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The Effectiveness of the Science, Technology, Engineering, Art, Mathematics, and Religious (STEAM.R) Approach on Students' Concept Understanding in Science Learning : An Analysis Based on Gender

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Abstract: This study aims to analyze the effectiveness of the Science, Technology, Engineering, Art, Mathematics, and Religious (STEAM.R) approach to understanding students' concepts in learning science which are analyzed by gender. The study used a quantitative approach with the Pretest-Posttest Control Group Design. The population used was class V MI TT AL-Mubarak Langsa, totaling two classes with 34 students. While the research sample was obtained using the Simple Random Sampling technique with the lottery method, it was obtained that the female students and the male students. The instrument used was a test in the form of an essay which consisted of 5 questions. The collected data were analyzed using the t-test through SPSS 24. The result showed, based on gender, that the average post-test score of the female students was higher than that of the male students, namely 89.53 > 74.24. From the results of the hypothesis testing, it was obtained $t_{count} > t_{table}$, namely 5.82 > 2.04, with a significant value of 0.00 <0.05, so Ha was accepted, and H0 was rejected. Therefore, it was concluded that the Science, Technology, Engineering, Art, Mathematics, Religious (STEAM.R) approach was significantly effective in understanding students' science learning concepts.

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Introduction

The science learning process requires the participation of students in the form of their activities in learning. The existence of student participation indicates a conceptual understanding of the subject matter. Based on the 2013 curriculum at the elementary school level, students are expected to have the ability, attitude, knowledge, and skills (Kemendikbud, 2016b). Therefore, in learning science, students can understand the concept of science to solve problems encountered in everyday life. However, science learning at the elementary level, such as SD/MI still needs to be carried out optimally in focusing children on teaching and learning activities. Teachers still dominate it (Fitriani, D. N., Setiyadi, D., & Listiani, 2019). As a result, students are only able to take notes and listen to material explained by the teacher, so students only remember what the teacher gives without understanding what they are doing, and students are less able to build their knowledge (Insyasiska, D., Zubaidah, S., Susilo, 2015). The students need help understanding science material. If learning in this condition is allowed to continue, it will harm students, where students cannot solve the problems they face later in everyday life. Therefore, it is necessary to have an approach that encourages students to participate in constructing their knowledge so that they can develop their conceptual understanding of learning science.

According to (Aunurrahman, 2012) conceptual understanding is a person's way of changing their knowledge to become more meaningful. Students are said to have good

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conceptual understanding if they can describe their expertise in their own words and apply the knowledge they receive in everyday life. In other comments, in understanding concepts, students not only know and know the concepts of the material being taught but also apply their knowledge more in solving problems. With a good understanding of the concept, students' understanding of the subject will increase. Therefore, understanding the concept is crucial in all subjects, including science. Following the statement, according to Septrian et al, understanding concepts is very important for carrying out teaching and learning, namely as a basis for measuring learning outcomes (Aen Rohaetul & Kuswendi Uus, 2020).

The results of other studies are related to literacy science and STEM fields by analyzing gender differences. The PISA report stated that male are more than females in math performance. Females feel less motivated to learn math and less confident in their abilities than males. It is a tough challenge to achieve gender equality in the STEM field of work in the future (OECD 2014). In the technology and engineering fields, the STEM field was dominated by males. Females mostly choose biology or science, and mathematics. If men choose more STEM fields, it is not because males have better PISA scores than females. Especially when measurable mathematical abilities are combined with other variables, gender differences remain significant (Hango 2013). Based on gender, male or females seem to have the ability the same cognation. On career aspirations, female students are more likely to choose a career that would not bother them in the future as a spouse or parent. Males have term expectations of higher length for themselves (Afriana et al., 2016).

Based on the results of observations in class V MI TT Al-Mubarak, students' understanding of concepts in science learning, especially in heat material, still needed to improve. They are evidenced by the average value of student learning outcomes of 69.80, which is below the minimum completeness criterion of 75. Poor understanding of concepts is triggered because students need more training to solve previous learning problems. Students need to be used to combining last and newly acquired knowledge Students also need help finding the necessary information to learn problem-solving activities (Yeni, 2018). It makes it difficult for students to understand the concepts being taught. The problem solution and an exciting learning approach are needed to make the classroom atmosphere conducive and enjoyable. Because learning strategies, methods, models, or processes and learning environments that are appropriate and interesting can increase students' understanding of scientific concepts (Fitriyani & Utama, 2019).

