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Development of Class V STEM-R Based Science Teaching Materials

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ABSTRACT

The aim of this research is to test the effectiveness of science teaching materials based on Science, Technology, Engineering, Mathematics, and Religion (STEM-R). The research design used is Research & Development (R&D) research with the ADDIE development model. This research also uses a pretest-posttest control group design, namely a research design with 2 comparison classes. This research was carried out at Cahaya Ilmu Islamic Elementary School, Semarang. The research subjects were class V students in the first semester of the 2024/2025 academic year, which consisted of two classes with a total of 50 students, namely 25 children as the experimental class and 25 children as the control class. Data collection techniques in this research are test and non-test techniques. The test data collection instrument uses essay questions, and the non-test data collection instrument consists of a questionnaire and observation guidelines. Data analysis techniques in research consist of normality tests, homogeneity, linear regression tests, and N-Gain tests. The results of this research are that STEM-R-based science and science teaching materials are effective in improving student learning outcomes. This is proven by student learning results during the pretest and posttest. The average student posttest score was 84.4. The results of the linear regression test show that the Sig value, namely 0.00, is less than 0.05, so it can be concluded that there is a significant influence of STEM-R-based science teaching materials on the learning outcomes of fifth-grade students at Cahaya Ilmu Islamic Elementary School. The students' n-gain scores showed that there was a significant increase from pretest to posttest or after learning with STEM-R-based science teaching materials on the learning outcomes of fifth-grade students at Cahaya Ilmu Islamic Elementary School. Next, an average calculation was carried out to obtain an average n-gain for fifth-grade students at Cahaya Ilmu Islamic Elementary School of 0.61, which is in the medium n-gain criteria. The conclusion is that STEM-R-based science and science teaching materials are effective in improving student learning outcomes.

Keywords: Teaching Materials, Science, STEM-R

INTRODUCTION

A teacher must have many abilities in teaching; the main thing is an elementary school teacher, because he will face students who will understand the material with concrete objects, simple but broad explanations, and teaching materials that are fun to learn. Elementary school teachers must be creative in teaching in the classroom, such as in choosing learning methods, learning media, and also the teaching materials that will be used. Not

only that, teachers must also be able to develop teaching materials. The development of teaching materials is able to make learning more enjoyable, effective, and efficient and does not deviate from learning objectives.

According to Lestari (2018), teaching materials are an important factor in teaching and learning activities, especially in elementary schools. Teaching materials or textbooks that are developed according to the needs of teachers and students will be able to improve the quality of learning. According to Patika & Surmilasari (2023) and Zulvira & Desyandri (2022), teaching materials are generally classified into printed teaching materials and non-printed teaching materials. Printed teaching materials consist of books, texts, modules or independent textbooks, brochures, and posters; non-printed teaching materials consist of models, audio programs, video programs, and multimedia programs. One type of printed teaching material that is commonly used is textbooks (Lestari, 2018; Nurhidayat & Asikin, 2021).

Natural and social sciences are two of the subjects that aim to understand the surrounding environment. It also explains that in science learning, the aim is to develop interest and curiosity, which can enable students to study phenomena in the surrounding environment in understanding nature. universe (Ilham et al., 2024). IPAS is an integration between social sciences and natural sciences, which is the key to success in the learning process. All aspects of social life in diversity, religious diversity, and mutual cooperation are covered in social sciences (Agustina et al., 2022; Alfatonah et al., 2023).

The reality in the field shows that the availability of science teaching materials to support teachers and students in the learning process is still limited. The teaching materials currently used by schools still do not show any integration of the material; the material is still presented separately. Previously, educators carried out learning related to conventional science material. This makes educators need to make changes in learning that provide innovation (Agustina et al., 2022).

The results of observations and interviews of 10 teachers from 3 schools, namely state elementary schools, private elementary schools, and Madrasah Ibtidaiyyah, showed that teaching modules play an important role in the learning process. The results from the three schools stated that they had used teaching modules but were not yet STEM-R based. One of the teaching modules used comes from government books and is still separated between science content and social studies content, so there is no visible integration of the two learning content. The learning material that will be delivered to students will also directly quote the essence of the material and then teach it to students. Teachers do not create or develop their own teaching modules but only take them from books and download them at PMM.

