



Analysis of the Application of STEM Approaches in Mathematics Learning in Junior High Schools

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Abstract

The integration of ICT in learning is a component of 21st-century learning. Science and technology always develop rapidly from time to time. The purpose of this study is to determine the knowledge and abilities of junior high school mathematics teachers in STEM learning. This research was also conducted to determine student knowledge related to STEM learning. This study used a mixed method. The results showed that most junior high school mathematics teachers in the Donggala district did not understand STEM/STEAM learning. The teacher has also not been able to apply the STEM/STEAM approach in the learning process. Therefore, it is hoped that mathematics teachers in the Donggala district can apply a STEAM-based approach combined with local wisdom in the Donggala district. And it is necessary to conduct training to improve teacher competencies related to STEM learning.

Keywords: *STEAM approach, ICT, local wisdom*

A. Introduction

The COVID-19 pandemic until the post-pandemic era has accelerated the integration of technology, information, and communication into the educational environment. Education in the 21st Century has become more reliant on information and communication technology (Wannapiroon & Pimdee, 2022). It is also characterized by the lack of face-to-face learning

which requires teachers, especially teachers in the Donggala district to use ICT media so that they must develop their professionalism as teachers so that learning goals can still be achieved. Aykan & Yildirim (2022) state these developments have also had ramifications on professional development, which has become harder to achieve since the pandemic due to the lack of face-to-face learning. The advent of new and emerging technologies has led to the emergence of innovative approaches to teaching and learning aimed at cultivating the critical thinking needed for the rapidly changing and complex digital era (Meletiou-mavrotheris et al., 2022). Related to that, innovation in learning is needed so that students can develop their skills. One of the learning innovations is STEAM-based learning.

STEAM learning is contextual learning in which learners are invited to understand the phenomena in the surrounding environment, then explore in their way, and are expected to create a unique work (Sartono et al., 2020). STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning is an innovation for education in Indonesia. STEAM seeks to develop humans to be able to create something based on science and technology. With STEAM, students are encouraged to think comprehensively to try to solve problems with the five aspects of STEAM.

The STEAM-based approach combines science, technology, engineering, arts, and mathematics. Mathematics has an intimate connection to science, engineering, and arts and this connection has been even more profound with technology (Belbase et al., 2021). (Rao et al., 2021) states that true STEAM education brings together educators with expertise from very disparate fields, professional learning experiences need to create interdisciplinary spaces where meaningful, cross-disciplinary collaborations can occur. Kim in Aykan & Yildirim (2022) states that some countries (UK, USA, Turkey, etc.) have integrated STEM into formal and informal education to improve science and math literacy, teach 21st-century skills, and facilitate collaboration between schools and industries. In applying this STEAM-based approach, a teacher can use the surrounding environment or local wisdom as a learning medium.

Local wisdom is substantially the norm that applies in a society that is believed to be true and becomes a reference in acting and behaving daily (Suastra & Arjana, 2021). With thousands of islands stretching from Sabang to Merauke, the Indonesian state has a lot of local wisdom. Therefore, teachers can easily apply STEAM learning combined with local context/wisdom owned by the area where they live. The learning process based on local culture and local wisdom makes it easier for students to understand the competencies in learning (Lubis et al., 2022). One area where there is a lot of local wisdom is the Donggala regency. So it is hoped that mathematics teachers in the Donggala district can apply a STEAM-based approach combined with local wisdom in the Donggala district. STEM learning directs students to think critically, collaborate well, communicate (communication), creativity to solve problems that occur in everyday life (Nurhaifa et al., 2020).

Local wisdom is a stronghold to ward off the entry of foreign culture into Indonesia, but currently, many Indonesians have abandoned local wisdom and are influenced by foreign cultures that are not by the personality of the nation, that many people have abandoned the teachings of heroes to maintain local wisdom which is the national identity of the Indonesian nation. Local wisdom is one of the characteristics of a nation in showing identity and life (Damanik & Lubis, 2022). Factors that cause this what happens is the development of technology or the digital era, in which all information is easily accessible via the internet (Rahardi, 2021). The dynamics of the times have a positive impact and also a negative in the younger generation (millennial generation), which makes it easier to access everything through the internet (Siregar & Selatan, 2022).