STEAM.R (Science, Technology, Engineering, Art, Mathematics, and Religion) is a science-based learning approach developed by STEAM that combines design and technology with religious aspects and art and mathematics (Azizah et al., 2019). STEAM is designed so that students can later have analytical, critical, creative, and communicative thinking skills for all fields and be able to collaborate with others. This approach motivates children to have curiosity by asking various questions to construct their knowledge through exploring various sources, observing things that happen, and being able to find solutions to the problems they face by carrying out scientific investigations of the issues to be solved (Siti Zuibah, 2019). STEAM also teaches children to process information through observing, playing, exploring models, practicing creative thinking skills, and collaborating to complete assignments given by the teacher (Salsabila & Muhid, 2021). In addition, the study's results (Oktaviani et al., 2020) found that student's ability to understand concepts using the STEAM approach was better than conventional learning.

STEAM is an interdisciplinary approach that integrates the five aspects of STEAM simultaneously so that students can combine all the abstract concepts in all aspects and solve problems in the real world. With this approach, students become more focused and enjoy

learning because the learning situation is accompanied by art that can be done during lessons in the form of singing adapted to the learning material. Thus, STEAM is an approach that can collaborate with all existing elements in learning concepts by relating them to the real world by utilizing technology (Amelia & Marini, 2022). Based on the previous approach, then STEAM. R combines with religious aspects where science is associated with the holy verses of the Koran related to the material being studied.

The STEAM.R approach requires teachers to participate in lesson design, create learning strategies, interact with students, pursue each student's individuality, and be open to students' assessments. Students as learning subjects are involved in learning new concepts, thinking, expressing ideas, asking questions, conducting simple research, applying learning outcomes through action, applying social interactions, and used as an interdisciplinary or transdisciplinary approach to teaching and learning that incorporates disciplines in a defined learning contest (Perignat & Katz-Buonincontro, 2019). In this case, applying religious aspects as manifestations enhance student character formation. Even though the roles of students and teachers are different, they need to collaborate to complete tasks as efficiently as possible. Based on gender from analysis of the effectiveness of the STEAM.R approach to understanding the concept of science learning from female and male students, this study aims to determine outcomes to support learning on science learning.

Research Method

This research approach was quantitative, using the experimental method with the Pretest-Posttest Control Group Design, which involves the experimental and control groups (Hastjarjo, 2019). The population in this study were all fifth-grade students at MI TT Al-Mubarak for the 2022/2023 school year, which consisted of 2 classes with female and male students. Through the Simple Random Sampling technique with the lottery method, the research sample was selected the female students that used the STEAM.R approach and the male students that used a conventional method (lecture).

Data was collected using an essay test totaling five questions to measure students' understanding of concepts. The test was carried out twice in each experimental and control class, namely pre-test and post-test, with the same time allocation. The test was prepared with some modifications based on a grid of conceptual understanding indicators adopted (Yuyu Hendawati and Cici Kurniati, 2017) with some modifications.

Table 1. Grid of Understanding the Concept of Pre-Test and Prost-Test Questions

Primary Competency	Aspect	Indicator	Cognitive	Number Question
Applying for calor transfer in everyday life	Interpreting	Give examples of calor transfer in everyday life	C2	1
	Explaining	Explaining the transfer of calor in the Qur'an	C2	2 and 3
		Explain the different ways of calor transfer in everyday life		
	Comparing	Comparing heat transfer in everyday life	C2	4
	Classifying	Classifying objects that accelerate and inhibit calor transfer	C3	5

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Before the test was used, trials were carried out on class VIA, which had studied the material with as many as 20 students to measure the instruments' validity, reliability, difficulty level, and discriminatory power. Data were analyzed using inferential statistics as a hypothesis test. To test the correctness of the hypothesis using the t-test (Independent Sample Test) from the two unpaired groups (Ahyar et al., 2020). Before trying the idea, first do the normality test and homogeneity test. Calculations from inferential statistics were analyzed using SPSS-24.

