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Research Artikel

ANALYSIS OF STUDENTS' ATTITUDES TOWARD STEM BASED-ON GENDER AND GRADE LEVEL: A COMPARATIVE STUDY BETWEEN INDONESIA AND THAILAND

ANALISIS SIKAP SISWA TERHADAP STEM BERDASARKAN GENDER DAN TINGKATAN KELAS: STUDI KOMPARASI INDONESIA DAN THAILAND

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Abstract

Attitude is a tendency to behave and react to a given stimulus. The smoothness of STEM learning involves students, one of which is students' attitude towards STEM. Students at the junior high school level are a transitional period from children to adolescents who are not yet considered adulthood. Besides that, there is behavior stereotypical in male and female students during learning. This research was conducted to analyze students' attitudes towards Science, Technology, Engineering, and Mathematics (STEM) in Indonesia and Thailand in terms of grade level and gender. The research method used is descriptive quantitative using a survey. This study used the STEM questionnaire distributed to 139 students in Thailand and 90 students in Indonesia. Data were collected using a questionnaire about students' attitudes towards STEM and interview protocols for science teachers. Analysis of student attitudes, which focused on self-confidence, enjoyment, interest, and anxiety, showed that these attitudes were more dominant among students at the highest grade level in both countries. However, there is no significant difference between the attitudes of male and female students in Indonesia and Thailand; both are the same in responding to STEM learning.

Keywords: students' attitudes, STEM, grade levels, gender.

Abstrak

Sikap merupakan kecenderungan berperilaku dan reaksi terhadap stimulus yang diberikan. Kelancaran pembelajaran STEM yang melibatkan siswa, salah satunya adalah sikap siswa terhadap STEM. Siswa pada jenjang sekolah menengah pertama merupakan masa peralihan dari anak-anak menuju remaja yang belum dikatakan masa dewasa, selain itu adanya perilaku stereotype pada siswa laki-laki dan perempuan pada saat pembelajaran. Penelitian ini dilakukan untuk menganalisis sikap siswa terhadap Sains, Teknologi, Rekayasa, dan Matematika (STEM) di Indonesia dan Thailand ditinjau dari tingkat kelas dan jenis kelamin. Metode penelitian yang digunakan adalah kuantitatif deskriptif dengan menggunakan survei berupa kuesioner. Penelitian ini menggunakan kuesioner STEM yang dibagikan kepada 139 siswa di Thailand dan 90 siswa di Indonesia. Data dikumpulkan dengan menggunakan kuesioner tentang sikap siswa terhadap STEM dan protokol wawancara untuk guru IPA. Analisis sikap siswa yang berfokus pada kepercayaan diri, kesenangan, minat, dan kecemasan, menunjukkan bahwa sikap tersebut lebih dominan di antara siswa pada tingkat kelas tertinggi di kedua negara. Namun tidak ada perbedaan yang signifikan antara sikap siswa laki-laki dan perempuan di Indonesia dan Thailand, keduanya sama dalam merespon pembelajaran STEM.

Kata Kunci: Sikap siswa, STEM, tingkatan kelas; jenis kelamin.

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INTRODUCTION

In STEM-based science learning, skill learning is not the only matter to be considered. Other aspects must also be considered, such as students' attitudes about the learning they receive (likes or dislikes science learning in school) (Koballa & Crawley, 1985). If they have pleasant experiences and positive feelings at the beginning of science learning, it will ease their learning process. Students will get a positive attitude during science learning, so they will be interested in science and are happy to learn. Students' attitude towards science is important because it can improve their learning outcomes and achievement, thus affecting their performance (Liaghatdar et al., 2011). An international survey by PISA revealed the high level of students' interest and positive attitudes toward subjects such as science. Schools must foster and reinforce these positive attitudes to ensure that students leave school with the motivation and competencies to continue learning (OECD, 2019).

