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Natural Science Learning Module Based on Multiple Intelligences in Elementary Schools

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ABSTRACT

This study aimed to produce a valid, practice, and effective natural Science learning module based on multiple intelligence to improve the higher-order thinking skills of elementary school students. The development research (R&D) which ADDIE development model was used in this research. The module was assessed using a questionnaire form consisting of 4 validating questionnaire forms (material, linguists, learning design, and learning media), teacher and student response questionnaires. Based on the validating result from the material, linguists, and learning design experts obtained the feasibility of the product with a very good category. The validating result from learning media experts obtained excellent category. On the other hand, the assessment from the teacher and student also showed a very good category. Furthermore, the product effectiveness was tested on the students through the pretest and posttest and showed that the products produced could improve student learning outcomes.

Keywords

Natural science, modules, multiple intelligences, HOTS

Introduction

Education has a very important role in the intellectual development of each individual. So, the learning process is expected to bring out all students' potential. One of the potentials possessed by students is multiple intelligence (Multiple Intelligence). Every intelligence in students will appear and develop at a certain time according to the stages of its development. Every intelligence in students will appear and develop at a certain time according to the stages of its development (Yetti et al., 2021). The developmental stages that occur starting from the sensorimotor stage (0-2 years), the preoperational stage (2-7 years), the concrete operation stage (7-12 years) to the formal operation stage (12 to adulthood) (Piaget, 1965). Through the learning process, students can also collaborate with the environment to improve and develop their abilities that include three domains, namely; the cognitive or knowledge realm, the affective or attitude domain, and the psychomotor domain, namely skills. Through these three abilities, a student is expected to be independent (Acesta et al., 2020).

One of the problems that are founded in the education field is the weakness in the learning process. The teachers' abilities are one of the

aspects that can influence the learning process quality, especially in the development of teaching materials (Rachmadtullah et al., 2020). Teaching materials have the potential to be developed in delivering learning materials to motivate, interest, and enthusiastic students to take part in learning, one of which is the module. The module can increase the learning process quality due to well constructed, independent, complete, and clear learning output (Diani et al., 2019; Wati et al., 2020). Moreover, the module also effectively learning materials for the students because students can learn without a teacher (independently), can study at any time, can learn according to their abilities and order (Alias & Siraj, 2012; Suryani et al., 2020). Teachers as the frontline in education who are directly involved in classroom learning are required to have competence in using and developing teaching materials. Teachers can not only develop modules limited to attracting and increasing student motivation in science learning, but also in enhancing and stimulating the emergence of multiple intelligences as well as increasing higher-order thinking skills.

Based on the results of Indonesian teachers' and students' observation, the handbooks that were used as the Indonesian main sourcebooks were

published from the Book Center of the National Education Department and other publishers. These books still have several weaknesses, including not being able to meet the learning needs of different intelligence and not being following each student's characteristics. The learning process is only directed at students' ability to memorize as if students are forced to remember and store various information without understanding the information obtained (Dewi & Primayana, 2019). This can be seen from students who only receive information abstractly, so they are unable to form the concept of the subject matter correctly. The teachers have not fully carried out active and creative learning in involving students and have not used various strategies and learning resources that vary based on the character of the subject matter. In general, teachers are only fixated on textbooks as the only source of teaching and learning.

39 Natural Science Learning (IPA) at the elementary school level (SD) is a means for students to be able to learn about various types of natural and artificial environments and their relationship with the ability to apply them in everyday life. The development of a Natural Science module based on multiple intelligence is very important to be developed because this concept facilitates all students who have various kinds of intelligence. Based on the concept of multiple intelligence from Howard Gardner, each individual is not divided based on high intelligence and low intelligence but is divided by the eight types of intelligence. If each student is stimulated, facilitated, and served well according to the concept of multiple intelligence, the students can grow and develop all their potential to the maximum (Gardner & Hatch, 1989). The concept of multiple intelligences is currently not optimally integrated with every education in schools. The application of multiple intelligences has only been implemented partially in an educational environment and has not been handled professionally so that it tends to ignore the fundamental aspects of multiple intelligences (Yaumi, 2012). Multiple intelligence is a new model of learning that helps students learn effectively. If teachers can determine the intelligence (enhanced abilities) in each student and then teach to those enhanced abilities, students will learn better (Nulhakim & Berlian, 2020).

