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UNDERSTANDING OF SCIENCE, TECHNOLOGY, ENGINEERING, ART, AND MATHEMATICS (STEAM) IN PGSD STUDENTS OF PGRI UNIVERSITY SEMARANG

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Abstrak

Studi ini bertujuan untuk mendeskripsikan pemahaman mahasiswa Pendidikan Guru Sekolah Dasar mengenai pembelajaran Sains, Teknologi, Teknik, Seni, dan Matematika (STEAM). Data penelitian dikumpulkan dari mahasiswa PJK di Universitas PGRI Semarang menggunakan kuesioner dan wawancara. Sebanyak 50 mahasiswa yang terdaftar dalam mata kuliah Pendidikan Lingkungan Hidup berpartisipasi sebagai responden dalam penelitian ini. Mahasiswa diberikan kuesioner dan diwawancarai untuk mendapatkan data tentang pemahaman mereka terhadap STEAM. Hasil penelitian menunjukkan bahwa pemahaman STEAM di kalangan mahasiswa PJK di Universitas PGRI Semarang dapat dikategorikan menjadi lima tingkatan: pemahaman sangat baik (SM), pemahaman baik (M), pemahaman cukup (CM), pemahaman buruk (TM), dan pemahaman sangat buruk (STM). Temuan menunjukkan bahwa 46% mahasiswa menunjukkan pemahaman sangat baik terhadap STEAM, 26% memiliki pemahaman baik, 24% memiliki pemahaman cukup, 2% memiliki pemahaman buruk, dan 2% memiliki pemahaman sangat buruk terhadap STEAM.

Kata kunci: Pemahaman, Pembelajaran, STEAM

Abstract

This study aims to describe the understanding of Primary School Teacher Education (PGSD) students regarding Science, Technology, Engineering, Art, and Mathematics (STEAM) learning. The research data were collected from PGSD students at Universitas PGRI Semarang using questionnaires and interviews. A total of 50 students enrolled in the Environmental Education course participated as respondents in this study. The students were given questionnaires and interviewed to obtain data on their understanding of STEAM. The results showed that the understanding of STEAM among PGSD students at Universitas PGRI Semarang could be categorized into five levels: very good understanding (SM), good understanding (M), fair understanding (CM), poor understanding (TM), and very poor understanding (STM). The findings revealed that 46% of students demonstrated a very good understanding of STEAM, 26% had a good understanding, 24% had a fair understanding, 2% had a poor understanding, and 2% had a very poor understanding of STEAM.

***Keyword**: Understanding, Learning, STEAM*

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INTRODUCTION

Learning is an effort to support students in their learning activities, enabling them to develop optimally. The learning process is not solely dominated by educators, but also involves students actively and creatively developing their own learning. Learning is essentially a planned activity that stimulates students to learn effectively (Rezkita & Wardani, 2018; Wulandari et al., 2020). Teachers and students play a crucial role in the success of the learning process. This success will create a competent young generation with high abilities and skills. Science, Technology, Engineering, Art, and Mathematics (STEAM) learning is a key element in education to face the era of Society 5.0. The implementation of STEAM learning is expected to bring about positive change (Bancong, 2024; Clarke, 2019; Fatimah et al., 2022).

STEAM-based learning places science and mathematics concepts within the context of engineering, technology, and the arts, guiding students in developing High Order Thinking Skills (HOTS), problem-solving skills, and creativity (Hasanah et al., 2021; Oktiningrum et al., 2024; Ulfa et al., 2019). Science itself is the scientific study of the universe and the events that occur within it, using scientific methods and reasoning to draw conclusions (Dibner & Snow, 2016; Wiryanto et al., 2023). Technology, simply defined, is a tool that facilitates or assists humans in carrying out their activities (Pardimin & Hikmah, 2023). Engineering is the science or knowledge of designing and creating products that involves problem-solving methods, and mathematics is the study of patterns and relationships that serve as the language of science, technology, and engineering in STEAM learning. Meanwhile, the addition of Art to STEM is expected to foster students' creativity and innovation through works produced according to their imagination but still actual and clear (Fatimah et al., 2022; Hasanah et al., 2021; Nisa & Hikmah, 2023; Wahyuningsih et al., 2020; Wulandari et al., 2020).