The teaching materials commonly used in schools today are still printed teaching materials that are too thick but not detailed. Books currently circulating do not yet appear to be integrated with the concepts of Science, Technology, Engineering, Mathematics, and Religion (STEM-R). In fact, on certain subjects, the integration of STEM-R in learning is effectively used as a learning resource. STEM-R-based teaching materials with high feasibility can be used as learning teaching materials (Rusilowati, 2020).

Religiousness in the module design that researchers have compiled will also have a big influence on students' literacy about Islamic stories or stories. So, in STEM-R learning, PAI material is inserted, which is integrated with science material. The STEM-R-based module aims to make students aware of the relationship between the knowledge they have and its application in real life, which can be known by reading, taking notes, researching, and conducting scientific research (Amalia et al., 2023). The aim of this research is to test the effectiveness of science teaching materials

based on Science, Technology, Engineering, Mathematics, and Religion (STEM-R).

MATERIALS & METHODS

The research design used is Research & Development (R&D) research with the ADDIE (Analysis, Design, Development, Implementation, Evaluation) development model.

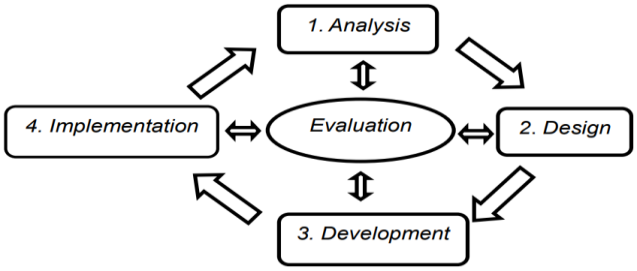


Figure 1 Stages of ADDIE Model Development

This research also uses a pretest-posttest control group design, namely a research design with 2 comparison classes, namely an experimental class and a control class. This research was carried out at Islamic Elementary School Cahaya Ilmu Semarang, Pedurungan District, Semarang City, with the research subjects being class V students in the first semester of the 2024/2025 academic year, which consists of two classes with a total of 50 students, namely with a breakdown of 25 students as the experimental class. and 25 students as the control class. Data collection techniques in this research are test and non-test techniques. The test data collection instrument uses 20 essay questions, and the non-test data collection instrument consists of a questionnaire and observation guidelines. The data validity tests in this research are the credibility test, transferability test, dependability test, and finally the objectivity test (confirmability). Data analysis techniques in research consist of normality tests, homogeneity, linear regression tests, and N-Gain tests.

RESULT

This research produces a product in the form of STEM-R-based teaching materials to improve the learning and religious outcomes of fifth-grade students at Cahaya Ilmu Islamic Elementary School in science and science learning. This development research refers to the ADDIE development model.

1. Analysis

At this stage, the main activity is to analyze the need for developed science teaching materials. At the analysis stage, the researcher carried out data collection, which aimed to collect data related to the problems faced in learning. Some of the problems that occur in science and science learning are the lack of student activity and understanding regarding the material being taught, teachers are only guided by books dropped from the government as learning support, and the learning that is applied tends to be oriented towards developing analytical thinking with problems that are monotonous and not yet comprehensive.

Apart from that, students in the class also do not appear to be actively participating in learning; the availability of science teaching materials to support teachers and students in the learning process is still limited. Factors originating from teachers are not maximizing the use of teaching materials to support ongoing learning activities. In learning, especially science material, teachers tend to explain the procedure for solving questions and then assign students to work on a number of questions contained in the student book or student worksheet. Student factors known through observation are students who talk to themselves during learning; there are still few students who are active during the learning process; students'

interest in learning is low because the teaching materials used are not interesting. Thus it can be seen that in class V of Cahaya Ilmu Islamic Elementary School there are problems with the lack of teaching materials, low student interest, and boredom using uninteresting teaching materials.

Based on a needs questionnaire that has been given by researchers to teachers and students. Most of them agree that STEM-R-based science and science teaching materials are applied as science teaching materials for the My Various Sounds chapter. The science teaching materials that will be developed are STEM-R-based. Teachers and students at Cahaya Ilmu Islamic Elementary School agree that they are used as teaching materials, especially in the My Diverse Sounds material. The following are the results of the analysis of teaching material needs that has been carried out at Cahaya Ilmu Islamic Elementary School.