In summary, from this overview, the purpose of this study is to determine the knowledge and abilities of junior high school mathematics teachers in STEM learning. This research was also conducted to determine student knowledge related to STEM learning. We intend to focus on what teachers need to improve their professionalism, especially in implementing STEM-integrated ICT-based learning combined with local wisdom where teachers teach.

B. Methodology

1. Research Design

The method used in this study is mixed. This method is used because this research combines qualitative and quantitative approaches in obtaining data.

2. Instruments

To obtain information related to the application of the STEAM approach in mathematics learning at junior high schools in Donggala Regency, an instrument in the form of a google form is used to find out the extent of teacher and student knowledge of the application of the STEAM approach in mathematics learning. Data collection techniques in the form of surveys using google forms. The subjects of this study were 20 mathematics teachers in the Donggala district and 17 mathematics education students at Tadulako University.

3. Technique of Data Analysis

The data analysis techniques used in the study are the data analysis techniques of the (Miles et al., 2014) model to analyze qualitative data and use Microsoft Excel to analyze quantitative data. The activities in the data analysis are data condensation, data display, dan conclusion drawing/verification. condensed data in the form of survey results through google forms related to teacher and student knowledge of STEM learning with local wisdom in accordance with research objectives and can provide a clear picture and make it easier for researchers to collect subsequent data, and search for it if needed. The presentation of data that has been condensed in this study is data in the form of descriptions or descriptions and if necessary will also be presented in the form of tables or diagrams. Drawing conclusions and verification is carried out after the stage of condensation and presentation of data.

C. Findings and Discussion

1. Findings

1.1 Analyst Results on Junior High School Mathematics Teachers in Donggala District

a. Survey related to teacher participation in STEM/STEAM learning workshops

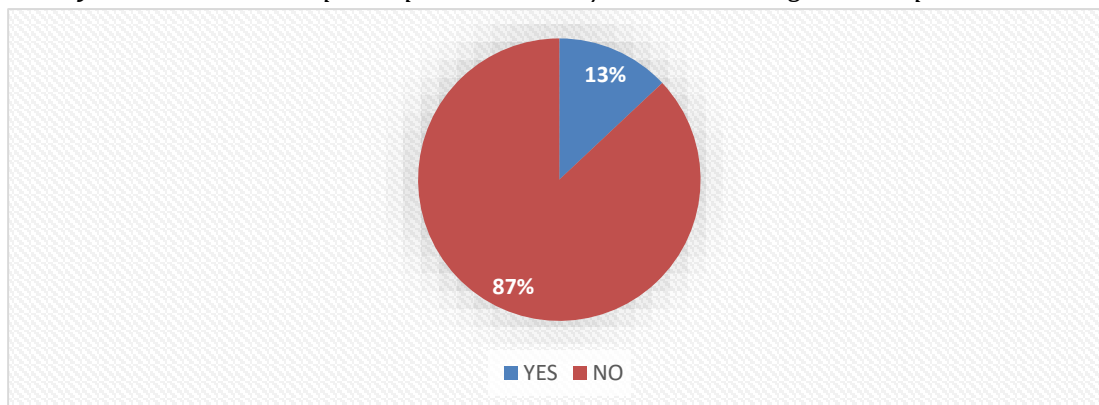


Figure 1. Diagram Of Teacher Participation In STEM/STEAM Learning Workshops

Based on the results of a survey that has been conducted on 20 junior high school mathematics teachers in Donggala district, it shows that as many as 17 teachers have participated in STEM / STEAM learning workshops or as many as 85% have participated in STEM/STEAM learning workshops. Then as many as 3 teachers have not participated in STEM/STEAM learning workshops or as many as 15% have not participated in STEM/STEAM learning workshops.

b. Survey on teachers' understanding of STEM/STEAM

Based on the results of a survey that has been conducted on 20 junior high school mathematics teachers in Donggala Regency, it shows that many of the teachers only know what STEM/STEAM stands for. Some state that STEM/STEAM is technology-based learning. Some state that STEM/STEAM is a learning innovation and problem solving. Some state that STEM/STEAM is knowledge and skills. Some state that

STEM/STEAM is ICT-based learning. And some claim that they don't know STEM/STEAM yet.