The prominence of the STEM approach to science learning during this globalized era needs to be supported by students' attitudes toward learning. Positive attitudes such as curiosity, interest, and fun can affect students' learning outcomes, especially for middle school students. They are at the transitional period, adolescence, which is neither a child nor adults. During this period, they experience rapid changes in attitudes, both in male and female students. Both male and female students have the same learning portion, and this difference becomes *a stereotype for educators*. One research about Indonesian Students' Attitudes and Interests in STEM stated that male students have more positive attitudes and beliefs in technology, engineering, and mathematics than females. Meanwhile, females have more positive beliefs and attitudes toward basic science (Suwono et al., 2019).

Research in Texas in 2014 showed differences in attitudes towards STEM careers between students in the first and second years; the first-year students had more good attitudes towards STEM careers (Christensen et al., 2014). Another research explained that STEM-based science

learning on curiosity and creative thinking skills significantly affected junior high school students (Hoeruni, 2017). It was corroborated by the research of analysis of students' attitudes toward science subjects indicated a positive attitude toward science subjects (Sukarni et al., 2020).

From the 2015 PISA (Program for International Student Assessment) data, Thai students' abilities in science, mathematics, and reading were ranked 55th, while Indonesia was ranked 62 out of 70 countries (OECD, 2016). However, in the 2018 PISA data, Indonesia has been downgraded, occupying the 72nd position of the 77 countries in the Organization for Economic Cooperation and Development (OECD), while Thailand's ranking is ranked 66th, still above Indonesia's. The two countries use curricula with the same backgrounds based on 21st-century education (OECD, 2019).

STEM education in Thailand was implemented in 2016 to elevate Thailand as an innovative and creative-based country (Chamrat et al., 2017). Valaya Alongkorn Rajabhat University Demonstration School, which was a laboratory of Valaya Alongkorn Rajabhat University under the direct auspices of the Kingdom. It has implemented STEM learning in science, mathematics, and art lessons since 2017. The school has regular classes and Intensive English Program classes (IEP), and every year holds a Science Day to encourage students' creativity. It was interesting to analyze the students' attitudes toward STEM learning in this school.

In Indonesia, STEM has been developing since 2013 (Nurazizah et al., 2018). In recent years, STEM education has been considered a gold standard for the Indonesian education system. However, research on Indonesian students' attitudes toward STEM has not been widely conducted. This fact, along with the 2018 PISA data regarding Indonesian students' competencies, underlines the necessity to survey the Thai students' attitudes toward STEM in terms of grade level and gender. This reason was based on the Thai students' PISA ranks being higher than in Indonesia. This study can be used as a reference to see the importance of students' attitudes toward STEM so that teachers do

not just apply the learning approach but also consider it by looking at students' interests.

Various students' groups and genders study STEM learning. It is necessary to research students' attitudes toward STEM to determine grade level and gender. This study analyzed the students' attitudes toward STEM learning in Thailand and Indonesia. The research was conducted by reviewing the grade level and gender. First, students' general attitudes toward STEM were analyzed. Then students' attitudes in terms of differences in class levels were analyzed. Then, students' attitudes toward STEM gender differences were analyzed. After that, the results were analyzed using the descriptive analysis method and comparing the two countries' results to see the differences between Thailand and Indonesia.

METHOD

This research was a quantitative descriptive study. Quantitative descriptive research analyzes the percentage of the obtained results (Hardani et al., 2020). The sample taken is the *Intensive English Program* classes (two seventh and two eighth grades). One hundred thirty-nine students from four classes in Thailand (66 seventh grade and 73 eighth grade students) were participated in this research, with 61 males and 78 females. Meanwhile, in Indonesia, 90 students from three classes (8 seventh graders, 52 eighth grade students, and 30 ninth graders) were participated in by 29 male students and 61 female students. Data were collected using a questionnaire modified from Faber's 2014 study entitled "*Student Attitude toward STEM: The Development of Upper Elementary School and Middle/High School Student Surveys*" (Faber et al., 2013). The survey used in Faber's research uses Likert scale items to measure students' attitudes towards science, mathematics, engineering, and 21st century technology and skills. The interviews with science teachers for seventh and eighth-grade IEP were also conducted.

