with commonly used teaching material. The results of different tests show that there is no significant difference in the value of the pre-test and post-test in both fields, this proves that the teaching material developed did not have a significant effect on improving higher-order thinking skills.

The ability to think high on the Bloom Revised Taxonomy is a sequence of levels of thinking (cognitive) from low to high. In the cognitive domain, higher-order thinking is at the level of analysing (C4), evaluating (C5), and creating (C6). Higher-order thinking skills is the ability to connect, manipulate and transform the knowledge and experience that is already owned to think critically and creatively to determine decisions and solve problems in new situations [15]. Based on data on the increase in higher-order thinking skills, it is known that the treatment class using teaching material based on multiple intelligences has higher results than the comparison class, although not significantly different.

It provides information that class that uses multiple intelligences teaching material, students facilitated the development of multiple intelligences, so that more developing many types of intelligence, then students will quickly adapt to the environment, how to learn the appropriate [4], and finally can have higher-order thinking skills. With other words, the ability of higher-order thinking occurs when someone takes the information stored in the memory and interconnected or find a possible answer in situation or confusing situation [15] and with the teaching material teaching multiple intelligences is also continuously improving the ability to think critically.

3.5 Student Response to Teaching Materials Based on Multiple Intelligences

Instruments in the form of student response questionnaires to teaching materials are given after students use teaching materials. The result is the average percentage of student responses which is 80.8 % with strong criteria and has a positive response. This shows that teaching material based on multiple intelligence are well responded by students and can be used as teaching material in Vertebrate material according to the 2013 curriculum to develop multiple intelligences and higher-order thinking skills of students.

Based on the results obtained that good student responses to the existence of these teaching materials. Student state that the teaching material developed is more interesting, there are a lot of pictures, new information, and describe new experiences and insights that were not previously present in the commonly used teaching material. This is consistent with what was stated that students’ positive responses can be used as a benchmark that students feel more comfortable with teaching materials used in the learning process. Most of the students’ attention will be focused on the learning process because students are interested in teaching materials and students will not quickly feel bored with the learning that takes place so that student learning outcomes can improve [13].

4. Conclusion

The results of identification show that each student has different intelligence. The more intelligence developed by himself will make him better prepared to solve problems, receive new information and other things. Intelligence development can be facilitated by teachers in teaching material, one of which is teaching materials based multiple intelligences that can be used in learning or independently. The
development of multiple intelligences makes students learn with their learning styles, learning becomes more meaningful.

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