c. *Survey related to STEM/STEAM implementation*

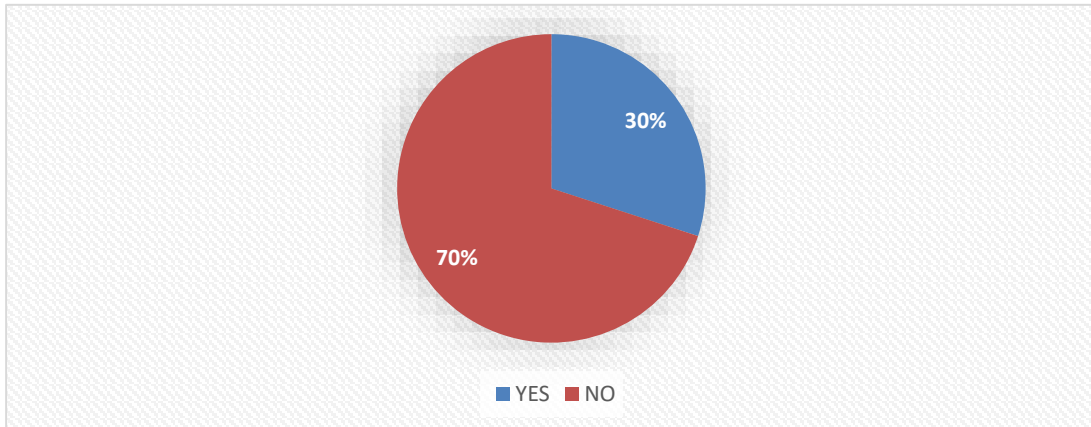


Figure 2. Diagram Of Teachers Applying STEM/STEAM Learning

Based on the results of a survey that has been conducted on 20 junior high school mathematics teachers in Donggala Regency, it shows that as many as 6 teachers have implemented STEM/STEAM learning or as many as 30% have applied STEM/STEAM learning. Then as many as 14 teachers have not implemented STEM/STEAM learning or as many as 70% who have not implemented STEM/STEAM learning.

d. *Survey of obstacles faced by before and after applying STEM / STEAM learning*

Based on the results of a survey that has been conducted on 20 junior high school mathematics teachers in Donggala Regency, it shows that the obstacles faced by teachers so that they have not implemented STEM/STEAM learning are because they do not know how to apply the STEM/STEAM approach. Meanwhile, the obstacles faced by teachers when implementing STEM/STEAM learning are due to inadequate electricity and networks and inadequate facilities and infrastructure.

e. *Surveys related to media / applications used by teachers when teaching mathematics*

Based on the results of a survey that has been conducted on 20 junior high school mathematics teachers in Donggala Regency, it shows that most teachers use GeoGebra. There are teachers who use Desmos, Liveworksheet, video and images, and PowerPoints. In addition, there are still teachers who have not used media / applications in teaching mathematics.

f. *Survey related to the use of local context/wisdom in learning*

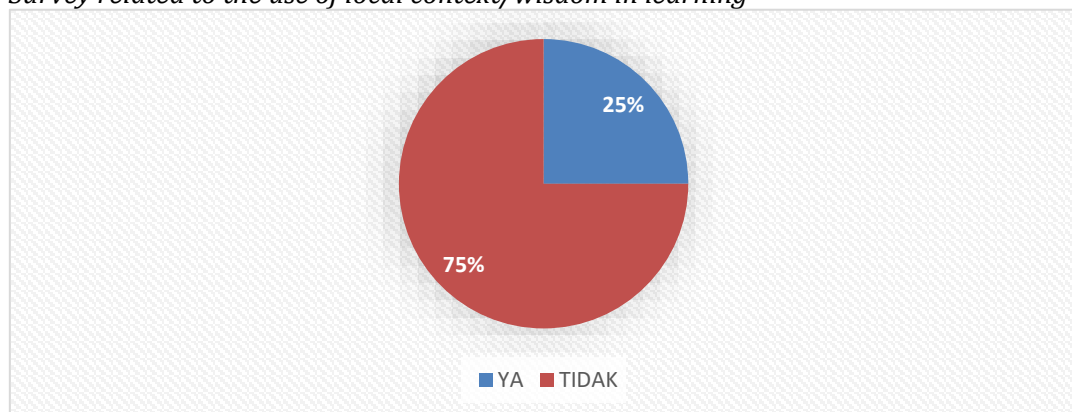


Figure 3. Diagram Of Teachers In The Use Of Local Context/Wisdom In Learning

Based on the results of a survey that has been conducted on 20 junior high school mathematics teachers in Donggala Regency, it shows that as many as 5 teachers have used local context/wisdom in learning or as many as 25% have used local

context/wisdom in learning. Then as many as 15 teachers have not used local context/wisdom in learning or as many as 75% have not used local context/wisdom of learning.

