Journal of Research in Instructional
e-ISSN: 2776-222X
Vol. 4(1) 2024, pp. 121 – 140
https://doi.org/10.30862/jri.v4i1.334

STEM career interest of junior high school students in Indonesia: A survey research

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Submitted: 11-01-2024

Accepted: 31-03-2024

Published: 26-04-2024

Abstract: Applying STEM integration in education has already become a concern because there is still a lack of STEM integration in schools. This study aims to analyze STEM career interest among junior high school students in Indonesia and analyze the factors that influence student interest and differ by grade. The researcher conducted survey research by adapting the STEM-CIS instrument in the shape of a 5-point Likert scale. The questionnaire consists of 44 questions with 4 dimensions of STEM and 8 open-ended questions. The survey was administered to 1510 junior high school students in several provinces in Indonesia. This finding obtained the value of the average and standard deviation for each dimension of STEM. The results also obtained factors that influenced student career interest in STEM, such as internal and environmental. This study can encourage science educators to improve STEM facilities and apply STEM learning to encourage students to pursue STEM careers in the future.

Keywords: Grade differences, STEM field, student career interest

Abstrak: Penerapan integrasi STEM di dunia pendidikan sudah menjadi perhatian karena masih kurangnya integrasi STEM di sekolah. Penelitian ini bertujuan untuk menganalisis minat karir STEM pada siswa SMP di Indonesia dan menganalisis faktor-faktor yang mempengaruhi minat siswa dan berbeda berdasarkan kelas. Peneliti melakukan penelitian survei dengan mengadaptasi instrumen STEM-CIS berupa skala Likert 5 poin. Kuesioner terdiri dari 44 pertanyaan dengan 4 dimensi STEM dan ditambah 8 pertanyaan terbuka. Survei dilakukan terhadap 1.510 siswa SMP di beberapa provinsi di Indonesia. Penelitian ini diperoleh nilai rata-rata, standar deviasi untuk setiap dimensi STEM. Hasil penelitian juga diperoleh bahwa faktor yang mempengaruhi minat karir siswa pada STEM seperti faktor internal dan lingkungan. Penelitian ini dapat mendorong para pendidik sains untuk meningkatkan fasilitas STEM dan menerapkan pembelajaran STEM untuk mendorong siswa mengejar karir STEM di masa depan.

Kata kunci: Perbedaan kelas, bidang STEM, ketertarikan karir siswa

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INTRODUCTION

Globally, every country has a common motivation and intention to make the new generations innovative and creative in changing the world by improving the educational system (Raja & Nagasubramani, 2018). Besides, a national concern is preparing the next generation of leaders and workers by integrating some fields such as science, technology, engineering, and mathematics (STEM) skills to improve society by applying the rules of reason, scientific discoveries, artistic art, and creativity. Students are promoted with STEM skills in the educational system with knowledge and skills based on their major and field (Kartini et al., 2021; Kopcha et al., 2017). Some studies have shown that learning by integrating science and mathematics in concrete and abstract forms can give motivational context to students. Several nations challenge to supply the human resources needed for careers in STEM fields (Regisford, 2021). STEM fields can improve the quality of human resources with massive energy and the capability to solve problems properly through the

existing career (Waite & McDonald., 2019). Several previous studies have investigated student career interest in STEM by using STEM-CIS that was developed by Kier et al. (2014) to measure the impact of STEM education on student career interest and awareness (Atabey et al., 2021; Zorlu & Zorlu, 2017)The results of these studies were developed to prove the psychometrically sound that can be used by researchers in the STEM field. In addition, there is a STEM semantic survey and the STEM career questionnaire was developed (Tyler-Wood et al., 2010). The study results show the effectiveness of measuring students' interest in STEM. In addition, previous studies have explored the factors that influenced STEM career choice (Blotnicky et al., 2018; Halim et al., 2018; Wiebe et al., 2018). Besides, there is some previous research focused on development of way to increase interest in STEM through STEM activities (Falco, 2017; Luo et al., 2021; Uğraş, 2020).