Previous research has demonstrated the effectiveness of STEAM learning (Amalia et al., 2021; Septiani & Kasih, 2021; Trivena et al., 2018; Ulfa et al., 2019). The results found that STEAM learning can increase student interest, make learning more meaningful, and improve students' problem-solving skills. It also presents a challenge and motivation, as it fosters students' creativity (Ulfa et al., 2019). Creativity is a character that can be developed through the STEAM approach, as research results (Hasanah et al., 2021; Wahyuningsih et al., 2020). Students who were taught using the STEAM method demonstrated higher creativity than those who were not. This form of creativity includes fluent, flexible, original, and detailed thinking

skills. In addition to creativity, STEAM can also develop children's independence during the learning process (Amalia et al., 2021; Septiani & Kasih, 2021). Although STEAM has advantages in developing children's creativity and independence, its implementation requires teachers to have a truly in-depth understanding of STEAM to be used effectively. Teachers who do not understand STEAM comprehensively still assume that the elements of Science, Technology, Engineering, Art, and Mathematics are separate from one another and not interrelated or integrated. This aligns with research results indicating that some teachers perceive STEAM as a field of study that is not integrated with each other. The elements in STEAM are only related to a few areas, for example, technology and experiments or science experiments. Therefore, children's abilities in problem-solving, systematic, and critical thinking cannot be developed through STEAM (Fatimah et al., 2022).

Students who will become prospective educators need to create a learning environment that supports classroom activities. Students in the 21st century are unlikely to fully understand the potential that prospective educators must have to develop an understanding of Science, Technology, Engineering, Art, and Mathematics (STEAM). Furthermore, students still do not understand the optimization and effectiveness of becoming educators who create a more efficient classroom learning atmosphere by implementing learning strategies that can later optimize the success of learning (Costantino, 2018; Oktiningrum et al., 2024; Wulandari et al., 2020). An understanding of STEAM is essential for teacher training students, especially those in PGSD programs, from an early age. Therefore, researchers are interested in exploring the understanding of PGSD students related to STEAM in Environmental Education lectures. Concern for the environment is essential to maintain environmental sustainability, ensuring it is not damaged or has a negative impact on living things (Rahmani & Rahiem, 2023). The mutual influence between humans and other living things creates an obligation for humans to make a positive contribution to preserving the environment. Therefore, it is necessary to foster environmental awareness (Nuvitalia et al., 2020, 2021; Rezkita & Wardani, 2018). Measuring STEAM understanding has not been carried out as a basis for implementing the concept. The results of understanding measurements can be used as a basis for evaluating learning to make it more optimal and effective in delivering the material. Based on the background above, the problem formulation in this study is as follows: How is the understanding of Science, Technology, Engineering, Art, and Mathematics (STEAM) among PGSD students at PGRI Semarang University?

METHOD

This study employs a quantitative approach with a descriptive analysis method, aiming to describe the level of understanding of PGSD students at PGRI Semarang University regarding the concept of STEAM (Abdussamad et al., 2024; Bagea & Bakar, 2025; Sugiyono, 2017). The study population consisted of all PGSD students, while the sample was selected using a purposive random sampling technique, specifically students who had taken environmental education courses. The research instrument was a STEAM understanding questionnaire using a Likert scale (Sugiyono, 2017). The questionnaire was used to determine students' understanding of the concept and application of STEAM. The questionnaire was also equipped with student answers that describe the understanding of the STEAM concept and the

integration between disciplines in STEAM. The data obtained were analyzed using descriptive statistics, including calculation of the average value and percentage. The results of the analysis were then categorized into five levels, namely very understanding, understanding, quite understanding, less understanding, and very not understanding, to provide a clearer picture of student understanding. The presentation of the results is done in the form of tables and diagrams for easier understanding.