g. Local context/wisdom surveys that can be used in learning

Based on the results of a survey that has been conducted on 20 junior high school mathematics teachers in Donggala Regency, it shows that in general teachers state that local wisdom in each region can be used in learning, such as batik bomba, sampoulo, siga, sirtu mine, Moringa leaves, and others. Furthermore, many of the teachers stated that mutual aid is a form of local wisdom that can be used in learning. In addition, there are teachers who state that culture and customs, marine resources, and the surrounding environment can be used in learning.

h. Surveys related to training needed by teachers to improve their competence

Based on the results of a survey that has been conducted on 20 junior high school mathematics teachers in Donggala Regency, it shows that the training needed by teachers to improve their competence is training related to improving teacher competence, especially in applying STEAM ICT learning.

1.2 Analyst Results on Students of the Mathematics Education Study Program FKIP Tadulako University

a. Survey of student understanding related to STEM / STEAM learning

Based on the results of a survey that has been conducted on 17 mathematics education students at FKIP UNTAD, it shows that most of them explain STEM/STEAM learning based on what STEM/STEAM stands for. In addition, there are students who do not know what STEM/STEAM learning is like.

b. Surveys related to participation in STEM/STEAM learning

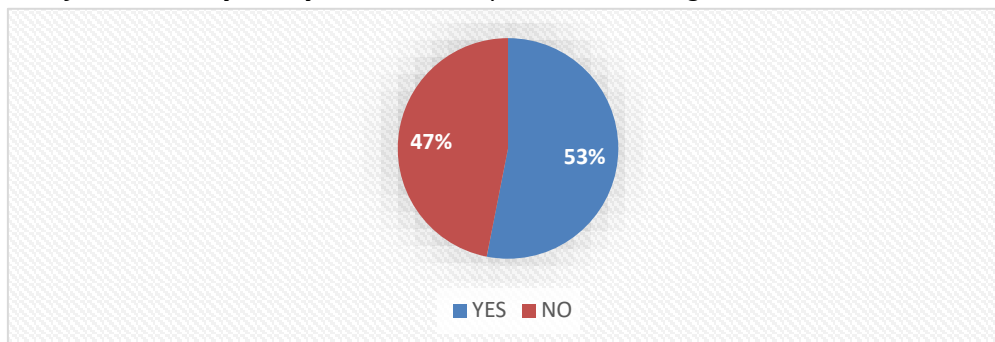


Figure 4. Diagram Of Students Participating In STEM/STEAM Learning

Based on a survey that has been conducted on 17 mathematics education students, FKIP UNTAD shows that 9 people have participated in STEM/STEAM learning or as many as 53% have participated in STEM/STEAM learning. Then as many as 8 people who have never participated in STEM / STEAM learning or as many as 47% who have never participated in STEM/STEAM learning.

c. Surveys related to media / applications that have been used when learning mathematics

Based on a survey that has been conducted on 17 mathematics education students, FKIP UNTAD shows that 17 people have used the GeoGebra application or as many as 100% have used the GeoGebra application in learning. Then as many as 5 people who have used Desmos or as many as 29.4% who have used the Desmos application in learning. As many as 3 people have used Nearpod or as many as 17.6% who have used the Nearpod application in learning. And no one has ever used the MathCityMap app yet.