STEM-CIS, developed by Kier et al. (2014), is an instrument that formed a good model with a valid scale. A valid and reliable scale, consisting of 40 items and four parts: science, mathematics, engineering, and technology, was obtained as a result of the analysis. The STEM-CIS had been developed to evaluate the effectiveness of measures aimed at increasing awareness of interest in and intent to pursue STEM-related careers within a rural minority middle school students. Mostly, a few of these previous researches adapted from STEM-CIS that were developed by Kier et al. (2014) were conducted in several country such as in Turkey, Hongkong, USA, Malaysia, and Canada, especially in middle school levels (Atabey et al., 2021; Blotnicky et al., 2018; Luo et al., 2021; Razali et al., 2021; Wiebe et al., 2018)

Currently, the Indonesian government has not officially released the rules about STEM education in the curriculum (Ardwiyanti et al., 2021). Surprisingly, nowadays, STEM education in Indonesia is still an up-and-coming subject in this nation (Suprapto, 2016). Researchers and scientific educators in Indonesia find STEM education to be a fascinating topic (Firman, 2015). The investigation of measuring student's interest in STEM careers has rarely been done (Ardianto et al., 2023), but there are some previous studies also already investigated in Indonesia, especially for junior high schools (Ardianto et al., 2023; Kaniawati et al., 2021; Sidiq et al., 2022; Suprapto, 2016). Besides, there are also studies on measuring student career interest in STEM for senior high school in Indonesia that was carried out by (Suwono et al., 2019) and also a study was carried out for pre-service teacher in Indonesia (Winarno et al., 2017). However, studies on measuring student career interest in STEM in Indonesia, especially junior high school students are still lacking especially differ according to their grades.

Based on the previous study, this aims to investigate STEM career interests survey for junior high school students in Indonesia and investigates the factors that influence STEM careers. Besides, this study also investigates junior high school student's career interest in STEM fields that is differentiated according to their grade. It is also contributing to the importance of measuring students' interest in STEM. This research also can be used as a reference for all stakeholders involved in science education and school counselors to know the factors that influence student career interest in STEM and to improve STEM facilities and encourage student career interest in STEM, especially for junior high schools in Indonesia. The research questions investigated in this research are:

1. How is the profiling student's career interest in Science, Technology, Engineering, and Mathematics?

2. What are the factors that influence student career interest in STEM for each field such as Science, Technology, Engineering, and Mathematics?
3. Are there differences in junior high school students' interest in STEM fields according to their grades?

METHOD

Research design

This research was conducted using a survey method. This research method is appropriate for this research, which investigates junior high school student's career interest in STEM in Indonesia. The process of collecting data in this research was carried out by distributing the STEM-CIS questionnaire through Google form to junior high school students in several provinces in Indonesia. The data collection was conducted for four weeks in May-Juni 2023.

Participant

This research involved 1510 junior high school students. This research was administered to several science teachers of junior high school through social media and was given to their students in several schools and provinces. Participants were recruited from 13 provinces in Indonesia such as Sumatra Selatan, Jambi, and Kep. Bangka Belitung, Lampung, Banten, DKI Jakarta, Jawa Barat, Jawa Tengah, DIY Yogyakarta, Jawa Timur, Kalimantan Barat, Nusa Tenggara Barat and Maluku. 665 students were males, and 845 were female students; 591 7th graders, 508 8th graders, and 411 9th graders were recruited from 45 schools in Indonesia. The students were in age rate between 11-16 years old, which are 12 years old (14.40%), 13 years old (36.60%), 14 years old (29.30%), 15 years old (18.70%), and others (1.0%). The data of participants in the survey is stated in Table 1.

Table 1. Data of junior high school students participating in the survey

Variables	Groups	N	Percentage
Gender	Male	665	44
	Females	845	56
Grade	Grade 7	591	39.1
	Grade 8	508	33.6
	Grade 9	411	27.2
Age	11 years old	7	0.53
	12 years old	217	14.37
	13 years old	552	36.6
	14 years old	443	29.34
	15 years old	282	18.7
	16 years old	9	0.60
Total		1150	100

Research instrument

STEM-CIS was used to determine pupils' interest in the occupations in STEM that were constructed by Kier et al. (2014). The original scale consists of 4 dimensions: science, technology, mathematics, and engineering. Each dimension has 11 items of statements. The

scale was designed as a 5-likert scale. As for the numbers 5 means “strongly disagree”, number 2 means “disagree”, number 3 means “neither agree”, number 4 means “agree”, and number 5 means “strongly agree. According to the researchers, the improvement in fit indices was attributed to the interconnections established among the error terms. The study determined Cronbach's alpha coefficients for different sub-dimensions, namely science, technology, mathematics, and engineering, as 0.77, 0.89, 0.85, and 0.86, respectively (Kier et al., 2014). This research was also adapted into Bahasa and several open-ended questions were validated by 1 science education lecturer as an expert and peer reviewed in science education program. The open-ended question contains 8 questions.