RESULTS AND DISCUSSION

Data was obtained regarding the understanding of the STEAM (Science, Technology, Engineering, Arts, and Mathematics) concept of Elementary School Teacher Education (PGSD) students in Environmental Education lectures. The assessment of understanding utilized a 15-item Likert scale instrument, which was then analyzed by calculating the questionnaire score. The instrument was used to measure students' STEAM understanding. The calculation results were then categorized into 5 aspects of understanding. Data were obtained from 50 respondents, and the results were grouped into five categories of understanding, namely: very understanding (SM), understanding (M), quite understanding (CM), not understanding (TM), and not understanding very much (STM). The results of the study are presented in Figure 1.

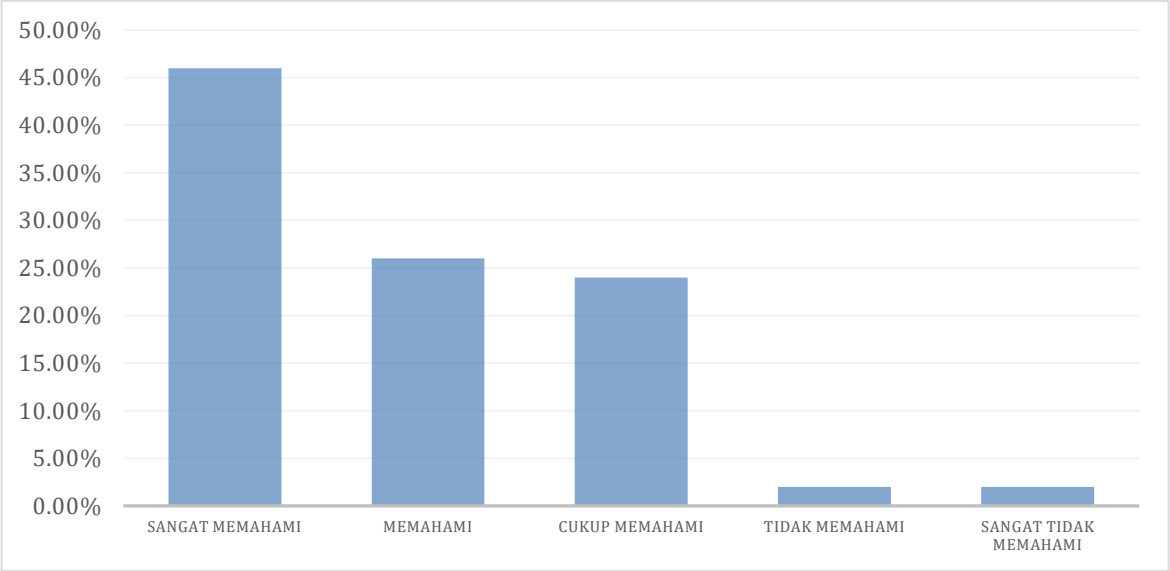

Figure 1. STEAM Understanding Categories

1. Highly Understanding (SM) Category
   A total of 23 students (46%) fell into the SM (highly understanding) category. This data indicates that they have a very good understanding of STEAM concepts, are able to integrate the knowledge learned in Environmental Education (PLH) lectures, and can apply the concepts appropriately.
2. Understanding (M) Category
   A total of 13 students (26%) fell into the M (understanding) category. They have a fairly good understanding but still need reinforcement in applying STEAM concepts. In-depth understanding also needs to be implemented through individual and group assignments to explore information about STEAM concepts related to the PLH material they have learned.
3. Fairly Understanding (CM) Category

A total of 12 students (24%) fell into the CM (fairly understanding) category. Students in the CM category have a basic understanding but still need guidance in understanding and applying STEAM concepts in their learning.

4. Not Understanding (TM) Category
   A total of 1 student (2%) fell into the TM (not understanding) category. They demonstrated difficulty understanding STEAM concepts and therefore required further guidance in their learning.
5. Very Poor Understanding Category (STM)
   One student (2%) fell into the TM (does not understand) category. In this category, students lack an adequate understanding and therefore require special attention in the learning process.