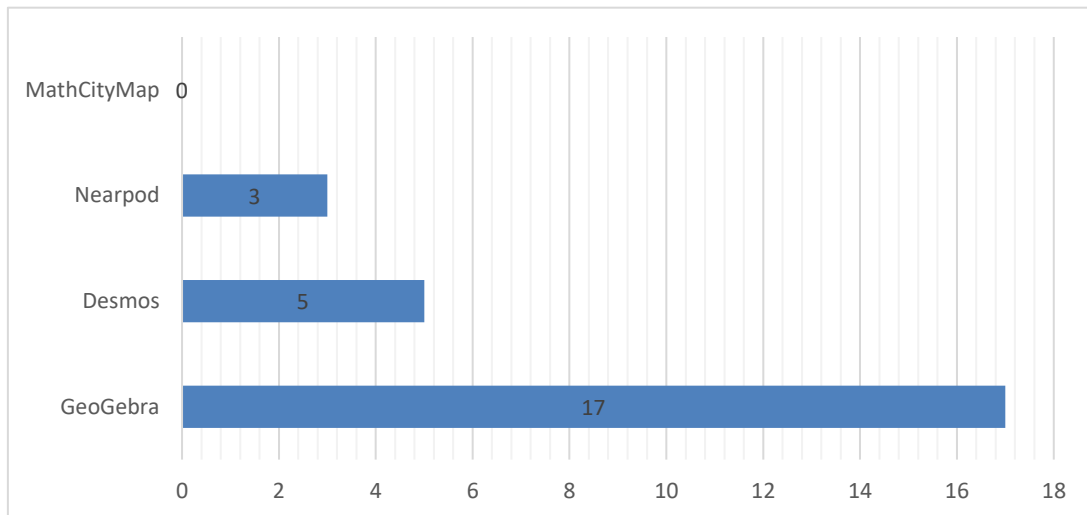


Figure 5. Diagrams Of Applications That Have Been Used While Learning Mathematics

2. Discussion

Based on the results of a survey that has been conducted on 20 junior high school mathematics teachers in Donggala district, it shows that there are teachers who are still not familiar with the STEAM approach because they have never attended a STEM/STEAM learning workshop which results in many of them not yet implementing the STEM/STEAM approach. (Morales et al., 2020) states that one that works within the bounds of Education 4.0 – necessitates quality STEAM teachers to help build STEAM-skilled citizens who are upskilled, reskilled and cross-skilled to enact STEAM curricula for global and societal needs. For this reason, trainings are needed for teachers to improve their competence so that they can become professional teachers who can create superior human beings and can be good in facing various problems. This is in line with the statement of (Mardhiyah et al., 2021) that the purpose of education is none other than to build superior human beings and can also survive in the face of various problems faced. Training and education for a sustainable future, including AI and other advanced technologies, needs special attention when it comes to minorities and underrepresented students (Skowronek et al., 2022).

Next, there are teachers who have implemented the STEM/STEAM approach even though they are not very familiar with how to apply the STEM/STEAM approach. As a result, teaching preparation is not good and the results to be achieved have not been achieved. In addition, they experience problems when applying it in learning including inadequate electricity and networks and inadequate facilities and infrastructure. In fact, to face life in the 21st-century, teachers are required to be qualified teachers to be able to innovate and characterize. This is in line with the statement of (Mardhiyah et al., 2021) that the 21st-century has very high demands to create quality human resources, these demands cause changes in the human life system in the 21st-century, so that humans in this century are required to have innovative and characteristic skills.

Then based on the results of a survey that has been conducted on 17 mathematics education students, FKIP Untad shows that many of the students can only explain STEM/STEAM by its abbreviation and some students do not understand STEM/STEAM. This is because not a few of the students have ever attended learning and workshops related to STEM/STEAM. As prospective teachers, students should prepare themselves for provisions as education staff later, one of which is by attending workshops related to education to become quality human beings, who can compete, and have skills in work. Apriliand in (Hariyanto, 2020) has explained that in this era teachers should be professional teachers, to be able to face challenges. So that by preparing from now on, students in the future can become professional teachers.

D. Conclusion

Based on the results of a survey that has been conducted on junior high school mathematics teachers in Donggala district, it can be concluded that most of these teachers do not understand STEM/STEAM learning. The teacher has also not been able to apply the STEM/STEAM approach in the learning process. Meanwhile, regarding the understanding of STEM learning, from the student side, they also do not have a comprehensive understanding. Meanwhile, Donggala Regency is one of the areas that has a lot of local wisdom that can be used as a medium in learning mathematics. However, the use of local wisdom in mathematics learning is still lacking. Furthermore, related to the application of ICT in the learning process of junior high school mathematics in Donggala district is also not optimal. Therefore, it is necessary to conduct training to improve the competence of teachers in this regard.

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