Actually, each individual only has one or more multiple intelligences that are the most dominant. Therefore, in learning in schools, it is appropriate for teachers to have data about the level of tendencies for each student's multiple intelligences (Amir, 2020). According to Ayesha et. al., multiple intelligence, learning skills, and academic achievement were interrelated constructs in the teaching and learning environment where the multiple it was significantly correlated positively with each other (Ayesha & Khurshid, 2013). Teachers could use special strategies that can improve students' linguistic, logical, spatial, bodily-kinesthetic, musical, intrapersonal, interpersonal, and naturalist abilities. Moreover, teachers can also communicate the importance of student learning skills and try to teach students various strategies where students can improve their learning skills. In line with this opinion of Samsudin et. al., science will achieve optimal if the theory of multiple intelligences becomes part of the teacher's thinking and teaching style (Samsudin et al., 2015). In science learning, mastery of science process skills is important for students to produce knowledge in science and be able to apply scientific skills in everyday life.

1 The most important educational implications from the theory of multiple intelligences can be summed up through Individual education. Individual education has typically been reserved for the wealthy and others who could afford to hire tutors. Technology has now made it possible for more people to access a variety of teachings and assessments depending on their needs. Presenting a variety of activities and approaches to learning can help the students and encourages them to be able to think about the subjects from various perspectives, deepening their knowledge of that topic (Marens, 2020). Therefore, this research has aimed to present a valid, practice, and effective Natural Science learning module based on multiple intelligence to improve the higher-order thinking skills of elementary school students. The novelty of the developed science learning module product was presenting subject parts that stimulate the emergence of multiple intelligence abilities or multiple intelligences in each chapter of the learning material.

Methodology

This study aimed to produce a valid, practice, and effective Natural Science learning module based on multiple intelligence to improve the higher-order thinking skills of elementary school students. This research was used the development research (R&D) which the ADDIE development model has five stages, namely analysis, design, development, implementation, evaluation (Widyastuti, 2019). The module was assessed using a questionnaire form consisting of 4 validating questionnaire forms for material expert, linguists' expert, learning design expert, and learning media expert. In addition, a questionnaire form was also given to teachers and students to find out their responses to the module. The questionnaire result data were obtained using a Likert scale with a scale of 5, namely; 1 = not good / irrelevant, 2 = not good / irrelevant, 3 = good enough / quite relevant, 4 = good / relevant, 5 = very good / very relevant. Based on the scale value, the average value of the interval range from each aspect can be found by using the equation (1).

$$\text{Interval Scale (IS)} = \frac{m-n}{B}$$

Information:

IS = Interval scale

m = Highest score on the answer score

n = The lowest score in the answer score

B = number of answer choices

After that, the result of the interval scale value was converted into a descriptive value and the interpretation was shown in table 1.

Table 1. Interpretation of the Interval scale value

Score range	Criteria
4.6 – 5	Excellent
3.7 – 4.5	Very good
2.8 – 3.6	Good
1.9 – 2.7	Bad
1 - 1.8	Bad

Furthermore, the percentage of feasibility based on the scale range data can be found by using the equation (2).

$$P = \frac{\sum x}{N} \times 100\%$$

Information:

P = Presentation scores for each criterion

$\sum x$ = number of answers for each criterion

N = maximum score for each criterion

The result of the presentation scores for each criterion was converted into feasibility data and the interpretation of a feasible score was shown in table 2.

Table 2. Interpretation of feasible score

Value Scale (%)	Eligibility Level
81-100	Very Feasible
61- 80	Feasible
41-60	Enough
21-40	Less Feasible
0-20	Not Feasible

In addition, the effectiveness of the module in the learning process was measured by giving students tests when the module was used. Participants in this research were 22 students in class IV elementary school. The sampling technique was conducted by using purposive sampling. The data was collected by providing a pre-test and post-test in the form of test questions (consisting of 25 multiple-choice questions). Then, data were analyzed using a paired sample t-test, which aimed to know the differences in learning outcomes before and after learning using the multiple intelligence-based science module. The hypothesis in the statistical analysis of the study is as follows:

H₀: There is no difference in student learning outcomes after using a science learning module based on multiple intelligence

H₁: There is a difference in student learning outcomes after using a science learning module based on multiple intelligence

Result

In this research, the development of natural science learning module based on multiple intelligence to improve the higher-order thinking skills of elementary school students was conducted. Figure 1(a) shows the cover of the natural science module based on multiple intelligence. The cover is made with simple colors

and images to make it attractive to elementary school students. The developed module was consisting of 10 sections for each material that stimulates students' multiple intelligences as shown in Figure 1 (b).