Results and Discussion

Research Instrument Trial Results

Based on the results of instrument testing of 20 grade VI students, calculating the test's validity using the gross moment product formula (r_{XY}) resulted in each item being declared valid. The results of estimating the fact of item no. 1-5 respectively are $r_1 = 0.774$; $r_2 = 0.507$; $r_3 = 0.579$; $r_4 = 0.532$, and $r_5 = 0.672$ while r table at a significance level of 5% obtained $r_{table} = 0.444$ so that it appears that r_{count} > from r_{table} and the items are declared valid. Therefore, it can be concluded that the items contained in the essay test are declared valid, and the questions describe the existence the suitability of the material being taught with the material being tested so that it is stated that the test can be used meets the criteria as a research data collection tool. The reliability values of the tests were obtained from the analysis of the test trials using the Cronbach alpha formula in SPSS 24.

Table 2. Test Instrument Reliability Test Results

Instrument	Cronbach Alpha	Reliability	Clarification
Tes	0,766	0,6	reliabel

The data generated from the reliability test in Table 2 shows a Cronbach Alpha value of 0.766 and a reliability limit of 0.6. Then the results of the test 0.766 > 0.6 indicate that the test items are declared reliable because they have a reliability coefficient value of ≥. 0.6 (Suharsimi Arikunto, 2010) the instrument can be trusted as a data collection tool.

In addition to measuring validity and reliability, measurements of the level of difficulty and discriminating power of the tests were also carried out to measure the difficulty level of the items and the discriminating power of the things. From the analysis of the instrument's difficulty level, the following data is obtained.

Table 3. Difficulty Level Test Results and Discriminating Power

Number Question	Level of Difficulty	Criteria	Discriminating Power	Criteria
1	0,82	Easy	0.57	Good
2	0,65	Normal	0,40	Good
3	0,68	Normal	0,45	Good
4	0,65	Normal	0,50	Good
5	0,65	Normal	0,60	Good

Based on Table 3, it was found that 4 questions were in the moderate category, and 1 question was categorized as easy. When viewed from the value of the differentiating power, all questions have suitable criteria. The instrument is appropriate to use because the questions can distinguish students' abilities, and the questions are not too difficult.

Science Concept Understanding Test Results

Before the learning activities were carried out, the experimental class and the control class were given a pretest to determine the initial abilities of the two classes. From the results of the initial test analysis, the average value of understanding the science learning concepts is shown in Table 4.

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Table 4. Science Concept Understanding Pretest Results

Data	Female Students	Male Students
Min	30	26
Max	78	64
Mean	58.12	50.71
Standard Deviation	13,955	11,767

Table 4 it shows that the average pretest value of the experimental class is 58.12 and the control class is 50.71, which is almost the same, and the standard deviation is not too far away. The distribution of scores obtained from both types is almost even or the same. It proves that the two classes show similar abilities and are considered to have the same initial knowledge. After carrying out learning activities from both classes, a post-test was conducted to determine students' understanding after the treatment was given. The results of the post-test data analysis can be shown in Table 5 below.

Table 5. Science Concept Understanding Posttest Results

Data	Female Students	Male Students
Min	78	56
Max	100	84
Mean	89,53	74,24
Standard Deviation	8,079	7,207

Table 5 shows that the average value of understanding the science concept in the Experiment class is better than the control class, namely 89.53 > 74.24. In addition, it was shown from the minimum and maximum final ability (post-test) values of the two types where students in the experimental class on heat transfer material were 78 and 100, respectively, and students had achieved the specified completeness score of 75. Meanwhile, the control class was 56 and 84, which showed that students still needed to complete mastery learning. The STEAM approach effectively understands the concept of science at MI TT Al Mubarak, Langsa City. There was a significant increase in the experimental class compared to the control class.

Hypothesis Result

The effectiveness of the STEAM.R approach significantly it can be done by testing the hypothesis using the t-test formula. The normality and homogeneity tests were first carried out before the inferential statistical test was carried out as a t-test. The normality test involves two data, namely pretest and posttest data from the experimental and control classes. This test is carried out to ascertain whether the data is distributed regularly or not. The results of the normality test using the Shapiro Wilk Test with the help of SPSS 24 can be seen in Table 6 below.

Table 6. Shapiro Wilk normally Normality Test

T		Shapiro-Wilk			
	Kelas	Statistic	Statistic	Df	Sig.
Result	pretes female students (STEAM)	.207	.953	17	.512
	Postes female students (STEAM)	.208	.868	17	.020
	Pretes male students	.226	.933	17	.241
	Postes male students	.288	.862	17	.017

a. Lilliefors Significance Correction

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The observation results in Table 6, which displays the normality test results for all pre-test and post-test data from the experimental and control classes, show that the Sig Shapiro Wilk value is > 0.05. Shapiro Wilk's sig scores for the pre-test and post-test for the experimental class were 0.512 and 0.20, respectively, while those for the control class were 0.241 and 0.17. Accordingly, both classes' pre-test and post-test data are normally distributed and meet the requirements to continue hypothesis testing.