Based on these results, it can be concluded that the majority of respondents (72%) are in the Understanding (M) and Very Understanding (SM) categories. This indicates a good understanding of the STEAM concept from most students. However, there are still 4% of respondents (as many as 2 students) who do not understand the STEAM concept well and require more intensive learning interventions in the next lecture. Therefore, actions must be taken to support students who experience learning difficulties. Based on the results of the analysis obtained, it is hoped that this can serve as a basis for designing more effective learning strategies to improve STEAM understanding among students, especially those in the UPGRIS Elementary School Teacher Education study program. This can be achieved through group project assignments that incorporate a variety of cognitive abilities. Data for STEAM understanding for each statement item is presented in Figure 2.

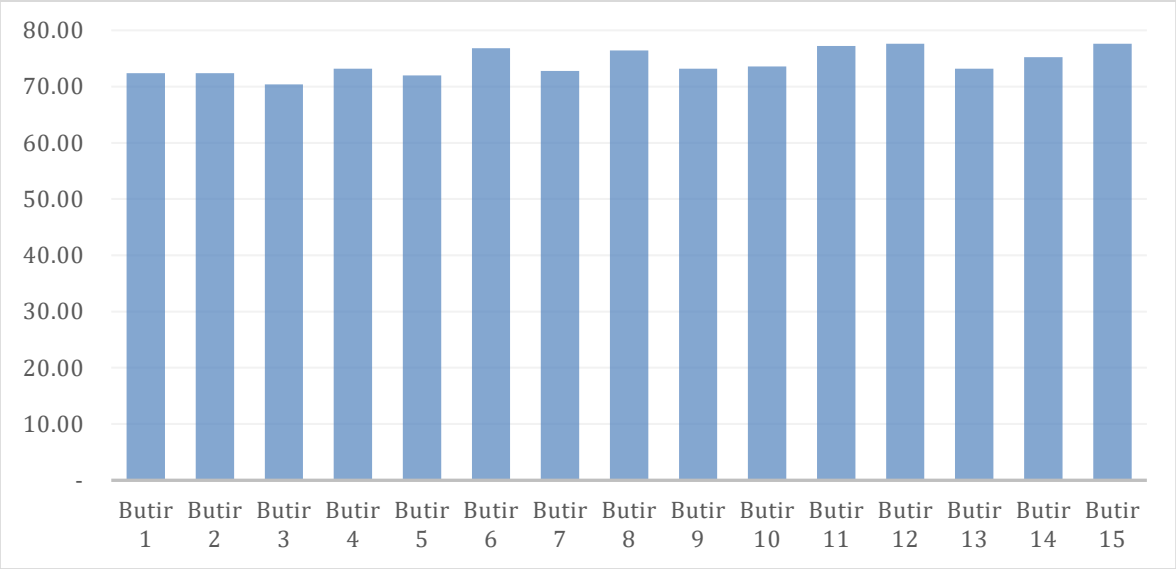

Figure 2. Understanding STEAM

Figure 2 illustrates that the analysis of statement items related to the implementation of STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning reveals variations in the level of understanding and application of STEAM concepts among respondents. The data indicate that the statement items with the highest scores relate to elements of technology and art, but it can be said that student respondents have a good understanding of STEAM, falling into the M (understanding) category. The highest score in the M category was

77.6, representing two statement items, and the lowest was 70.4. This suggests that the technological and artistic aspects of STEAM learning are more easily understood and applied by respondents. Furthermore, respondents demonstrated a high enthusiasm for integrating technology and art into the learning process, whether through the use of digital devices, creative applications, or project-based learning methods that involve artistic creativity.

Students' understanding of technology encompasses knowledge of how to use new technologies, an understanding of how new technologies are developed, and the ability to analyze how new technologies affect individuals and society. The technological era also influences students in completing individual and group assignments, such as during presentations. Students have used digital media, such as applications, to provide solutions to problems encountered during project assignments. The technological element is represented by the use of technology during learning activities, such as operating the internet, computers, and other practical tools. The rapid development of technology in everyday life is considered capable of solving problems in human life (Nuvitalia et al., 2020). Therefore, the use of technology is considered capable of addressing the problems faced as part of the solution.