Data analysis

The data were examined utilizing the statistical package for the social sciences (SPSS) version 25. The data was analyzed using descriptive statistics, which include average and standard deviation. Besides, a non-parametric Kruskal-Wallis test was used to determine the significant difference between students’ grades in STEM dimension.

RESULTS AND DISCUSSION

Creating a profile of junior high school student’s career interest in STEM

The survey of student career interest in STEM was divided into 4 dimensions which are science, technology, engineering, and mathematics. In this section, the researcher found the findings that in line with the first research question which is “How is the profile of students’ career interest in science, technology, engineering, and mathematics?” by using descriptive statistics. The average Junior High School Students’ Interest in each field of STEM which are science, technology, engineering, and mathematics shown in Figure 1.

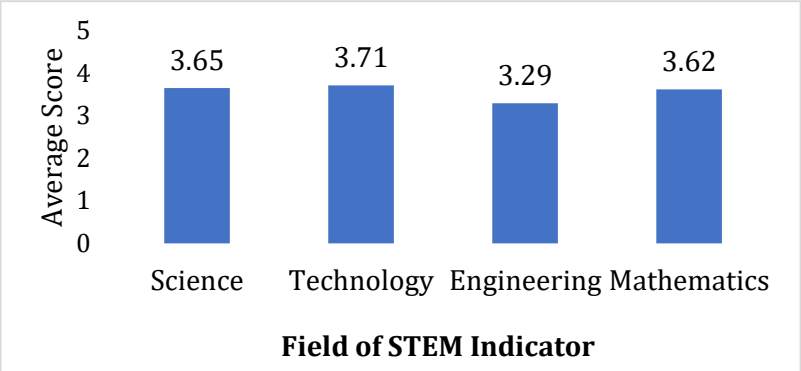

Fig. 1. Average of junior high school students’ interest in each field of STEM

Figure 1 shows the average of Junior High School Students’ Interest in each field of STEM which are Science, Technology, Engineering, and Mathematics. The results obtained that 3.29 to 3.71 with a maximum scale of 5.00. The profiling of students’ career interests in STEM explains the highest score average is in the technology field which has a value of 3.71. However, the lowest score is the engineering field which has a value of 3.29. Other field has a value of 3.65 belongs to the science field, and mathematics has a value of 3.69. The results indicated that there is a tendency in junior high school students to be interested in the field of STEM, especially in the technology dimension. The reason behind of high value that was

carried out by the technology field is probably because students already have experience in using technology in their class (Ranasinghe & Leisher, 2009).

Nowadays, because the development of technology has improved, students commonly use computers and gadgets in daily life. Many schools already applied and increased the availability of technology use for their needs to get more information and communication (Wen et al., 2023; Yomaki, et. al 2023, Yuldasheva & Mohidilxon, 2024). Besides, many studies such as explained that using technology for classwork purposes is very beneficial to academic achievement (Ben Youssef et al., 2022). Therefore, many students commonly to utilize technology for their purposes. However, the reason behind the low value of engineering as a field of STEM career interest is that students still lack engineering knowledge. It also related to the previous research that stated students engineering understanding of mechanical and other aspects that are structurally such as designing and creating something are limited to the possible engineering careers for them (Reeping & Reid, 2014). According by Liu and Chiang (2020) also stated that about engineers in school, and the majority of students had never participated in engineering-related courses or training. Instead, they learn more about engineers from the media and their families. The component that contributes to the poor average is the lack of knowledge pupils have about engineering-related activities and job kinds (Sidiq et al., 2022). So, they are unfamiliar with that. Since engineering is not part of the K-12 curriculum in school, they also don't have more information on certain types of careers in engineering (Feder et al., 2009). However, the mathematics & science average are in medium level.

This research also stated about the average of standard deviation of STEM Career interest of junior high school in some dimensions which are science, technology, engineering, and mathematics. These data shown also about the code which means as the number statement on the questionnaire for each dimensions such as S means science, T means technology, E means engineering, and M means mathematics. These data shown in Table 2 – 5 for each dimensions which are science, technology, engineering and mathematics.