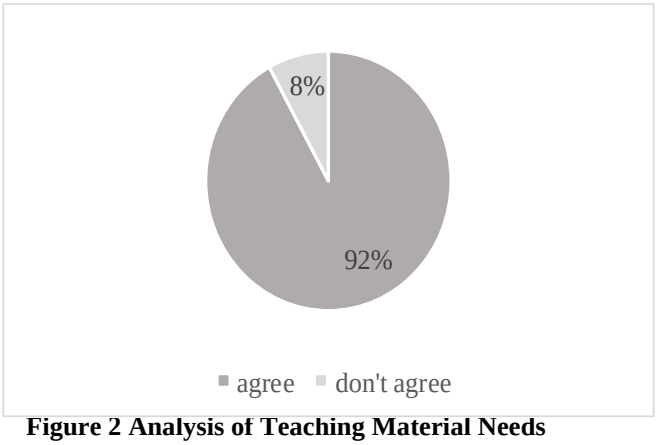


Figure 2 Analysis of Teaching Material Needs

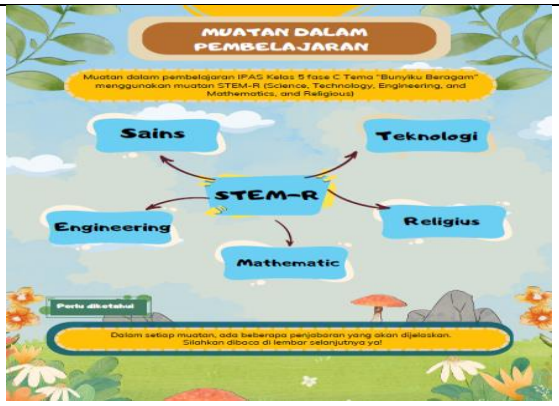
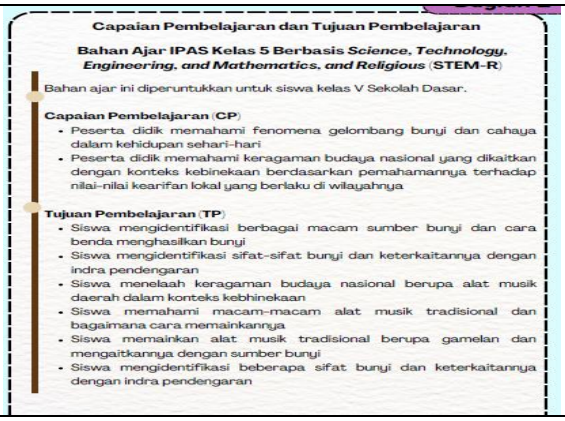
Figure 2 is the result of an analysis of the needs for teaching materials needed by students at Cahaya Ilmu Islamic Elementary School. Based on the recapitulation of the results of the student needs analysis, it shows that there are 23 (92%) students who agree that if STEM-R-based science and science teaching materials are used as social science teaching materials with the Bunyiku Diverse material, while there are 2 (8%) students who disagree that STEM-R-based science and science teaching materials are used as science teaching material.

2. Design

After carrying out the analysis, the next step is the design stage. This stage is carried out to design STEM-R-based science teaching materials that are expected to be in accordance with the analysis of teacher and student needs. Next, the researcher designed teaching materials that were developed according to needs and in accordance with the learning outcomes and learning objectives of the My Diverse Sounds chapter.

STEM-R-based science teaching materials are teaching materials designed with a learning concept that integrates science, technology, engineering, mathematics, and religion. This teaching material consists of instructions for using teaching materials, learning outcomes and objectives, STEM-R and its indicators, meeting 1 and meeting 2, as well as LKPD for students. Apart from that, it is also equipped with a summary, practice questions, an answer key, references, an assessment rubric, and material attachments. The following is the design of STEM-R-based science teaching materials.

Table 1 Bebrasis STEM-R Teaching Material Design

No.	Part	Picture
1.	Cover	
2	STEM-R payload	
3	CP and TP	
4	Teaching Module	

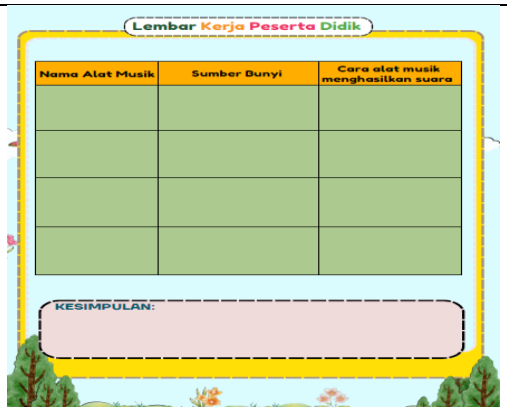
5	LKPD	

Table 1 is a design of teaching materials prepared by researchers to be assessed or validated by experts so as to produce designs that are attractive and in line with the objectives to be achieved in this research.