Students filled out the questionnaire. It used the Likert Scale: Strongly agree, Agree, Disagree, and strongly disagree. Data were analyzed using descriptive statistical analysis. Descriptive statistics are related to recording, compiling, presenting, and

summarizing by describing the data (Iskandar, 2013). The first step is to calculate the average of these values, and the last step was to calculate the percentage using the following formulae:

$$P = \frac{F}{N} \times 100\%$$

Information, symbol F is frequency, N is the number of respondents, and P is the percentage number. Furthermore, the standard intervals from Arikunto (2006) were used to analyze the results of the students' attitudes with the following percentages: 76%-100%= Very Good; 56% - 75% = Good; 40% -55% = Fair; <40% = Poor (Arikunto, 2006).

RESULTS AND DISCUSSION

The attitude of Junior High School Students toward STEM-based on Grade Levels

Students confident in STEM

Table 1. Indonesia Students' and Thai Students' self-confidence toward STEM-based on Grade Levels

	Grade 7		Grade 8		Grade 9	
	INA	THAI	INA	THAI	INA	THAI
Very Good	50%	37.5%	50%	25.5%	27%	-
Good	50%	20.6%	50%	31.4%	70%	-
Fair	0%	39.25%	0%	16.6%	3%	-
Poor	0%	2.65%	0%	26.5%	0%	-

As we can see in the Table 1, students' self-confidence in Thailand shows that grade 7 students have greater self-confidence than grade 8. This level of confidence is obtained when students fill out the questionnaire confidently in the science laboratory at a Lab school of one public university in Thailand. Grade 7 students ask more questions than 8th-grade students to the teacher. This self-confidence appears differently in each phase because, in each phase, the individual's ability to behave and act in dealing with a situation differs from phase to phase (Diananda, 2019). While students' self-confidence in Indonesia shows that grades 7 and 8 have the same self-confidence, in grade 9, students' self-confidence decreases compared to grades 7 and 8 an excellent category.

The state of students' self-confidence in Indonesia and Thailand towards STEM is not much different. The attitude of self-confidence can be observed when students are in class, the ability to

ask questions in class, the higher the grade level, the less often they ask. The ability to ask questions is one of students' curiosity about new things that have never been encountered before, resulting in behavior that begins to bring up one's character (Desmita, 2010).

The difference in student self-confidence in Thailand has not reached 50% in the very good category, while it has reached 50% in Indonesia. This difference can be seen because in Thailand, STEM learning has been applied to science learning both in theory and practice, it can be seen from the textbooks used by students in Thailand that already use the standard STEM book, the book is entitled "Think Big Plus Science" author by Pimpan Dachakupt, Ph.D and others. Whereas in Indonesia, the basics are only for support such as books and applied to subjects not optimally, the level of difficulty and challenges is different from students in Thailand who have applied almost optimally. One of the STEM support activities in Thailand running from year to year is "Science' day". National Science Day is observed in Thailand every year on 18th August (Sumonta, 2007). This activity allows students to show their abilities, such as teamwork in class to make valuable products from plastic costumes or used paper, setting up an exhibition stand for student-made natural hand washing soap, air freshener, and other experiments—activities like this need to be in Indonesian schools to support STEM learning.