Table 2. Data of student's interest in science dimension according to STEM-CIS instrument

Code	N	Average	SD
S1	1510	3.78	0.91
S2	1510	3.90	0.90
S3	1510	3.55	1.07
S4	1510	3.90	0.96
S5	1510	3.98	0.96
S6	1510	3.67	1.01
S7	1510	3.46	1.03
S8	1510	3.73	0.98
S9	1510	3.34	1.07
S10	1510	3.47	0.96
S11	1510	3.40	1.14
Average		3.65	1.00

The data in Table 2 shows about the average and standard deviation of students interest in science dimension according STEM-CIS Instrument. As the results in Table 2, the total average science dimension was obtained as 3.65 and the total average of standard deviation was obtained as 1.00. It shows that S1, S2, S4, S5, S6 and S8 are above the average. Students said they were able and liked to learn Science. They also state that science is fun because it gives knowledge about natural phenomena that are included in daily life. They are interested in science because science is a subject that can help them to achieve their career in the future. However, some statements are still in the low average such as S3, S7, S9, S10, and S11. The result also shows that the lowest average is on S9 with the value of 3.34, which is an item *"I have a role model in science career".* Students also stated that they still don't have a role model in science.

Table 3. Data of student's interest in technology dimension according to STEM-CIS instrument

Code	N	Average	SD
T1	1510	3.70	0.93
T2	1510	3.83	0.89
T3	1510	3.80	0.97
T4	1510	3.95	0.88
T5	1510	3.89	0.90
T6	1510	3.60	0.89
T7	1510	3.87	0.94
T8	1510	3.69	0.92
T9	1510	3.48	0.98
T10	1510	3.54	0.94
T11	1510	3.51	1.03
Average		3.71	1.00

The data in Table 3 shows about the average and standard deviation of students' interest in technology dimension according to STEM-CIS instrument. As the results in Table 3, the total average of technology dimension was obtained as 3.71 meanwhile the total average of standard deviation of the technology dimension was obtained as 1.00. It shows that T2, T3, T4, T5, and T7 are above the average. Students said they could learn new technology. They also state they like to use technology for class work and help them in school because it can make it easier to do their tasks by involving technology, improving their knowledge, and giving new information. Besides, they also plan to use technology for their future career because it has a lot of opportunities in the future. However, some statements are still below the average such as T1, T6, T8, T9, T10, and T11. The result also shows that the lowest average is on T9 with a value of 3.48, which is *"I have a role model who uses technology in their career".* Students also stated that they still don't have a role model in technology.

Table 4. Data of student's interest in engineering dimension according to STEM-CIS instrument

Code	N	Average	SD
E1	1510	3.27	0.93
E2	1510	3.30	0.90
E3	1510	3.30	0.95
E4	1510	3.39	0.93
E5	1510	3.46	0.94
E6	1510	3.28	0.92
E7	1510	3.22	0.95
E8	1510	3.29	0.93
E9	1510	3.13	0.98
E10	1510	3.40	0.93
E11	1510	3.15	1.07
Average		3.29	0.95

As the results in Table 4, the total average of engineering dimension was obtained as 3.29 and the total average of standard deviation of engineering dimension was obtained as 0.95. It shows that E2, E3, E4, E5, E8, and E10 are above average. Students said they can and will work hard to complete activities in school involving engineering because they like to create something that involves creativity. They also plan to use engineering and learn a lot about engineering for their future career because it has many future opportunities, such as development and industry, renewable energy, software engineering, machine engineering, etc. However, some statements are still under the average such as E1, E6, E7, E9, and E11. The result also shows that the lowest average is on E9 with a value is 3.13 which is *"I have a role model in my engineering career".* Students also stated that they still lack knowledge and understanding about their role models in engineering careers.