In addition to normality, do a homogeneity test from the experimental and control class data. Two groups are considered homogeneous if they have the same variance. If the Sig value < 0.05 or lower is declared non-homogeneous, and if the Sig value is > 0.05 then the data from two or more population groups are the same or homogeneous (Sari et al., 2017). The results of the homogeneity test for understanding the concepts of the two classes using SPSS can be seen in Table 7 below.

Table 7. Test of Homogeneity

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Result	Based on Mean	.348	1	32	.559
	Based on Median	.276	1	32	.603
	Based on Median and with adjusted df	.276	1	31.566	.603
	Based on trimmed mean	.395	1	32	.534

Table 7 shows the results of the homogeneity test of understanding the concept of the sig Based on the Mean score in the experimental and control class students is 0.559. This means that at a significant level of 5%, a sig value > 0.05 is obtained to conclude that the pre-test and post-test variances of the experimental and control classes are the same. The data can be continued for hypothesis testing.

Hypothesis testing was conducted to determine the effectiveness of the STEAM.R approach to students' understanding of science concepts. The two classes used the inferential statistical test, namely the t-test (independent sample t-test) assisted by SPSS-24. At a significance of 5% obtained t_{count} 5.825 > t_{table} 2.036 with a significance value of 0.00 <0.05. Thus, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_a) is accepted, concluding that the Science, Technology, Engineering, Art, Mathematics.Religious (STEAM.R) approach effectively influences students' understanding of science learning concepts at MI TT Al Mubarak Langsa, and the influence exerted is positive in increasing understanding of science learning concepts.

Discussion

Based on the research results, it is proven that the Science, Technology, Engineering, Art, Mathematics. Religious (STEAM.R) approach positively affects students' understanding of science learning concepts based on gender. Because by using STEAM R, children become more active in learning activities related to students' real world. In addition, students directly conduct experiments on heat transfer using practicum tools found in everyday life. With the participation of female students and male students in direct learning, such as experiments, students can build their knowledge based on their experiences to find ideas for solving the problems they face in everyday life and apply their knowledge in various situations. The experience gained by observing will help their memory of all concepts last longer (Wahab & Rosnawati, 2021). The existence of observation of an object can produce new information in building the knowledge needed to understand the concept (Iwantara et al., 2014). STEAM approach. R is a modified approach from STEAM.

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Research-based on gender looks at differences in science learning outcomes. What makes that difference from female students are more interested in science problems, bearing all or part of scientific inquiry and responsibilities for environmental resources. Female students more than male students are one of the factors that improve the attitude aspect of female students more than male students from gender difference. Gender relations are moderate interest with a desire to learn. Male students are more interested in physicals and chemistry and achieve a higher desired score, but the level of interest of female students is not correlated with learning achievement (Larson et al., 2014).

Learning with the STEAM approach is contextual learning (Yakman, Georgette., Hyongyong, 2012) which invites students to understand everyday phenomena or be close to the environment. The STEAM approach makes students want to learn more, understand what is happening, its causes, and its impacts, and try to overcome problems. It happens because students can immediately relate, connect, and even find solutions to problems. Students also feel involved in participating in the learning that occurs and will seek solutions to any problems. By associating it with the holy verses of the Koran, STEAM.R's approach becomes interesting so that the atmosphere becomes more enjoyable because of the integration of science that studies the concepts of science, technology, engineering, art, mathematics, and religion.

The STEAM.R approach is an active learning approach that requires students to work together in groups when working on LKPD. Group work can help students share knowledge and foster cooperation, responsibility, and independence. Collaboration in completing tasks is easy because they provide various inputs to each other. Learning to use the STEAM.R approach is very important because it teaches students how to integrate all the elements simultaneously. Learning from the six perspectives can shape subject knowledge more comprehensively. STEAM.R in science education enables students to design experiments and use technology to validate scientific ideas. Learning using the STEAM approach shows collaboration between different models and approaches in thematic learning contexts so that STEAM can be used as a means to improve students' critical thinking (Azizah et al., 2019).