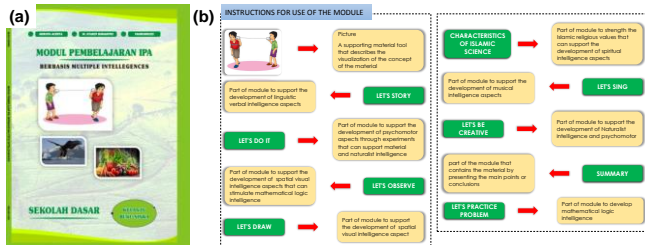


Figure 1. (a) Cover and (b) the summary section of the natural science module based on multiple intelligence

Each section of the natural science module based on multiple intelligence serves to stimulate elementary school student abilities as was described in table 3.

Table 3. The part of the natural science learning module based on multiple intelligence

No.	Section	Description
1	Picture	A supporting material tool that describes the visualization of the concept of the material
2	Let's story	Part of a module to support the development of linguistic verbal intelligence aspects
3	Let's do it	Part of a module to support the development of psychomotor aspects through experiments that can support material and naturalist intelligence
4	Let's observe	Part of a module to support the development of spatial-visual intelligence aspects that can stimulate mathematical logic intelligence
5	Let's draw	Part of a module to support the development of spatial-visual

No.	Section	Description
		intelligence aspect
6	Characteristics of Islamic science	Part of a module to strengthen the Islamic religious values that can support the development of spiritual intelligence aspects
7	Let's sing	Part of a module to support the development of musical intelligence aspects
8	Let's be creative	Part of a module to support the development of Naturalist intelligence and psychomotor
9	Summary	part of the module that contains the material by presenting the main points or conclusions
10	Let's practice problem	Part of a module to develop mathematical logic intelligence

Validation Result Data

The Validation result of the developed science learning module based on multiple intelligence by experts was shown in table 4. Based on the results of validation by experts (material, linguists, learning design, and learning media experts) shows that the developed science learning module is in a very good category from the material, linguist, and design learning experts and excellent category from learning media expert. The results of the validity test were obtained an average result of 4.5 where the teaching materials developed met the valid category, based on predetermined criteria. Because all aspects of the assessment are in the valid category, the teaching materials can be used in class. Furthermore, the percentage of feasibility based on the natural science learning module showed that the module was suitable for use in the learning process because the result of questionnaire value was above 85% (Amir, 2020; Nisa & Setiawan, 2018).

Table 4.The validation result of the developed science learning module by experts

No	Expert Validation	Score	Category	Percentage score
1	Material Expert	4.4	Very good	89.5%
2	Linguist Expert	4.2	Very good	
3	Design Learning Expert	4.5	Very good	
4	Learning Media Expert	4.8	Excellent	

Teacher Response to Natural Science Learning Module

The teacher responses result in the natural science learning module based on multiple intelligence can be seen in table 5. Based on the data, the teacher's response showed that all categories, namely content of the material, learning, design, language, and illustration aspect were in a very good category. According to the teacher, the

developed natural science learning module could bring out multiple intelligence from elementary school students. This corresponding to the research that according to the teacher response, the module based multiple intelligence could bring out the students' potential in the mathematic lesson (Putri & Ahda, 2020; Setyaningrum & Siswantari, 2020).

Table 5.The result of teachers' response

No	Assessment Aspects	Average score	Category	Percentage score
1	Material Content	3.7	Very good	80,8%
2	Learning aspects	4.0	Very good	
3	Design Aspects	4.3	Very good	
4	Language Aspect	3.8	Very good	
5	Illustration aspect	4.4	Very good	

Student responses to the Science Module

The students' responses result in the natural science learning module based on multiple intelligence can be seen in table 6. Based on the data, the student's response showed that all categories, namely convenience aspect, attractiveness aspect, and benefits aspect were in the very good category. According to students, the developed science learning module can make it more easily for students to learn science. In

addition, the module also makes it easier to visualize the natural science phenomenon. This result was corresponding to the other research that the teaching material in the form of a developed learning module has several advantages, such as make students learn independently, be more active, efficient in learning, and can visualize abstract objects (Gita et al., 2018; Rahmawati et al., 2019). So the learning process becomes more effective and makes it easier to achieve the desired learning goals.

Table 6.The result of students' response

No	Assessment Aspects	Average score	Category	Percentage score
1	Convenience Aspect	3.8	Very good	82%
2	Attractiveness Aspect	4.5	Very good	
3	Benefits Aspect	4.0	Very good	

Effectivity of Natural Science Learning Module

The learning outcome assessment was used to know the effectiveness of the natural science learning module based on multiple intelligence.