3. Development

The existence of teaching materials in a learning activity has many benefits. These benefits include making learning activities more interesting, giving students the opportunity to learn independently and reducing dependence on the teacher's presence, as well as making it easier for students to learn the competencies they must master. Feasibility tests are carried out by material, language, and media experts. The following are the results obtained from testing the feasibility of teaching materials presented in Table 2.

Table 2 Results of Feasibility Testing of Teaching Materials

Expert	Percentage	Criteria
Material	98%	Very worthy
Language	100%	Very worthy
Media	93%	Very worthy

Table 2 is the result of testing the suitability of teaching materials at Cahaya Ilmu Islamic Elementary School. Based on Table 2, it appears that STEM-R-based science and science teaching materials meet the very appropriate criteria so that they can be used as supporting media in science and science learning.

4. Implementation (Use)

The next step is the use of STEM-R-based science and science teaching materials. These teaching materials are used in learning activities in class V of Cahaya Ilmu Islamic Elementary School. After these teaching materials are used in learning activities that have been improved according to suggestions from media and material expert validators, a practicality test is then carried out. This practicality test was carried out by users, namely teachers and students.

a) User (Teacher)

This practicality test was carried out directly, namely by using a research instrument in the form of a questionnaire that was filled out by the teacher V of Cahaya Ilmu Islamic Elementary School after seeing learning activities using teaching materials created by the researcher. The user (teacher) practicality test will be carried out in November 2024.

In the user (teacher) response questionnaire, there are 13 assessment criteria items with a rating scale from 1 to 4, namely, 1) Poor; 2) Fair; 3) Good; 4) Very Good. Based on the results of the user (teacher) questionnaire, the fifth grade teacher at Cahaya Ilmu Islamic Elementary School gave positive responses to 13 aspects with an overall response percentage of 90%, if converted, it is included in the very practical criteria.

b) Students

Based on the recapitulation results of the questionnaire, users (students) gave a good

response with an average percentage of 88.46%. The questions are contained in teaching materials and can be used to achieve learning objectives. The shape and size of the letters, colors, and components used are neat and attractive; the vocabulary used in teaching materials is not foreign to students. Students experience difficulties when working on questions; this is because students are not used to the form of the questions, so students have difficulty understanding and working on the questions. Besides that, students have difficulty working because they are not careful enough. Furthermore, students do not experience difficulties in using teaching materials, and the instructions for using teaching materials are also clear.

Based on the overall percentage of student responses, it can be concluded that STEM-R-based science and science teaching materials are practically used as a support for learning the Science and Science chapter of the Bunyiku Diverse chapter for fifth-grade elementary school students.

5. Evaluation

After going through the next implementation stage, namely evaluation. At this stage the teacher carries out an evaluation or self-assessment by looking for deficiencies or weaknesses and problems that occur during the process of using STEM-R-based science and science teaching materials in learning activities.

The previous description shows that the problem in implementing STEM-R-based science and science teaching materials is students' difficulty in designing simple musical instruments from materials available around them (engineering) and identifying sound frequencies (mathematics). This is because identifying sound frequencies and designing musical instruments requires the ability to analyze, compare, and solve problems. This ability is a high-level thinking ability; students are not used to doing this, so students experience difficulties.

Therefore, repetition and practice activities are needed so that students are accustomed to dealing with situations that require high-level thinking skills. Children who are often given practice using their analytical skills to solve problems will respond quickly and be able to solve them.

Data on the effectiveness of the teaching module obtained from the learning process, namely pretest and posttest, were then analyzed to obtain hypothesis testing results. Student learning outcomes are measured using a test in the form of a description of 15 questions with indicators of learning outcomes in the My Various Sounds chapter. The following are the pretest and posttest results of fifth-grade students at Cahaya Ilmu Islamic Elementary School.

