The Analysis of STEM Career Interest of Students Aged 13-15 as an Overview for The Development of STEM Career Counseling

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Abstract. This study aims to provide an overview of the career interests profile of students aged 13-15 years in the fields of Science, Technology, Engineering, and Mathematics (STEM) in Indonesia. This study used a descriptive survey research design. The data is collected by using the STEM-Career Interest Survey (STEM-CIS). The survey sample consisted of 263 random online surveys using Google Forms. Analysis of the average student STEM-CIS data per question item was carried out to describe each aspect of social-cognitive career theory (SCCT). Based on the results of STEM-CIS, the average value of students' STEM career interests in the science field is 3.37, the technology field is 3.57, the engineering field is 2.95 and the mathematics field is 3.42. The implication of this research is to provide suggestions for suitable and more effective career counseling programs to increase students' interest in STEM careers.

Keywords: STEM-CIS, social-cognitive career theory, STEM career, career counseling

1 Introduction

Career is one of the major factors to people for taking path for their education journey. It is often becoming a main reason for one career development and choices. To be clear, given its importance, career development and interest should be introduced from the early phases of one's education as the part of long journey of their career development and starting with their own beliefs, interest and goals to further influence one's academic path [1]. Career on STEM (Science, Technology, Engineering, Mathematics) put its own issue for majority of students in Indonesia, since its implementation on Indonesia's Education.

However, the demand of STEM graduates has been increasing, especially in Indonesia. Those demand must be answered by the supply of graduates to increase Indonesia's chances to global competitive opportunity to face Industry 4.0. Therefore, students must have the information they might need such as career opportunity and academic path in order to meet one's goal to develop career in STEM disciplines.

School, in this case, has a role to nurture students career development and interest in STEM disciplines. One of the duties of a school counselor is to provide career counseling services to students. Of course, this is very important to maintain students' motivation in learning, especially in STEM material because of the difficulty level in STEM learning [2]. Li et. al. [3] stated, although students' STEM career interests are influenced by many things, school

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counselors can improve students' STEM career development by providing services that focus on improving students' self-efficacy and outcome expectations. Of course, the consultation provided by the BK teacher must be based on the right data and information. To make this easier, BK teachers must understand and understand the profile of students' interests in careers in the STEM field.

The STEM Career Interest Survey instrument [4] is based on the social-cognitive career theory (SCCT) by Lent [5]. Kier et al. [4] describes the aspects of SCCT that are measured using STEM-CIS are self-efficacy, personal goals, outcome expectations, interests, personal inputs and contextual supports. The purpose of this study is to provide an overview of students' STEM career interests based on aspects of SCCT using the STEM-CIS instrument. The SCCT aspect is analyzed per question item as information that can be used by school counselors in providing guidance to develop students' STEM career interests. Some suggested activities are also given as consideration in student career counseling activities.

2 Research Method

The design of this study used a descriptive survey method. The survey data was taken from an online survey using a Google Form link distributed through social networks and chat applications. The sample consisted of 263 students aged 13-15 years from various schools in Indonesia. Data collection was carried out on November 15 to December 1, 2021. The survey instrument used was the Indonesian translation of the Science, Technology, Engineering and Mathematics Career Interest Survey (STEM-CIS) by Kier [4] using the back translation method. The validity of the Indonesian translation instrument ranges from 0.244 to 0.645 (rtable = 0.2352). The reliability of the Indonesian translation instrument has a Cronbach Alpha between 0.852 – 0.911.

The instrument consists of 44 question items which are divided into 4 areas of study. Each field of study consists of 11 question items. The sample was asked to answer each question by choosing among 5 answer options: Disagree (1), Slightly Disagree (2), Neutral (3), Agree (4), Strongly Agree (5). The average of the sample answers is used to describe the level of students' interest in STEM careers. Analysis of each question item based on social-cognitive career theory (SCCT) was carried out to see the causes of students' high and low interest in STEM careers. Recommendations for career counseling activities are given to counselors based on the results of the analysis

3 Result and Discussion

The survey results using STEM-CIS are divided into 4 fields of study: science, engineering, technology and mathematics. Each field consists of 11 question items. The average for each field is illustrated by the diagram below.