In learning the STEAM.R approach, students are required to master the six elements of STEAM.R, which are integrated with the learning process activities. The first is the element of science this stage, students associate the material with everyday life by giving examples of heat transfer in real-world situations. This activity encourages students to explore their knowledge so that each student has a variety of ideas. Because the STEAM approach can motivate student learning to explore their understanding through the methods they have (Nurfadilah & Siswanto, 2020). At this step, students can associate their knowledge with previous knowledge to make learning more meaningful. The two elements of the technology at this stage are the teacher using PPT and learning animation videos in the form of YouTube. The teacher provides opportunities directly for students to express opinions from the videos they observe so that students are more active in the learning process. The use of technology aims to make students better understand the material presented. The media used can help students improve students understanding of concepts. According to research from (Ferawati, 2011) students' mastery of concepts can be improved by using interactive multimedia. The existence of videos can also stimulate students to learn to generate great curiosity (Lari, 2014).

For the three technical elements, at this stage, students conduct experiments on heat transfer from tools and materials that have been agreed upon beforehand. Through experiments, students feel and experience what they do, such as carrying out a game. Using tools and materials in everyday life can explain abstract concepts into concrete, and students

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understand the concepts being taught more. Research from (Hadiyati & Wijayanti, 2017) that the experimental method using concrete objects can improve students' science learning outcomes. The four elements of art, students are invited to sing according to the subject matter during the learning process at this stage. Singing is done so students can easily remember the subject matter using song lyrics that students already know. When the students sing, they seem very happy, enthusiastic, and happy to follow the lesson. The lyrics displayed are adapted to the conditions of the students at the madrasah primary level, and elementary-level students have a high memory, making it easier for them to memorize lyrics from caloric material. The singing method can increase interest in learning, memory, and student learning motivation (Siti Anisah & Maulidah, 2022). Having singing for children makes learning more fun, and they are not burdened with the material being taught, so they understand the material being taught.

The five mathematical elements of this stage were found when students carried out experiments by measuring the time needed to make observations and were able to explain the relationship between time and the heat produced by metal. In addition, during the experiment, students can determine the position of the distance between the hand and the flame. In this condition, students learn to use their mathematical abilities in measuring time and distance using a clock and a ruler. This illustrates the numeracy literacy skills of students and student achievement is influenced by numeracy literacy (Anderha and Maskar, 2021). The six religious elements at this stage, the learning material are associated with the holy verses of the Qur'an. Considering that the children come from the Integrated Tahfiz Ibtidaiyah madrasah, this activity can be carried out and is very helpful in research. The teacher and students jointly associate the material with the holy verses of the Qur'an through its translation and determine the verses following the caloric material. It aims to raise students' awareness and responsibility for everything created by Allah SWT to be able to maintain and protect the environment around them. With the integration of science with the holy verses of the Qur'an, it is hoped that students will more easily understand the material and have broader knowledge and views to have Faith and Taqwa (IMTAQ). Thus it is concluded that the STEAM approach has a good impact on the development of the learning process, especially in early childhood, to increase student interest and understanding of technology and the ability to solve problems in the real world (Thuneberg et al., 2018). This study proves that the STEAM.R approach improves students' understanding of science learning concepts. The existence of a religious combination in learning activities makes STEAM.R a practical method for associating material with religious elements in it.

Conclusion

Based on the research results, it can be concluded that the approach is Science, Technology, Engineering, Art, and Mathematics, Religious (STEAM.R) significantly affects students' understanding of science concepts on heat material at MI TT Al-Mubarak Langsa. It was shown from the average value of understanding the concept in the female students 89.529 and 74.234 in the male students and based on the hypothesis test from the understanding of the concept based on gender stated $t_{count} > t_{table}$, namely 5.82 > 2.04 and a significant value of 0.00 <0.05. Therefore, there is a significant influence on the Science, Technology, Engineering, Art, Mathematics, Religious (STEAM.R) approach to understanding the concept of learning science based on gender.

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Recommendation

This research is expected so that science teachers provide development of exercise to improve understanding and assessment of science learning outcomes equally for female students and male students. The development of exercise is expected to increase the learning motivation potential of male students for better outcomes and the same understanding of science as female students. The result of this research is recommended for further researchers to develop and add variables related to gender differences in improving learning outcomes with other methods.

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