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ATTITUDE TOWARDS STEM AND TECHNOLOGY ADAPTATION AMONG PRIMARY SCHOOL STUDENTS

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ABSTRACT

The rapid development of information technology requires Indonesia to have human resources who master in STEM. In order for STEM to be well mastered, Indonesian human resources need to develop a liking and learn STEM well from an early age. Appropriate attitudes, thinking habits, interests, and behaviors are needed to develop them. One of the most important and appropriate levels of education for the development of love and mastery of STEM is primary school education. The purpose of this study is to acquire an overview of the attitudes of primary school students towards STEM, as well as their adaptation to technology. This research uses quantitative methods. Data collection was carried out through a questionnaire filled by students. Participants include 54 students, consisting of 16 5th grade students of a public primary school in Salatiga and 38 4th grade students in a private primary school in Yogyakarta. Data was then processed using SPSS. The results showed that student attitude towards STEM is considered moderate; and adaptation to technology is considered moderate. In addition, it was found that there was no correlation between attitude towards STEM and the level of technology adaptability. That is, student attitudes towards STEM and the level of adaptation of students to technology do not influence each other. Differences in sex are also found not affecting attitudes towards STEM and their adaptation to technology. The results of this study are expected to be a reference for further research related to STEM and technology adaptation, especially in primary students.

Keywords: *STEM, technology adaptation, students, primary schools, education*

1. PREFACE

According to Pirzad (2023), the term "industry 5.0" refers to humans using robots and intelligent machines to boost economic growth and productivity. Robotic assistants will make work easier for employees while prioritizing collaboration and safety, thanks to cutting-edge technology like the Internet of Things (IoT) and big data. The shortage of qualified people who can run and maintain these complicated systems is another issue.

The quality of education in Indonesia is not yet advanced. The International Student Assessment survey results from the 2018 Program, show that Indonesia is rated 72 out of the 78 participating countries. The researcher proposes a way to address the issue by creating a learning model that encourages students to connect with nature, learn to locate, plan solutions, and solve difficulties. The Science, Technology, Engineering, and Mathematics (STEM) learning model is the one that

has been determined to be acceptable (Sudarsono et al., 2022). The increase in the use of technology-based learning media influences pedagogical and technological knowledge.

Several schools in large cities in Indonesia have received government recommendations to implement STEM-based education (Zhao et al., 2022). Indonesian teachers frequently employ problem-solving techniques in their lessons. If learning activities are teacher-centered, pupils have limited opportunity to contribute. Additionally, teachers hardly ever explain the material using tech-based learning media. As STEM education was adopted in Indonesia, some changes was brought. STEM-trained teachers integrate mathematics, physics, and engineering concepts into their lessons (Zhao et al., 2022).

STEM or science, technology, engineering, and mathematics is a field and curriculum that focuses on educating students in these four areas (Hallinen, 2023). The STEM curriculum has been used by countries such as Australia, China, France, South Korea, UK, and Taiwan (Hallinen, 2023). The STEM workforce is essential to the prosperity of the world due to the rising prevalence of innovation and technology in today's global economy (Dlouhy & Froidevaux, 2022). Whereas STEM learning is beneficial to enhance 21st century skills, such as complex problem solving, critical thinking, communication skills, and teamwork (Han et al., 2022). According to researchers, students' interest in STEM vocations will grow through practical STEM experiences in STEM education, and these experiences will also prepare them for future employment chances (Kier et al. in Han, 2021).

From emotion, behavior and cognitive aspects, attitudes can accurately forecast how behavior will turn out (Rajecki, 1990). Students who have a positive learning attitude can let go of their negative learning emotions, which is crucial for them to retain what they have learnt and continue to study. According to Chen et al. (2018), solving arithmetic problems improves the way the hippocampus, a crucial memory region of the brain, functions when one has a favorable attitude toward mathematics. Although there are undoubtedly many other factors that are considered to be significant, learning attitude is among the most crucial in affecting students' learning behaviors and outcomes (Sun et al., 2020). Considering that, Sun et al. (2020) argued that evaluation of primary school students' interest in STEM courses is crucial from an early age. Researchers and educators have indicated several benefits for employing technology in the classroom. They claimed that technology-rich classrooms have had good effects on students' success in all areas (Butler, 2008). Technology offers a lot of conveniences. As technology is present in education, students may easily access a variety of learning resources and are not just focused on their teachers (Wantini et al., 2022). The direct use of technology increases student enthusiasm and eases their worries about STEM. A committed and knowledgeable teacher may inspire students' interest in STEM fields and help them acquire the skills they need to pursue careers in these fields by serving as a positive role model (Vakaloudis et al., 2019).

For the majority of employment in the 21st century, a certain level of STEM expertise is necessary. There is a growing need for professionals with STEM skills and competences, as well as a growing need for a workforce that is sufficiently trained in this field (Cheng et al., 2021). STEM identity needs to be built from an early age that can be enabled through activities, tasks and processes that require higher order and reflective cognitive processing (Forbes, 2020).