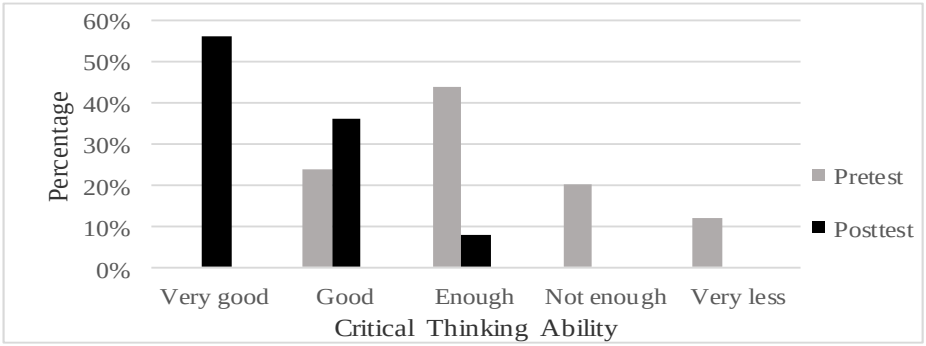


Figure 3 Learning Results of Class V Students at Cahaya Ilmu Islamic Elementary School

Figure 3 is the learning result of experimental class students who learned using STEM-R based teaching materials. Based on Figure 3, it can be seen that the learning outcomes of experimental class students experienced a significant increase from pretest to posttest. In the control class, learning is carried out using teaching

materials commonly used in class. The following are the learning results in the control class.

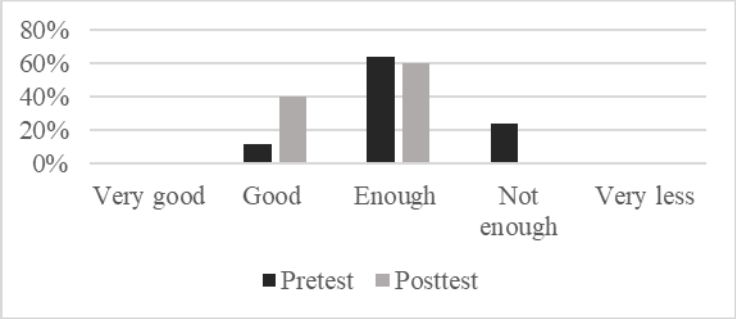


Figure 4 Learning Results of Class V Students at Cahaya Ilmu Islamic Elementary School

Figure 4 is the learning result of control class students who studied using conventional teaching materials. Based on Figure 4, it can be seen that the learning outcomes of control class students did not have a significant increase from pretest to posttest.

1. Linear Regression Test

The aim of the regression test is to see whether there is a correlation, meaning that the independent variable is correlated with the dependent variable. The following are the results of the simple linear regression test presented in Table 3.

Table 3 Simple Linear Regression Test Results

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
	Constant)	8.000	.972		7.643	.000
	Hasil Belajar	3.400	.144	.732	7.442	.000
a. Dependent Variable: Hasil Belajar						

Table 3 is the result of a simple linear regression test that was tested using SPSS version 25. Based on these results, it can be seen that the Sig value is 0.00, which means less than 0.05, so it can be concluded that there is a significant influence between STEM-R-based science teaching materials on the learning outcomes of fifth-grade students at Cahaya Ilmu Islamic Elementary School, or H0, were rejected, and H1 was accepted.

2. N-Gain Test

The magnitude of the increase before and after the use of STEM-R-based science teaching materials on the learning outcomes of fifth-grade students at Cahaya Ilmu Islamic Elementary School was calculated using the normalized gain formula. The following are the results of n-Gain for class V of Islamic Elementary School Cahaya Ilmu presented in Figure 5.

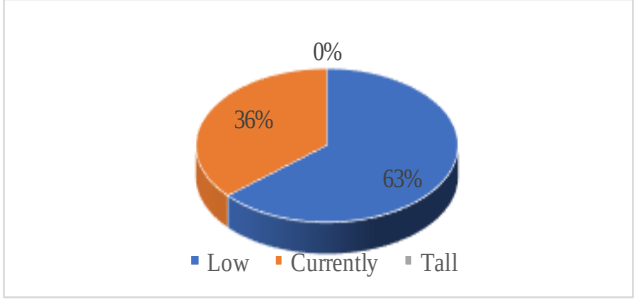


Figure 5 Experimental Class N-Gain Test Results

Figure 5 is the result of the N-Gain test in the experimental class. Based on the results of the N-Gain test, it shows that there is a significant increase from pretest to posttest or after learning with STEM-R-based science teaching materials on the learning outcomes of fifth-grade students at Cahaya Ilmu Islamic Elementary School. Next, an average calculation was carried out to obtain an average n-gain for fifth-grade students at Cahaya Ilmu Islamic Elementary School of 0.61, which is in the medium n-gain criteria. The following are the results of n-Gain for class V of the SD Islam Cahaya Ilmu Control Class presented in Figure 6.