The learning outcome assessment was used in the form of pre-test and post-test consisting of 25 multiple-choice questions. The result of this assessment was shown in table 7.

32 **Table 7.**The result of students pre-test and post-test

Score Interval	Pre-test		Posttest	
	The number of students	Percentage (%)	The number of students	Percentage (%)
60-63	2	9.09	0	0
64-67	3	13.64	0	0
68-71	10	45.45	1	4.54
72-75	5	22.73	2	13.64
76-79	2	9.09	3	13.64
80-83	0	0	7	31.82
84-87	0	0	5	22.73
88-91	0	0	2	9.09
92-95	0	0	1	4.54
96-98	0	0	1	4.54

33 In the sample school, the minimum completeness criteria for natural science courses that were set by the teacher is 75.00. Based on table 6 showed that only 31.82% of students could reach the minimum completeness criteria before using a developed natural science learning module. The lowest and highest score on the pre-test were 60 and 75. On the other hand, the use of developed natural science modules given an impact on the students' learning outcome. The 95,45 students could reach the minimum completeness criteria after learning the developed natural science learning module while only one student had not reached the minimum completeness criteria. The pretest and posttest values show an increase in learning outcomes (N gain) 0.4 including the moderate

criteria. This corresponding to the previous research which shows that the use of modules can improve students' cognitive abilities (Khasanah et al., 2017; Prihatnawati et al., 2017; Sung et al., 2019)

Normality Test

The normality test is used to determine whether the analyzed data is normally distributed or not. The Kolmogorov-Smirnov was used as normality statistical analysis with the significance criteria if the significance of the calculation results from more than 0.05, it can be concluded that the data is normally distributed. The result of the normality test can be seen in table 8.

Table 8.The result of the normality test

	Tests of Normality					
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre-test	.186	22	.047	.918	22	.068
Post-test	.198	22	.025	.955	22	.399

a. Lilliefors Significance Correction

16 Based on the normality test result showed that the pretest significance value was more than 0,05 (0.068 of pre-test value and posttest 0.399 of post test value). This value indicated that both the pre-test and post-test values were normally distributed.

Paired- Sample Test

6 The result of the paired sample test is shown in table 9. Based on table 9, the average value of student learning outcomes before using the

developed module modules was 69.95. While the average value of learning outcomes after using the developed modules was 82.59. This indicated that the average results of student learning outcome increased after using a developed science learning module based on multiple intelligence of 12.64.

20 **Table 9.**The result of the paired sample test

	Paired Samples Statistics			
	Mean	N	Std. Deviation	Std. Error Mean
Pair 1 Pretest	69.95	22	4.562	.973

posttest	82.59	22	6.602	1.408
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Paired samples Correlations Test

6 The relationship between learning outcomes before and after using a developed natural science learning module based on multiple intelligence can be seen in table 10. Based on the test results showed that the correlation between the two variables was in the r-value of 0.380. This value was greater than the r table (0.081) that indicates the significant and positive correlation between the average values of learning outcomes before and after using the multiple intelligence-based science learning modules.

25 **Table 10.** The result of the paired sample correlation test

Paired Samples Correlations			
		N	Correlation Sig.
Pair 1	Pretes & postes	22	.380 .081

Hypothesis Test

4 The result of the hypothesis test is shown in table 11. Based on the result showed that the t value was -9.382 with a significance of 0.00. Because the significance value was smaller than 0.05, it can be concluded that H₁ is accepted. This indicated that there were differences in student learning outcomes before and after using natural science learning modules based on multiple intelligence.

13 **Table 11.** The result of the hypothesis test

		Paired Differences					t	df	Sig. (2-tailed)
		95% Confidence Interval of the Difference							
Pair		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
1	pretest - posttest	-12.864	6.431	1.371	-15.715	-10.012	-9.382	21	.000

Discussion

The professionalism competence component that should be had by the teacher compiles the quality of teaching materials based on the core competencies and basic competencies that are following the needs and characteristics of students. The arrangement of teaching materials according to the needs and characteristics of students will greatly assist the teacher in the learning process so it will help students understand the learning material and the desired learning objectives can be achieved (Fitria & Idriyani, 2017). The development of teaching materials is very important for teachers to make learning more effective, efficient, and in accordance with the competencies to be achieved and to facilitate the learning process. Teachers play an important role in the learning process so that teacher performance is needed to achieve learning goals. Therefore, teaching materials are very important to be developed in both printed

and non-printed forms as a means of support to improve the quality of learning (Amir, 2020).