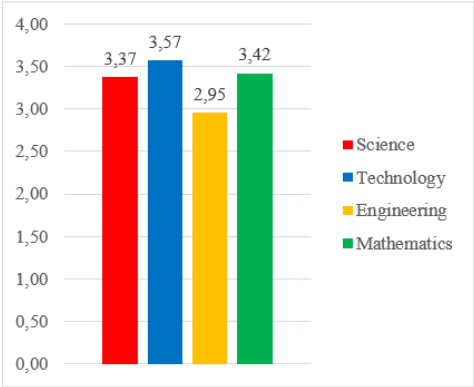

Fig 1. The average data of STEM-CIS in each field

Based on the diagram above, it can be seen that the average for each field is quite low. In comparison, the level of interest in STEM careers for pre-service teachers in Indonesia using the STEM-CIS instrument has an average of 3.80 in the field of science and 4.08 in the field of technology [6]. Using the STEM-CIS instrument, researchers can measure several aspects of SCCT. Among them are self-efficacy, personal goals, outcome expectations, interests, contextual supports, and personal inputs. The six aspects of SCCT are divided into four categories of fields of study, namely Science, Technology, Engineering, and Mathematics. The following is a student's SCCT aspect average score based on the STEM Career Interest Survey in each field of study.

Table 1. Average data of student's SCCT Aspects based on STEM-CIS

SCCT Aspects	Item No.	N	Science	Technology	Engineering	Mathematics
Self-Efficacy	1	263	3.30	3.62	2.98	3.48
	2	263	3.69	3.73	2.99	3.75
Personal Goals	3	263	3.32	3.66	2.94	3.35
	4	263	3.71	3.86	3.09	3.96
Outcome Expectations	5	263	3.71	3.86	3.14	3.68
	6	263	3.58	3.45	3.08	3.54
Interest	7	263	3.22	3.84	2.84	3.08
	8	263	3.40	3.46	2.97	3.39
Contextual Support	9	263	2.83	3.04	2.62	2.94
	11	263	3.17	3.37	2.79	3.27
Personal Input	10	263	3.18	3.38	3.06	3.20

3.1 Analysis of SCCT Aspects

Self-Efficacy

In the field of science, the average value of self-efficacy for the 2 question items is 3.30 and 3.69. This shows that the average student has the confidence to get good grades in science class.

In addition, the question item number 2, namely "I am able to complete my science homework" has a greater average than the question item number 1. This illustrates that students are more confident in doing their homework than getting good grades in science class. In the field of technology, the average value of student self-efficacy is quite high, namely 3.62 for question item number 1 and 3.73 for question item number 2. This number shows that students have high self-efficacy in carrying out activities involving technology. In addition, the question on item number 2 in the field of technology, "I am able to learn new technologies" shows that students also do not have significant obstacles in learning new technologies.

In the engineering field, the average self-efficacy of students is the lowest among the four other fields of study. The average self-efficacy of students in the engineering field is 2.98 for question item number 1 and 2.99 for question item number 2. This may be because students do not fully understand the form of activities that involve engineering. This was revealed in an interview session with 10 randomly selected students. 7 out of 10 students stated that they did not understand engineering activities, so they were not confident in answering that they were able to carry out engineering-related activities.