Furthermore, in the understanding of art, students understand it as a form of freedom to express innovative and creative ideas, work collaboratively, and develop integrated thinking and problem-solving skills. Interview results indicated that respondents enjoyed and found it easy to understand the art element in solving problems in groups. The art element in STEAM can design innovations that encourage students to approach scientific and technical problems with a more creative perspective (Bancong, 2024; Hasanah et al., 2021; Oktiningrum et al., 2024). The art element in STEAM provides students with opportunities to solve problems in unique ways and illustrates that science and technology are not just about numbers and formulas (Clarke, 2019; Fatimah et al., 2022). Students can learn the beauty of communication skills in conveying ideas by integrating art in STEAM (Wulandari et al., 2020). The hope for the future is that in the workplace, students will be able to face various complex problems and can also contribute positively.

The lowest level of understanding concerns knowledge of the STEAM learning approach and its application to the learning process. This understanding is a concern for researchers who introduce the term STEAM and aim to provide students with a better understanding of how to apply it in their learning. This low score indicates a gap in understanding the basic concepts of STEAM and how to integrate the five elements of STEAM comprehensively into learning activities. This could also be caused by a lack of training or socialization regarding the concept and implementation of STEAM in the educational environment for students. As prospective educators, Elementary School Teacher Education students will have a role that is not only as a deliverer of material, but also must be skilled in preparing learning needs. To prepare these provisions, actions must be taken to understand the term STEAM and its application and be able to implement it in the future. Interview results also obtained information that training is needed on teaching modules or lesson plans that integrate STEAM as a provision for prospective elementary school teachers. Training is needed to develop HOTS-based lesson plans by implementing STEAM-based learning approaches (Dewi et al., 2022). The results showed that students were able to effectively plan STEAM-based learning implementation and

improved their mastery of the aspects learned during the activities, thus stimulating student creativity. Teachers are expected to generate engaging and creative ideas in implementing STEAM learning, fostering students' curiosity in the teaching and learning process (Mufida et al., 2022; Nuvitalia et al., 2021). Furthermore, developing learning modules that integrate the five STEAM elements proportionally can be a solution to improve educators' understanding and skills in applying STEAM. Thus, the implementation of STEAM learning can be more optimal and have a positive impact on the development of 21st-century skills in students. This understanding impacts student creativity and collaboration when working in groups to complete a project (Hasanah et al., 2021; Septiani & Kasih, 2021).

The STEAM approach can enrich learning experiences through collaboration, environmental exploration, and the development of positive character traits such as responsibility, cooperation, and concern for society and nature (Rahmani & Rahiem, 2023). Interviews with respondents revealed that students understand STEAM and can then implement it by transforming unused items into useful products as part of an Environmental Education project. The student's work or products include repurposing used items into useful and marketable items, such as flower pots made from used towels, shopping bags crafted from bottle caps combined with decorations, bags made from plastic coffee wrappers, and ecobricks used for chairs and study tables. Furthermore, organic household waste is processed into liquid organic fertilizer (POC) and compost. Students understand the meaning of STEAM through discussions and information searches related to their assignments. Students also gain knowledge from discussions inside and outside the classroom with their teams, as well as through research articles in research journals (Oktiningrum et al., 2024). Furthermore, working on projects in groups allows students to collaborate with their peers. After completing the course, students also experience the benefits of using STEAM in their daily lives. However, there is a concern: creating a learning plan, such as a teaching module, requires in-depth research so that it can be effectively implemented by teachers in the field.

CONCLUSION

Understanding of Science, Technology, Engineering, Art and Mathematics (STEAM) in PGSD students of Universitas PGRI Semarang is grouped into five categories of understanding, namely: very understanding (SM), understanding (M), quite understanding (CM), not understanding (TM), and not understanding at all (STM). Students are classified as very understanding of STEAM as much as 46%, understanding of STEAM as much as 26%, quite understanding of STEAM as much as 24%, not understanding STEAM as much as 2%, and not understanding STEAM as much as 2% of the total research respondents.

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