18 The use of teaching materials should be able to involve students mentally in carrying out the learning process so that it is easier for learners to achieve the competencies to be achieved. The teaching materials should contain materials that are tied to the real world around the student environment so that teachers can more easily provide examples in learning activities (Svofyan et al., 2019). This research produced a natural science learning module based on multiple intelligence to improve higher-order thinking skills for fourth-grade elementary school students. Based on the results of field trials, it could be concluded that the developed natural science module could effectively improve student learning outcomes. It could be seen from the comparison of the pre-test and post-test mean scores.

37 The novelty of the science learning module product based on multiple intelligence for grade

IV elementary school students that has been developed is that in each chapter of the learning material that is presented there are subject parts that stimulate the emergence of multiple intelligence abilities or multiple intelligences. For example; let's tell a story is a means to support the stimulation of linguistic verbal intelligence, let's draw is a means to support the development of aspects of spatial-visual intelligence, let's do it is a means to stimulate the development of aspects of naturalist intelligence, let's observe and the material of practice questions is a means to stimulate aspects of developing logical intelligence mathematics, let's sing is a means to support aspects of the development of musical intelligence, let's be creative is a means to support the development of aspects of kinesthetic intelligence, the horizon of Islamic science is a means to support the development of aspects of spiritual intelligence.

In each part of the subject as a whole, there are clear illustrations related to everyday life that can help students to make it easier to learn the material so that students can implement/apply their knowledge in the surrounding environment. This is reinforced by Gani's opinion that the basic concepts of Natural Science should be studied and mastered perfectly so that they can be applied in solving problems faced by every human being in living his life (Gani, 2016). Science education is expected to be a vehicle for students to learn about themselves and the natural surroundings as well as the prospect of further development in applying it in everyday life. In line with Iskandar's opinion (Iskandar & Kusmayanti, 2018) that Natural Science or science is taught at the level of non-formal education from early childhood to continuing learning in Elementary Schools, the learning process of Natural Sciences is designed to produce critical human resources, sensitive to the environment, and able to solve environmental problems in everyday life (Iskandar & Kusmayanti, 2018). Therefore, it is necessary to strive for science learning that can facilitate students to be able to think critically, creatively, and think innovatively, be able to collaborate and communicate well so that they can solve environmental problems.

The natural science learning module based on multiple intelligences that had been developed by

researchers has several advantages including 1) the module could be studied independently by students because it had been adjusted to the level of development and ability of students and was equipped with the instructions. 2) The module was equipped with illustrated images and explanations following the material, 3) Teaching materials contained materials that were following the curriculum for grade IV Elementary School. 4) The module had been equipped with exercises for multiple-choice questions and essays as well as assignments for both group and independent assignments. The science learning module based on multiple intelligence was expected to be an enrichment material and a source of information for learning science material so that it could help students achieve predetermined competencies because students have been able to study the material thoroughly and could apply their knowledge according to the learning package. This is following by Nurdyansyah's opinion explaining that teaching materials were useful in helping teachers in carrying out teaching and learning activities (Nurdyansyah, 2018). For teachers, teaching materials were used to focus all learning activities, while for students as a guide that should be studied in the following learning, teaching materials function as individual learning tools to evaluate the achievement of student information acquisition processes. The module is designed to help students master learning objectives and as a means of independent learning according to the level of cognitive abilities of each student.

In line with Nurbaeti's opinion explained that teaching materials that were well arranged and equipped with interesting material and illustration images will stimulate students to use teaching materials as a learning resource in supporting the learning process (Nurbaeti, 2019). The use of teaching materials can be a solution to the problem of limited student understanding and the ability of teachers to design classroom learning. The development of teaching materials also can improve the quality of learning. The developed natural science learning module still has several things that need to be improved and perfected. However, after several improvements, revisions, and improvements, the module got better. Some of the deficiencies in this module include; a) Some pictures are unclear to observe, have been

corrected so that the image is clear to be observed, b) there is unclear writing due to inappropriate color composition, it has been corrected and perfected so that the writing appears clear c) there are no instructions for working on practice questions, it has been corrected before the practice questions there are instructions for working on practice questions.

Conclusion

22 The conclusion of this study indicated that the natural science learning module based on multiple intelligence to increase the higher-order thinking skills of students in elementary schools was feasible to use. Based on the validating result from experts showed in very good categories. While the teacher and students also give a good response to the developed natural science learning module. The effectiveness of the developed natural science learning module showed that there were differences in student learning outcomes before and after using natural science learning modules based on multiple intelligence. 24 It can be seen by the data from pre-test and post-test results and also from the paired sample t-test analysis.

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