In the field of mathematics, the highest average student self-efficacy in item number 2 is 3.75. Question item number 2, “I am able to complete my math homework” revealed that students were more confident in doing their math homework compared to getting good grades in math class. The self-efficacy of students is very important to determine the level of interest of these students in taking a career in the STEM field. In the social-cognitive theory by Bandura [6], self-efficacy greatly affects a person's interest in doing an activity. The higher a person's self-efficacy, the more confident that person can master a field in his life. Through activities related to STEM, it is hoped that someone can increase interest in a career in the STEM field. Bandura [7] explains that in addition to self-efficacy can affect behavior and the environment, self-efficacy can also be influenced by these two things. this means that self-efficacy can be an input for behavior and the environment, but it can also be an output due to the influence of behavior and the environment.

Personal Goal

Based on table 1, it can be seen that the average of personal goals in the field of science is quite high. Question item number 3 and question item number 4 in the field of science which measures personal goals gets an average 3.32 and 3.71 . If we compare the averages for items number 3 and 4, it can be seen that the tendency of students is more to try hard in science class than to plan to use science in their future careers. It can be said that many students do not plan to pursue a career in science. Through further investigations to find out why students do not plan to use science for their future careers, it was found that most of the reasons are because work in science is very difficult and complicated. So, they put aside suggestions to pursue a career in the STEM field in the future.

In the field of technology, question item number 3, namely gets an average of 3.66. This figure shows that many students are aware of the use of technology to help their career in the future. While the question item number 4 got a higher average of 3.86. This means that students tend to learn to use technology to help them achieve success in school. From these two things, it can be concluded that more students are not future-oriented. Lent et al. [5] states that career goals are often perceived as ideals and dreams when measured long before they actually start a career, so they have no real consequences or require commitment. For example, during elementary school, students' ideals can still change. When compared to when students enter high school, students' goals usually tend to focus on only one area.

In the field of engineering, question item number 3 got an average of 2.94, the lowest compared to other fields. While the question item number 4 also gets the lowest average

compared to other fields, which is 3.09. These two question items indicate that students do not yet understand the usefulness of engineering for their future careers, but they are aware that school activities that use engineering can help them. Research by Sarı, Şen, and Alıcı [8] which shows that at the time of the pretest, jobs in the engineering field were the least chosen by students compared to other fields. Researchers suspect the low average personal goal in engineering is because there are still many students who do not understand about activities or careers that use engineering.

In the field of mathematics, question item number 3 gets an average of 3.35. This confirms that students still do not know whether the field of study will really be useful for their future careers. While the question item number 4 got the highest average of 3.96. This further strengthens the notion that students are still oriented towards current activities rather than future plans.

Outcome Expectation

Outcome expectations according to Lent et al. [5], are described as the expected consequences of doing certain activities, for example, "when I do this, what will happen?". Meanwhile, Bandura [6] divides outcome expectations into several categories that can influence behavior in choosing a career, such as the anticipation of physical (e.g. financial), social (e.g. approval) and self-evaluative (e.g. self-statistical). Mitchell and Krumboltz in Lent (1994) state that career counseling methods that focus on the consequences of decisions from several choices also implicitly justify the importance of outcome expectations.

In the field of science, question item number 5 gets a fairly high average of 3.71. This figure shows that students realize the importance of studying science well in class for their future career needs. In addition, question item number 6 in the field of science got an average of 3.58. It also shows that many students perceive their parents' expectations for them to take up a career in science.

In the field of technology, statement item number 5 gets the highest average compared to other fields, which is 3.86. Based on the statement items, most students think that studying technology will open up their opportunities to get jobs and wider career prospects. While the question item number 6 gets an average of 3.45. This shows that students are more likely to think that learning technology will be useful in the future compared to today.

In the field of engineering, question item number 5 and question item number 6 get the lowest average among other fields. Even so, among all of the questions in the engineering field, the questions that measure outcome expectations get the highest average compared to other question items. Researchers suspect this is because students actually know several types of work in the engineering field but are not familiar with the skills needed to work in this field.

In mathematics, the average of question number 5 is 3.60 and question item number 6 is 3.41. Students understand that mathematics can help their careers in the future, but there are still many students who do not know the type of work in mathematics. Based on the results of the interviews, some students did not seem to know that a job such as an accountant is a type of job that belongs to the field of mathematics. Even though they mentioned that one of the jobs that their parents liked was accountant.