Table 5. Data of student's interest in mathematics dimension according to STEM-CIS instrument

Code	N	Average	SD
M1	1510	3.68	0.96
M2	1510	3.82	0.90
M3	1510	3.53	1.03
M4	1510	3.93	0.92
M5	1510	3.94	0.94
M6	1510	3.68	0.95
M7	1510	3.32	0.99
M8	1510	3.58	1.02
M9	1510	3.39	1.04
M10	1510	3.40	0.96
M11	1510	3.50	1.05
Average		3.29	0.98

The data in Table 5 shows about the average and standard deviation of student's interest in mathematics dimension according to STEM-CIS instrument. As the results in Table 5, the total average of mathematics dimension was obtained as 3.29 and the total average of standard deviation of mathematics dimension was obtained as 0.98. It shows that M1, M2, M4, M5, and M6 are above the average. Students said they can complete math tasks and will work hard in mathematics class because they want to get good grades and like to calculate in mathematics. However, some statements is still below the average such as M3, M7, M8, M10, and M11. The result also shows that the lowest average is on M7 with a value of 3.32, which is" I am interested in career that *use mathematics".* Students stated that they still lack information and understanding about the career in mathematics, because they prefer to have career out of mathematics.

Factors influence student career interest in each field of STEM

Our second research question is "what are the factors influence student career interest in STEM for each field such as Science Technology, Engineering, and Mathematics?" In this section, it shows about the results of descriptive statistic and factor influence student career interest based on open-ended question for each field of STEM. The percentage and of the amount of students' career interest in science field shown in Table 6.

Table 6. Percentage of student career interest in science field

Answer of pen-ended question (*Do you interest in science career?)*	**N**	**Percentage**
Interested in Science	1050	69.5%
Not interested in science	460	30.5%
Total	1510	100%

Table 6 shows the percentage of student career in science field such as "Do you interest in science career? and "Explain the reason based on what you choose!". As the results, it indicate the percentage of students interested in science is 69.5% and the total is 1050 students. Meanwhile, the percentage of student who is not interested in science is 30.5%, and the total is 460 students. The factors that influence student career interest in the science field is some of the students say that they like science subjects in school because science is fun and they love to learn natural phenomena and doing experiments. Besides, they also have a career dream related to science in the future such as doctor, scientist, and many more. However, the factor that influences students who are not interested in science is that some of them don't like science because it is complicated. Additionally, they also state that science has many formulas to memorize.

In Indonesia, science subjects is integrated in the curriculum. At this grade, pupils begin acquiring an interest in STEM as they recognize science and technology from an uncommon and in-depth perspective (Christensen et al., 2017). Besides, the results also contribute the correlation between some factor that affects such as internal and environmental factor. The findings indicated that the internal is related to their motivation and interest. Previous research stated that internal factors included self-efficacy and students perceptions in STEM careers (Mohtar et al., 2019). In this instance, the environment a component is linked to learning experiences, social variables, and media all

play an important role in developing self-efficacy and favorable perceptions of STEM field, which in turn influences interest in career opportunities in this field (Mohtar et al., 2019). The previous research also stated that in science motivation toward science affected their science career interest (Razali et al., 2021). The way that students view themselves concerning science is referred to as their motivation towards science. This includes their readiness for self-directed learning activities and processes as well as their consistency in moving toward more concentrated science learning (Hora & Oleson, 2017). The way that students view themselves about science is referred to as their motivation towards science Additionally, Nasir et al. (2023) stated that the primary factor in meeting students' learning requirements during the teaching and learning process and achieving the desired curricular goal is always motivation. A strong level of motivation will not only help students to study, but it will also encourage them to respect the science curriculum they have studied and spark an interest in the jobs they want to pursue (Beerenwinkel & von Arx, 2017).

Table 7. Percentage of student career interest in technology field

Answer of open-ended question (*Do you interest in technology Career)*	**N**	**Percentage**
Interested in technology	1169	77.4%
Not interested in technology	341	22.6%
Total	1510	100%

The data in Table 7 shows the percentage of student career interest in technology field based on the open-ended question, such as “Do you interest in technology career? and “Explain the reason based on what you choose!”. As the results, it indicates the percentage of student who is interested in technology field is 77.4% and the total is 1169 students. Furthermore, it is assumed that the factor that influences student career interest in the science field is internal and external. The internal is related to their motivation and their interest. The external factor is related to the learning activities, habits, and knowledge such as the experience utilizing of technology. It also because the development of technology has improved, students commonly used computer and gadgets in daily life. Previous research also stated that many schools already applied and increased the availability of technology use for their needs to get more information and in communication (Wen et al., 2023). The term "technology-enhanced learning strategies" may be used to describe the use of technology to enhance learning in in-person classrooms, the development and utilization of digital resources for asynchronous learning, or the promotion of collaborative learning via the use of social media and other platforms (Ansari & Khan, 2020). Many students choose to learn independently and at their own speed using internet resources, and they are capable of doing it. Therefore, students are engaged in involving technology in their learning activities to get knowledge and new information (Wekerle et al., 2022). Moreover, they also engaged in a career in the technology field.