Students' Interest in STEM

Table 2. Indonesia Students' and Thai Students' interests toward STEM-based on Grade Levels

	Grade 7		Grade 8		Grade 9	
	INA	THAI	INA	THAI	INA	THAI
Very Good	25%	39.4%	25%	34.2%	17%	-
Good	75%	16.7%	73%	28.8%	77%	-
Fair	0%	36.4%	2%	24.7%	7%	-
Poor	0%	7.6%	0%	12.3%	0%	-

STEM learning in Thailand in grades 7 and 8 showed very good interest, but grade 7 students showed greater interest in STEM than grade 8 even though the percentage difference was not too far as depicted in Table 2. The data from the two tables show that all grade levels agree that interest and

curiosity about STEM are significant to learning. This result is shown by the general statement of eighth-grade students in Thailand, the use of technology in every lesson is essential, especially science material. This study proves that STEM is a necessary learning process, and students are more interested in hands-on activities than reading science books alone. The student's interest in STEM learning was also supported by the statement of the science teacher who taught the four classes. "... Students have experience, learn to use equipment, scientific tools in experiments, collect data, summarize results, and present in various formats. Collaboration with other people makes them excited to learn..." Even textbooks are filled with STEM activities that contain experiments for each lesson. Students are more enthusiastic when they are in a laboratory or learning that makes them "move."

STEM learning in Indonesia from the sample results showed the highest interest in the good category at all grade levels. Grade 9 showed good and highest interest from grades 7 and 8, but showed the lowest percentage in the very good category with statements often chosen by grade 9 students regarding "the use of technology in every lesson is important, especially science material."

Students in Thailand and students in Indonesia show that the level of interest increases along with the level. These results are in line with the statement from George (2006), which explains that a decrease in student attitudes can be associated with courses or interest in the knowledge taken by students in each class (George, 2006). In the upper grades, science is taught in a collection of facts and concepts rather than means of inquiry. The difference in Thailand, both seventh-grade and eighth-grade students often carry out the learning process through investigations and experiments in the laboratory and the laboratory so that the interest between the two levels in STEM is not too significant. Another study with results showed an attitude of being interested in STEM to learn more about it (Popa & Ciascai, 2017).

The Students' Enjoyment toward STEM Learning

Table 3. Indonesia Students' and Thai Students' enjoyment toward STEM learning based on Grade Levels

	Grade 7		Grade 8		Grade 9	
	INA	THAI	INA	THAI	INA	THAI
Very Good	88%	43.9%	69%	31.5%	57%	-
Good	13%	24.2%	31%	37%	43%	-
Fair	0%	24.2%	0%	17.8%	0%	-
Poor	0%	7.6%	0%	13.7%	0%	-

As we can see in Table 3, students' enjoyment of STEM learning in Thailand shows that grade 7 enjoys more than grade 8. Not much different from students in Indonesia in STEM learning, students at grade 7 enjoy more than grade 8 and 9 students. The fun is superior to grade 7 because of STEM learning in junior high school. Grade 7 students from Thailand and Indonesia mainly chose the statement in the survey, "I often use technology in my daily life and for me by using technology, learning science is easier to understand." The transition from elementary school to junior high school towards introducing technology in science learning is exciting and fun.

Enjoyment of learning is the extent to which students enjoy the learning process to be happy and satisfied (Kupari & Nissinen, 2013). This research can manifest in a love of science learning or being happy working on projects or experiments so that students will care about their environment. It is proven by the increasing number of statements that students prefer to be involved in science projects, such as making hand soap from pandanus together with their classmates. Enjoyment facilitates the learning process.

Interviews with science teachers in Thailand also support students' study related to their enjoyment of STEM learning. They said, "...do students enjoy learning STEM? Yes, they work systematically by using creativity and creating innovations...." Students' innovation and creativity can be observed in Science Day activities. They looked happy and very enthusiastic.

Students' Anxiety about STEM Learning

Table 4. Indonesia Students' and Thai students' anxiety toward STEM-based on Grade Levels

	Grade 7		Grade 8		Grade 9	
	INA	THAI	INA	THAI	INA	THAI
Very Good	50%	43,9%	31%	31,5%	17%	-
Good	50%	24,2%	69%	37%	77%	-
Fair	0%	24,2%	0%	17,8%	7%	-
Poor	0%	7,6%	0%	13,7%	0%	-

The very good category explains that grade 7 students in Thailand are better at dealing with STEM learning anxiety than grade 8. The data results are shown to students in Indonesia also show that grade 7 students are better at dealing with STEM learning anxiety than grade 8 and grade 8. 9 as displayed in Table 4.