Interest

Interest in the STEM field is divided into two types, namely vocational interest and occupational interest. Vocacional interest describes how students are interested in learning knowledge from a field of study. While occupational interest describes how students are interested in doing work in a particular field.

In the field of science, question item number 7 gets an average of 3.22. While the question item number 8 average is 3.40. This difference in mean indicates that students enjoy learning

science in class but are less likely to have a career in science. Some students revealed through interviews that a job in science would be very difficult to achieve.

In the field of technology, question item number 7 has an average of 3.84. And question item number 8 has an average of 3.46. These two question items get the highest average compared to other fields. This shows that students are more interested in learning and using technology in particular to help them in classroom activities, but not very interested in pursuing a career in technology. Even so, the average number of students who are interested in work in technology is still higher than in other fields.

In the field of engineering, question item number 7 has an average of 2.84, and question item number 8 has an average of 2.97. In contrast to the technology field, in the engineering field, questions 7 and 8 received the lowest average among other fields. Researchers suspect that the low average is caused by the factor of students' lack of knowledge about engineering activities and types of work in the engineering field.

In the field of mathematics, question item number 7 and question item number 8 received an average of 3.08 and 3.39, respectively. Apart from being difficult for students to work in the field of mathematics, the types of work in mathematics are also not widely known by students. This is what causes students to have less interest in work in the field of mathematics.

Contextual Support

In the field of science, question item number 9 "I have a role model in a science career" and question item number 11 "I know of someone in my family who uses science in their career get the lowest average among other SCCT aspects. The average for question item number 9 is 2.83 and for question item number 11 is 3.17. Based on the two question items, it can be concluded that there are still many students who do not have role models in science work. This can be overcome by implementing a counseling program involving people who work in science to inspire students in schools.

In the field of technology, the average question item number 9 has an average of 3.04. While the question item number 11 is 3.37. Based on this average, it can be said that many students also do not have role models in the field of technology work. Even so, many of them know that there are family members who work in the technology sector and do not choose to use their family members as role models.

The average question item in the engineering field, namely number 9 is 2.62. As for the question item number 11, the average is 2.79. Question item number and question item number 11 has the lowest average among all fields. Among SCCT aspects, the average for contextual support in engineering is also the lowest. This is because many students do not understand the types of engineering activities and careers in engineering. So students have difficulty determining whether any of their family members are engineers. In addition, due to limited knowledge in engineering, students also have difficulty finding role models who work in this field.

In mathematics, question item number 9 has an average of 2.86, while question item number 11 has an average of 3.15. Based on the average results, it is clear that many students cannot determine whether someone has a career in mathematics. However, students know that some of their family members have careers that use mathematics in their work. These two things are because students' knowledge about the types of careers in mathematics is very minimal.

Personal Input

Personal input by Lent et al. [5] is heritable attribute factors such as gender, race/ethnicity, socio-economic status, and physical condition. These factors affect a person's level of self-confidence and self-efficacy. Kier et al [4] uses question items such as “I would feel comfortable talking to people who work in science careers” to be able to see how much someone has the

confidence to be engaged in one of the STEM fields. From this, it can be seen that feeling comfortable can describe a person's level of self-efficacy in a field.

In science, the average is 3.18. This figure illustrates that students' self-efficacy regarding the field of science is still lacking. While in the field of technology, although the average is the highest among other fields, namely 3.38, it still shows that students are not comfortable to be involved in a career in technology. The engineering field got the lowest average of 3.06, while mathematics was 3.20. Based on the average of the two fields, it further strengthens that student do not have sufficient self-confidence and self-efficacy to take a career in the STEM field.