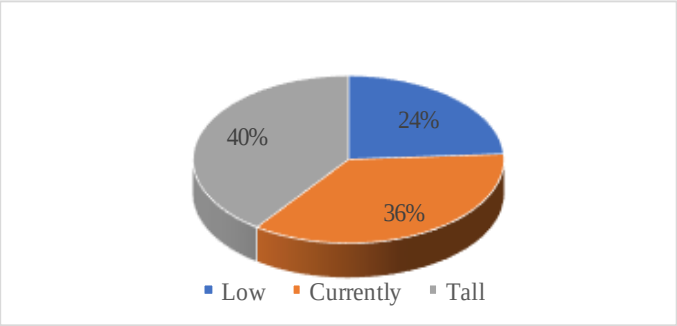


Figure 6 Control Class N-Gain Test Results

Figure 6 is the result of the N-Gain test in the control class. Based on the results of the N-Gain test, it shows that there is no significant increase from pretest to posttest using conventional teaching materials on the learning outcomes of fifth-grade students at Cahaya Ilmu Islamic Elementary School. Next, an average calculation was carried out to obtain an average n-gain for fifth-grade students at Cahaya Ilmu Islamic Elementary School of 0.26, which is in the low n-gain criteria.

DISCUSSION

Students' completion after learning using STEM-R-based science and science teaching materials reached 92%, while 8% were incomplete. This shows that student learning outcomes have shown a significant improvement after learning using STEM-R-based science and science teaching materials.

In learning using STEM-R-based science and science teaching materials, students in the experimental class showed high enthusiasm and curiosity. The STEM-R-based science and science teaching materials used in learning are attractive to students so that students are able to achieve the expected mastery, namely a classical average score of > 75. It is evident from the results of this study that the class taught with STEM-R-based science and science teaching materials obtained the posttest average of 84.4. This shows that the STEM-R-based science and science teaching materials are successful in making students complete the material in the My Various Sounds chapter.

This success is in line with research results from Izzah et al. (2023) that, based on the data, three results can be stated in this research. Firstly, the application of STEM-based science and physics teaching materials will be more effective if carried out at the high school level. Both types of teaching materials will be more effective if applied in STEM-based science and physics books. The three STEM-based science and physics teaching materials provide an effective influence on student learning outcomes in the areas of knowledge, skills, and attitudes. This is also in line with research results from Rusilowati (2020); the research results show that (1) the characteristics of digital books contain all components of the STEM approach, which includes aspects of science, technology,

engineering, and mathematics; (2) the digital books developed meet valid criteria from the material aspect. , media, and language; (3) the digital books developed are effective in improving students' critical thinking skills; and (4) the practicality of using digital books is considered very good by students and teachers.

The completeness obtained in this research shows that the success of STEM-R-based science and science teaching materials. Teaching materials can be a form of visual media in the form of prints that can be used in learning. The reason for using these teaching materials is the large usability value of teaching materials that can meet the needs of two parties, namely educators and students. STEM-based teaching materials are appropriate alternative media for learning science. In addition to developing content knowledge in the fields of science, technology, engineering, and mathematics, STEM integration education also seeks to foster skills such as scientific inquiry and problem-solving abilities. Plus, by integrating religious values in students. Apart from students being skilled at solving problems, Islamic values are also maintained through this learning.

CONCLUSION

The conclusion obtained from this research is that STEM-R-based science and science teaching materials are effective in improving student learning outcomes. This is proven by student learning results during the pretest and posttest. The average student posttest score was 84.4. The results of the linear regression test show that the Sig value, namely 0.00, is less than 0.05, so it can be concluded that there is a significant influence of STEM-R-based science teaching materials on the learning outcomes of fifth-grade students at Cahaya Ilmu Islamic Elementary School. The n-gain score of students who got a low n-gain score was 24%, students who got a medium n-gain score was 36%, and students who got a high n-gain score were 40%. This shows that there is a significant increase from pretest to posttest, or after learning with STEM-R-based science teaching materials on the learning outcomes of fifth-grade students at Cahaya Ilmu Islamic Elementary School. Next, an average calculation was carried out to obtain an average n-gain for fifth-grade students at Cahaya Ilmu Islamic Elementary School of 0.61, which is in the medium n-gain criteria.

Declaration by Authors

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