Students in Thailand in grade 9 are more likely to agree with anxieties such as using technology and engineering activities such as making robots. Meanwhile, grade 8 students in Indonesia agreed with the statement, "I am not the type of person who is optimistic in learning science, let alone making engineering and products such as making robots and air fresheners."

Students from Thailand and Indonesia still feel unprepared when faced with learning product manufacturing engineering. Integrated STEM learning involves engineering, meaning that students must be invited to engineer a product from their 7th grade so that when the grade level goes up, their engineering ability also increases. In interviews at Thai Schools, the teachers suggested STEM activities in schools that could support students' future careers, such as robotics. However, not all students are interested and happy to make robots, even though more than half of the students expressed a positive attitude.

Anxiety about STEM learning mainly occurs in eighth-grade students, and a study shows that student attitudes decrease as the class progresses (Akpınar et al., 2009). George (2006) explains that science is often taught as a collection of facts and vocabulary to be memorized and not as a means of investigation in upper grades. This result causes students' curiosity to decrease, and they gain confidence that science is a complex subject.

The attitude of Junior High School Students toward STEM-based on Genders

Students' confidence toward STEM

Table 5. Indonesia Students' and Thai students' confidence toward STEM in terms of genders

	Female		Male	
	INA	THAI	INA	THAI
Very Good	41%	48.2%	48%	34.2%
Good	55%	21.4%	52%	31.5%
Fair	3%	19.6%	0%	26.0%
Poor	0%	10.7%	0%	8.2%

In Thailand, female students have a higher confidence level than male students. Meanwhile, in Indonesia, male students have higher self-confidence than female students. However, in both countries, male students agreed on statements about their skills in all aspects of their STEM learning and technology skills. Meanwhile, female more confident female students have more confident attitudes in their learning process and believe that it makes them have more logical, critical, analytical, and creative thinking processes. Data OECD supports this result in 2019, which states that girls outperform boys in science with a score of 20 points in Thailand. In Indonesia, girls outperform boys in science with a score of 7 points. Meanwhile, the average of all OECD countries in the 2018 PISA data shows that women slightly outperform men with a score of 2 points (OECD, 2019).

Students' Interest in STEM

Table 6. Indonesia Students' and Thai students' Interests toward STEM in terms of genders

	Female		Male	
	INA	THAI	INA	THAI
Very Good	26%	35.9%	14%	37.7%
Good	70%	23.1%	83%	23.0%
Fair	3%	33.3%	3%	26.2%
Poor	0%	7.7%	0%	13.1%

As we can analyze in the Table 6, the results showed that students' interest in Thailand for male students, 37.7% of them had a very good interest in STEM learning. Meanwhile, female students have a percentage that is not slightly different from male students' interest, with a percentage of 35.9%. While the results in Indonesia, female students have an advantage in interest in STEM learning compared to male students, where the percentage of

female students is 26%, and male students have a percentage of 14%. Male and female students in both countries already have a good interest in STEM learning.

Thailand and Indonesia have students' interest in STEM showing no significant difference between genders. The results of the questionnaire from both countries, female students are less interested in STEM learning if it involves technology and learning outside of school hours. Meanwhile, male students do not have a good interest in technology and engineering, such as plant genetic engineering. In general, all students are interested in all learning that involves STEM. Male students are interested in all STEM subjects and understand the importance of STEM learning. Most of them prefer to experiment and project together rather than reading science magazines and books. A study showed that female students showed more interest in learning science (Akpinar et al., 2009). This study proves that interest in STEM studies is not only dominated by one gender, and both showed an interest in STEM learning.