Given its urgency in the current time, it is necessary for us to see from now on, how are the attitudes of primary school students in Indonesia towards STEM learning. At the same time, we wanted to see whether a good attitude towards STEM learning also makes students have a higher

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adaptability to technology. Both are expected to be useful for consideration in Indonesia's education development plan that is based on the importance of STEM careers. The results of this study are also expected to be a reference for future studies related to STEM and technological adaptation, especially in primary school students.

The term "STEM education" refers to teaching and learning strategies that integrate the learning objectives of Mathematics (M), Science (S), Technology (T), Engineering (E), and other multidisciplinary courses into open-ended, realistic problem scenarios. Given that one of the fields within STEM is Technology (T), we hypothesized a relationship between students' attitudes towards STEM and their adaptation to technology. We propose the following hypotheses to guide the research: There is a correlation between STEM learning attitude and technology adaptability among primary school students.

2. RESEARCH METHOD

The study was conducted using a quantitative method by distributing questionnaires. Based on the research topic, there are two variables used, “STEM learning attitude” and “technology adaptation”.

Participants were 16 fifth grade students at a public primary school in Salatiga and 37 fourth grade students at a private primary school in Yogyakarta, 53 students in total. A total of 53 questionnaires were distributed for this research, and 53 data were received. Among the samples, twenty six (49%) were boys and twenty seven (51%) were girls. The mean age of the sample was nine to ten years old (see Table 1 for an overview).

Table 1
Data on students’ gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Boys**	26	49.1	49.1	49.1
	Girls	27	50.9	50.9	100.0
	Total	53	100.0	100.0	

The original STEM Learning Attitude Scale was formulated for Chinese Primary School students, and translated into English. It was based on the questionnaire of Sun et al. (2020). Based on the reliability test, this measuring instrument is reliable and can be used because this measuring instrument has a Cronbach's alpha value of 0.889. The measuring instrument consists of twenty-five items and three dimensions, which are mathematics, science, and ICT. The measuring instrument has been used to measure attitudes towards STEM in primary students in China (Sun et al., 2020).

The Technology Adaptation Scale (TAS) was largely based on two different questionnaires. The first questionnaire was the Digital Adaptability Scale (DAS) of Puckett (2019). This DAS questionnaire was previously used on 897 students in 27 public schools in Chicago. There are as many as 15 items and 5 dimensions. These dimensions include Design Logic, Efficiencies, Management of frustration and boredom, Willingness to Try and Fail, and Use of Models. Each dimension has 3 items in it.

The second one was Technological Pedagogical Content Knowledge (TPACK) of Schmid et al. (2020). This TPACK questionnaire was previously used for Pre-Service Upper Secondary School Teachers at Swiss University. This questionnaire has 28 items.

Based on the reliability test, the DAS measuring device is said to be good and can be used because this measuring instrument has Cronbach's alpha value of 0.77. The results of the reliability test on the TPACK measuring device have Cronbach's alpha value between 0.77 and 0.91, which means the questionnaire is also reliable. Both questionnaires were formulated in English. In order to use both questionnaires in our sample, and increase its effectiveness to be filled by primary school students in Indonesia, items in the questionnaire were translated into Indonesian and simplified using sentences that are easier to understand. The STEM Learning Attitude Scale questionnaire consisted of 21 items and the TAS questionnaire consisted of 15 items, to 36 items in total. All items were rated on a five-point scale (1 = "strongly disagree" to 5 = "strongly agree").

3. RESULTS AND DISCUSSIONS

The goal of this study was to see if there was a correlation between "student's learning attitude towards STEM subjects" and "student's technology adaptation" ability. We processed the data using SPSS. Before the data can be processed, we recoded the negative items and use Series Mean (SMean) to replace lost data. After the step is taken, the new researcher can test the validity, reliability, and test correlation of the two questionnaires. After conducting a correlation test, the researcher conducted a descriptive analysis to see the norms and Mann-Whitney U test to see whether sex determines the attitude of students towards STEM learning and their ability to adapt to technology.

From the results of Pearson's Correlation validity of the STEM Learning Attitude Scale, four items do not correlate between variables, because their significance is > 0.05. Four items that are not correlated are IPA2n, IPA3n, TIK4, and MTK7n. The Technology Adaptation Scale has three items that are not correlated between variables because their significance is > 0.05. Three items that are not correlated are TAS5, TAS8, and TAS11.

Theoretically, the STEM Learning Attitude Scale variable has three dimensions: Mathematics, Science, and Information Technology. Based on factor analysis through SPSS, there were 6 dimensions. The validity test shows that there were six dimensions of this variable. The results of the validity test showed that there are two to seven items per-dimension, with the differential value of the item at ≥ 0.2, and the reliability value of Cronbach's Alpha is 0.79. The Technology Adaptation Scale has several dimensions, and based on factor analysis through SPSS, three dimensions are obtained. The validity test results show that there are seven items with a differential value of the item at ≥ 0.2, and the reliability value of Cronbach's Alpha is 0.614.