Meanwhile, the percentage of students who are not interested in technology is 22.6%, and the total is 341 students. The factors that influence student career interest in technology are that some students like to learn technology in school because it is fun, modern, and easy to learn. Besides, technology also has a big role in life to help human needs, especially in the future. They want to contribute their selves to make a good impact on the world. However,

the factor that influences student who is not interested in technology is that some of the students say they don't like technology career because they still don't understand technology, and also, they said technology is complicated such as programming. Therefore, they aren't interested in technology careers. According to Astuti et al. (2021) also stated that the awareness of digital technology to fulfill the competency of 21st-century skills is still under minimum requirement.

However, without awareness of digital technology and capability will not be formed because it is the fundamental way to shape digital literacy (Beck et al., 2021; Deja et al., 2021; Jang et al., 2021; Purnama et al., 2021). Moreover, the absence of proficiency in digital technology will result in a lack of inventiveness while using it (Nasution et al., 2020). Similarly, the latter highlights the necessity for innovation while utilizing digital technology to reach a critical (Mulyanto et al., 2020; Mutohhari et al., 2021; Birgili, 2015). Additionally, the teacher has a role as a facilitator in learning activities that utilize technology and must be able to teach students to develop their digital technology ability to engage their interest in technology. The percentage and of amount of students' career interest in the engineering field are shown in Table 8.

Table 8. Percentage of students' career interest in engineering field

Answer of open-ended question (*Do you interest in engineering career?)*	**N**	**Percentage**
Interested in engineering	683	45.2%
Not interested in engineering	827	54.8%
Total	1510	100%

The data in Table 8 shows the percentage of students' career interest in engineering field by using 2 open-ended questions such as "Do you interest in engineering career? and "Explain the reason based on what you choose!". As the results, it indicate the percentage of students interested in engineering is 45.2% and the total is 683 students. Meanwhile, the percentage of students who are not interested in engineering is 54.8%, and the total is 827 students. The factors that influence student career interest in engineering field is some of student says that engineering field offers good job opportunities in the future. Besides, they also said that they love to practical activity for producing new ideas in designing and changing something that's called as engineering. Besides, engineering can solve human problem based on their needs. However, the factor that influence student who is not interested in technology is because most of students says they still don't understand and unfamiliar what engineering is.

Furthermore, it is assumed that the factor that influence student career interest in engineering field is internal and external factor. The internal is related to their motivation, interest, and their understanding. The external factor is related to their learning environment, facilities, and family background. The previous research also stated that the students knowledge of engineering in middle school are still limited (Liu & Chiang, 2020). Liu and Chiang (2020) also stated that about engineers in school, and the majority of students had never participated in engineering-related courses or training. Instead, they learn more about engineers from the media and their families. The component that contributes to the poor average is the lack of knowledge pupils have about engineering-

related activities and job kinds (Sidiq et al., 2022). Additionally, many schools are also haven't applied the engineering design process in learning because some of obstacles to apply. Many obstacles exist in applying the EDP, including student conditions, school support, teacher readiness, and facilities they have (Eastman et al., 2017). Teachers struggle to apply engineering designs and locate relevant material sources. Many educators lack the knowledge or extraordinary readiness to apply engineering design in learning activities in school (Bagiati et al., 2015).

Table 9. Percentage of students' career interest in mathematics field

Answer of open-ended question (*Do you interest in mathematics career)*	**N**	**Percentage**
Interested in mathematics	893	59.1%
Not interested in mathematics	617	40.9%
Total	1510	100%