The Students' Enjoyment toward STEM Learning

Table 7. Indonesia Students' and Thai students' enjoyment toward STEM learning in terms of genders

	Female		Male	
	INA	THAI	INA	THAI
Very Good	69%	32.1%	66%	44.3%
Good	31%	37.2%	34%	23.0%
Fair	0%	20.5%	0%	21.3%
Poor	0%	10.3%	0%	11.5%

After we look at Table 7, male students in Thailand enjoy STEM learning more than female students. Most men enjoy hands-on learning in technology, such as making robots or "herbal hand washing gels," as a support activity in science learning. Meanwhile, female students enjoy learning if they are supported and motivated by the teacher. The enjoyment of STEM learning in Indonesia is superior for female students compared to male students. The survey results show that female students in Indonesia enjoy STEM learning more if they are supported and motivated by teachers; This is not much different from female students in Thailand.

In both countries, male and female students like to make hand soap together, which means they are a collaborative rather than individualistic activity. Students' enjoyment of learning affects their behavior or cognitive aspects (Syyeda, 2018). The more they enjoy learning, the more they engage in problem solving activities, and thus, it will enhance their learning.

Students' Anxiety about STEM Learning

Table 8. Indonesia students' and Thai students' enjoyment toward STEM learning in terms of genders

	Female		Male	
	INA	THAI	INA	THAI
Very Good	33%	32.1%	17%	44.3%
Good	66%	37.2%	79%	23.0%
Fair	2%	20.5%	3%	21.3%
Poor	0%	10.3%	0%	11.5%

Anxiety is believed to have an impact on attitudes and learning motivation and, consequently, student achievement (Getahun et al., 2016). The very good category shows a low level of anxiety as mentioned in Table 8. The results of the data show that in Indonesia female students have a better ability to deal with anxiety than female students. Meanwhile, male students were better at dealing with anxiety than female students in Thailand. Anxiety on STEM learning in Thailand is higher than students in Indonesia because the statement that often appears in the questionnaire data is anxiety about using technology properly in science learning. The anxiety of male students revolves around their laziness. They find STEM learning difficult, and they prefer the instant learning process. They have learning anxiety that involves engineering and computing. Female students have anxiety related to homework, such as designing a product.

Female students attach importance to learning technology and engineering, such as building robots, while male students attach importance to the presence of STEM learning in lessons. Anxiety tends to be higher in eighth graders. Several studies have shown that science is often taught as a collection of facts and vocabulary to be memorized in higher grades, and there is a lack of experimentation for students. This result will reduce students' curiosity and stigma that science is a complex subject (Akpinar et al., 2009).

CONCLUSION

The results from both countries, students' attitudes towards STEM in terms of grade level, all levels have a good attitude towards STEM learning. Students' attitudes of self-confidence, interest, and enjoyment tended to decrease in the very good category in both countries, except for student anxiety, which increased as grade level increased. Students' attitudes in terms of gender, male and female students showed very good attitudes towards STEM learning with not too striking differences. In Thailand, female students showed an attitude of self-confidence, enjoyment of STEM learning, overcoming anxiety superior to boys, except for the attitude of interest in STEM, female students were lower than boys. While student attitudes towards STEM in Indonesia show that self-confidence, enjoyment in STEM learning, and ways of dealing with anxiety are superior to male students than female students, female students only excel in attitudes of interest in STEM.

This study showed the positive attitude that many appear then STEM learning is interesting and if more negative attitudes appear then the learning creates anxiety for students. There is a need for further research on the analysis of student attitudes towards STEM in Indonesia in terms of grade level and gender. The existence of STEM learning in schools is an innovative learning that supports 21st century skills and improves the quality of learning science and mathematics in schools. However, this learning needs an evaluation every semester so that students do not feel anxiety in the learning. Thus, this research can be used as a reference material for science education students and science teachers to evaluate learning about student attitudes in each science lesson, especially in STEM learning.

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