Based on descriptive statistics, it was found that the variable Adaptation to Technology has a mean value of 3,69 and the STEM Learning Attitude scale has a mean value of 3,83. Based on this value, in general, the average value of the research variable is above the average measurement instrument value, which is 3 (the measurement scale is Likert 1-5).

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Table 2
Correlation Between Student's STEM Learning Attitude Scale and Technology Adaptation Scale

		Total_STEM	Total_TAS
Total_STEM	Pearson Correlation	1	.209
	Sig. (2-tailed)		.133
	N	53	53
Total_TAS	Pearson Correlation	.209	1
	Sig. (2-tailed)	.133	
	N	53	53

As shown in Table 2, there were no correlations between student's STEM learning attitude and technology adaptation [r(51) = .209, p = .133 (p > 0.01)]. From these data, it can be concluded that students' attitudes toward STEM learning and their adaptability toward technology do not influence each other. For example, based on data from the norm test results, 5 respondents have a high attitude towards STEM learning, but show low adaptability technology.

Table 3 shows categorization by percentile. In the STEM Learning Attitude variable, the 53.00 percentile is considered a low category, and the 61.00 percentile is considered a high category. In the TAS variable, the 23.00 percentile is considered a low category and 28.00 percentile is considered a high category.

Table 3
Descriptive Frequencies STEM and TAS

		Total_STEM	Total_TAS
N	Valid	53	53
	Missing	0	0
Mean		57.4717	25.7990
Median		58.0000	26.0000
Percentiles	27	53.0000	23.0000
	73	61.0000	28.0000

In the STEM Learning Attitude variable, of the 53 respondents, 12 respondents were in the low category (<53.00), 28 respondents were in the medium category (53.00 - 61.00), and 13 respondents were in the high category (> 61.00). From these data, it can be seen that the majority of respondents are within the medium category. This means that the majority of students have moderate attitude towards STEM learning. More can be seen in Table 4.

Table 4
STEM Norms Categorization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Low**	12	22.6	22.6	22.6
	Medium	28	52.8	52.8	75.5
	High	13	24.5	24.5	100.0
	Total	53	100.0	100.0	

In the Technology Adaptation Scale (TAS) variable, from 53 respondents, there were 10 students were within the low category (<23.00), 30 respondents were in the medium category (23.00 - 28.00), and 13 respondents were in the high category (> 28.00). From these data, the majority of respondents are included in the medium category. This means that the majority of students have a medium level of adaptation to technology (see Table 5).

Table 5
Technology Adaptation Scale Norms Categorization

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Low**	10	18.9	18.9	18.9
	Medium	30	56.6	56.6	75.5
	High	13	24.5	24.5	100.0
	Total	53	100.0	100.0	

According to the norm category data, there are less students in the low category compared the medium and high categories. This frequency applies to both variables, STEM Learning Attitudes and Technology Adaptation Scale.

Table 6
Mann-Whitney U Test

	Total_TAS	Total_STEM
Mann-Whitney U	342.500	326.000
Wilcoxon W	720.500	677.000
Z	-.152	-.446
Asymp. Sig. (2-tailed)	.879	.656

We also conducted Mann-Whitney U test to compare scores in men's groups (n = 26) and scores in women's groups (n = 27). From TAS data, it appears that at the alpha 0.05 level, the score distribution in men and women does not differ significantly (u = 342,500, p> 0.05). TAS variable do not differ significantly in terms of sex. From the STEM data, it appears that at the alpha 0.05 level, the distribution of scores in men and women does not differ significantly (u = 326,000, p> 0.05). The STEM variable does not significantly differ in terms of sex. From the results of the Mann-Whitney U test, it was found that sex differences did not affect attitudes towards STEM learning and their adaptability towards technology.

4. CONCLUSIONS AND SUGGESTIONS

The results show that students' attitudes towards STEM and adaptation to technology were classified as moderate. This category was obtained through a descriptive analysis using SPSS. In addition, through the correlation test method with Pearson Correlation at the 0.05 alpha level, it was found that there was no correlation between student attitudes towards STEM learning with the level of student adaptability to technology [r (51) = .209, p = .133 (p> 0.01)]. It can be concluded that the two variables do not influence each other, despite Technology (T) being a part of STEM learning. Through Mann-Whitney U testing, researchers also found that sex has no influence on student attitude towards STEM and their adaptability to technology.

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Researchers found that primary school students show good STEM Learning Attitude and Adaptation to Technology. This is based on data showing that the majority of students fall into the medium and high categories. Therefore, the researcher concluded that STEM learning and the development of students' adaptability to technology is ideally conducted at primary school level.

The findings of this study are expected to be a reference for further research related to STEM and the adaptability to technology, especially in primary school students. Researchers hope that these findings can be a reference and consideration in the educational development plan in Indonesia based on the importance of STEM careers. Subsequent research is advised to take more samples from other primary schools to diversify the data.

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