The data in Table 9 shows the percentage students' career interest in mathematics field by using 2 open-ended questions such as "Do you interest in mathematics career? and "Explain the reason based on what choose!". As the results, it indicates the percentage of student who is interested in mathematics field is 59.1% and the total is 893 students. Meanwhile, the percentage of student who is not interested in mathematics is 40.9%, and the total is 617 students. The factors that influence student career interest in mathematics field is some of student says that they love to learn mathematics and the things that is related to calculation because mathematics is fun. Besides, they are interested to job that is related to mathematics such as businessman, accountant, and many more. However, the factor that influences students who are not interested in mathematics is because some students said they don't like mathematics because mathematics has many formulas to memorize and is difficult to understand. The previous findings by Mariamah et al. (2021)also stated that the majority of the reasons why students dislike math classes are related to the teacher. The teachers in it are too serious, they encourage pupils to memorize things, they want them to take notes all the time, they don't employ the play style of instruction, and they don't show their students any affection or creativity. According to Cvencek et al. (2015) stated that one of the primary variables that might affect how students learn in a classroom is the instructor. A teacher's educational background, prior teaching experience, and approach and media usage are some of these characteristics. A teacher's ability to instruct will be significantly impacted by their educational background.

This study also related to the prior study that also showed about the factors influencing students interest in mathematics such as teacher, class size, government factor, instructional strategy, math anxiety, and infrastructional problem that can lead to the contribution of student interest in mathematics (Anigbo & Idigo, 2015). Additionally, since the students felt mathematics is difficult also related to their achievement and psychology factors. According to Carey et al. (2017), another key element is the link between academic worry and mathematical success. Students whose repeated failures result from poor performance experience increased academic apprehension due to their increased familiarity with mathematical success and failure (or testing scenarios in general); however, this effect does not manifest in children who excel in mathematics. A recent research of

elementary and secondary school pupils discovered a considerable gap between cognitive and emotional math difficulties (Devine et al., 2018). These findings prompted the question of whether arithmetic anxiety is a generic, separate proxy for these emotional disorders, or if other emotional issues may account for the difficulties linked with poor math performance. Thus, some of factors that has explained are influencing to student career interest in mathematics.

Student career interest in STEM areas according to grade

Our third research question was: *1. Are there differences in junior high school students' interest in STEM fields according to their grades?* by using descriptive statistics and the Kruskal Wallis test that is shown in Table 10 to 12. Table 10 shows how junior high school student's interest in STEM fields differs based on their grades by using descriptive statistics which are average and standard deviation. The descriptive statistics for participants' STEM-CIS scores regarding their grades shown in Table 10.

Table 10. Descriptive statistics for participants' STEM-CIS scores regarding their grade

Grade	N	Mean	SD
7	591	3.60	0.29
8	598	3.57	0.34
9	411	3.54	0.33

According to Table 10, the STEM career interest of seventh grade was 3.60 as the highest level of interest, while the eight grade was 3.57 as the medium level interest of in STEM, and the ninth grade was 3.54 as the lowest level of interest. It also indicated that the STEM career interest level, in general, decreased as grade level increased. The descriptive statistics for each field of science, technology, engineering, and, mathematics scores regarding students' grade are shown in Table 11.

Table 11. Descriptive statistics for each field of science, technology, engineering, and mathematics scores regarding their grade

Dimensions	Grade	N	Mean	SD
Science	7	591	3.67	0.98
	8	508	3.67	1.02
	9	411	3.61	1.00
Technology	7	591	3.73	0.91
	8	508	3.67	0.96
	9	411	3.74	0.94
Engineering	7	591	3.62	0.93
	8	508	3.31	0.98
	9	411	3.26	0.94
Mathematics	7	591	3.67	0.96
	8	508	3.61	0.98
	9	411	3.55	0.99

Table 11 shows that for the science field, the highest average was 3.67 which was carried out by grades 7 and 8. Meanwhile, the highest standard deviation in science was 1.00 was carried out by grade 8. For the technology field, the highest average was 3.74, carried out by grade 9. Meanwhile, the highest standard deviation in the technology field was 0.96 was carried out by grade 8. For the engineering field, the highest average was 3.62 was carried out by grade 7, meanwhile, the highest standard deviation was 0.98 which was carried out by grade 8. For the mathematics field, the highest average was 3.67 that carried out by grade 7, meanwhile for the highest standard deviation was 0.96 which was carried out by grade 7.

As the results indicated some different values for each STEM field and grade, STEM-CIS is feasible to measure students at different levels. A research that investigated whether secondary school students' interest in STEM occupations altered according to grade levels discovered that their interest differed only in life sciences, not in the other sub-dimensions of physical sciences, technology, and mathematics (Yerdelen et al., 2016). Thus, throughout junior high school, a student's perceptions about ability and interests begin to build up. (Warne et al., 2019). In other words, activities in which students were engaged during middle school are not sufficient to improve students' STEM career interests considering the stability in students' STEM interest level during the high school. The importance of education in middle school can be better understood. Hence, science curricula can be enriched by integrating STEM-related activities to support students' interest in STEM-related careers (Yerdelen et al., 2016).

The findings of the Kruskal Wallis test for science, technology, engineering, and mathematics scores and their STEM-CIS scores based on students' grades are shown in Table 12.

Table 12. Kruskal Wallis test results for STEM-CIS scores according to the students' grade

	STEM Career Interest
Kruskal-Wallis H	2.527
df	2
Asymp. Sig.	0.283

The data in Table 12 shows about Kruskal Wallis test results for STEM-CIS scores according to the students' grade. As the results indicated that the scores for science there is no significance different in STEM Career Interest among grade 7, 8, and 9 (Asymp. Sig = 0.283; $p>0.05$). It was most likely due to a constant change in interest as people mature, particularly throughout adolescence. The variables influencing junior high school pupils might be for a variety of reasons. Blotnicky et al (2018) states that middle school pupils may not be able to differentiate between the complexity of career activities and interests in the same way that older students and young people could happen. In this age, teenager still explore and find things that might they have enjoyment interest in some field. Middle school students still don't have take the mature decision which career they have taken. This also indicated that the most impact they have upon their decision, followed by friends and instructors (Mitsopoulou & Pavlatou, 2024). Teenagers accept significant influence from their parents in order to make critical decisions regarding their lives (Mitsopoulou & Pavlatou, 2024). It would affect the changing of their planning over time. They might be

having current role model and a certain favourite subject in a certain time. Then, when they move go up another level, they might have another interest to another field because of environmental factors too that push them to change their interest. This difficulties in making career selection influenced byb professional objectives, life aspirations, talents, failures, abilities, expectations, and personal preferences. Choosing a professional path might be challenging, but it's a normal experience (Hussain, 2024).

The grades 7–9 (12-15-year-olds) are the important stage for shaping STEM career interest and fostering self-efficacy in mathematics and science (Blotnicky et al., 2018). Similar adaption times have been noted as a significant difficulty in other contexts as well (Potvin, 2020). In junior high school age which are range about Besides, the STEM activity in school also can influence student interest in the STEM field. If the school they attended has good facilities in STEM, it can encourage student to pursue their interest and motivation in STEM career and their academic achievement (Hiğde & Aktamış, 2022). These are also extremely important ages for encouraging STEM fascination.

The solution that can increase student career interest in STEM has been found in the previous research that were conducted by Beier et al. (2019), Bicer and Lee (2023), Drymiotou (2021), Lin et al. (2023), Perea et al. (2021), and Peterman et al. (2016) that applied the STEM project to student in learning activities. Additionally, the previous study also stated that STEM problem-based learning can be applied to encourage students to pursue STEM careers (Laforce et al., 2017; Lou et al., 2011; Sarı et al., 2018; Nariman., 2021). As a result, this study offers suggestions through examples of learning models that might be used in the learning process. to encourage students to pursue STEM careers because to increase students interest, motivation, and career interest towards STEM. Besides, in order to maintain interest in STEM courses, students should engage in active hands-on learning through STEM apparoach. This initiative demonstrates the need of integration STEM field into active learning methodologies in schools (Mohd Shahali et al., 2019).

CONCLUSION

This study investigated junior high school students career interest in STEM by using STEM-CIS instrument. This study created the profile of junior high school students in each dimension of STEM, the factor that influenced their STEM career interest, and also the factors influence of student career interest according to grade. This finding obtained the value of the average and standard deviation of STEM field and based on their grade as well. However, the results of STEM career interest according by grade is no significant different. Attitudes acquired throughout middle school have a significant impact on students performance in school, which in turn influences their career aspirations. Understanding middle school student's views of STEM is essential for developing our future STEM workforce and citizens.

This research can provide the empirical evidence that STEM-CIS can be also used as valid survey instrument to measure students' interest in STEM. For future research, the students' achievement in STEM might be compared. STEM education contributes to enhancing the skills of students, especially 21st century skills such as creativity, communication, critical thinking, and collaboration. aThe results of this study can encourage science educators, and school counsellor to improve STEM facilities and applying STEM learning for encouraging students to pursue STEM careers in the future.

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