3.2 Career Counseling

Efforts to increase student interest in the STEM field are pursued by implementing STEM learning in schools. Research using problem-based learning (PBL) in STEM activity instruction is able to change students' perceptions of careers in the STEM field [8]. The implementation of PBL in the classroom has also been shown to be related to students' interest in STEM careers [9]. The development of mathematical talent in middle school is also positively related to the decision to take a career in the STEM field [10]. But efforts to increase career interest with STEM learning alone are not enough. Further action is needed using career counseling programs for students in schools.

Based on the results of the analysis, it can be concluded that there are several factors that cause students' low interest in careers in the STEM field. Among them are the lack of information and exploration of students about careers that can be pursued in the STEM field, low self-efficacy of students to engage in STEM fields, student orientation which focuses more on current activities than future plans. Lack of external support from educational and family environment also contributes to students' interest in STEM careers. Through a career counseling program that focuses on the above factors, it is hoped that students' interest in STEM careers can be increased. To tackle those problem factors, the following are some recommendations for counselors that can be considered to develop STEM career counseling programs in school.

Career Exploration

To overcome the low interest in career due to lack of information and exploration, career counselors should consider activities in the form of career exploration. Career exploration can be done by inviting figures who work in each STEM field to inspire students, or by increasing the counselor's knowledge about STEM careers. Falco [11] stated that counsellor can provide career experiences by introducing students to STEM role models. The level of student knowledge about a job and career has a close relationship with the intensity of career exploration carried out by students [12]. Rossalina [13] adds that students need to be given assistance not only how to be fluent in studying at school, but also must be given assistance regarding the need for students to explore careers.

According to Schmidt [14], as a student's first gateway before stepping into the world of work, counselors should start to increase awareness of career opportunities in the 21st century, especially in the STEM field. Schmidt then recommends several things counselors can do about this. Among them are, increasing knowledge about the role of school counselors in career exploration activities, increasing knowledge of content and future job opportunities, exploring individual career preferences, and embracing leadership roles in career decision making. Hossain [15] suggested that teachers and counselors in schools learn more about careers in the STEM field in order to provide better advice to students to increase students' interest in STEM careers. Zainudin [16]adds that the counselor acts as someone who is responsible for providing exposure and understanding to students about careers in the STEM field.

Support Services

In addition to increasing the intensity of career exploration in the STEM field, counselors also need to provide career guidance based on individual students. Every student has his own uniqueness. Student self-efficacy is an important factor that can determine student decisions in taking a career in the STEM field. Therefore, school counselors should design career guidance programs that have a positive impact on students' self-efficacy [11]. Falco [11] added, one way that counselors can improve student self-efficacy is to support student achievement, especially in the STEM field.

It is also possible to encourage students to take additional lessons in math and science. Because math and science coursework can be the basis of an educational pathway that can lead students to STEM careers [17]. So counselors need to pay special attention to students who have good achievements in science and mathematics and encourage them to continue to the next level. Improving and maintaining the level of self-efficacy in STEM fields should be the most important factor in providing support services to students.

Collaboration

Increasing students' interest in STEM careers is not just the job of a counselor or teacher. But it involves many parties such as parents, teachers, and counselors who have direct relationships with students to be able to work together. Counselors need to work with science or mathematics teachers in schools to provide counseling programs for student achievement and self-efficacy. Schmidt [14] gave an example that counselors can help teachers provide information to teachers about the subject of interest of students, and identify biases that students have regarding STEM fields. Support from parents can also have a profound effect on students' motivation and expectations to develop careers in the STEM field [18]. Falco [11] added, counselors can provide information and training to parents regarding the importance of prudence when talking about student effort and achievement in the STEM field.

4 Conclusion

Based on the results of STEM-CIS, the average career interest of STEM students aged 13-15 years is 3.37 for science, 3.57 for technology, 2.95 for engineering and 3.42 for mathematics. The results of the SCCT analysis based on each question item on the STEM-CIS show the factors that cause students' low interest in STEM careers. Among them are the lack of information and exploration of students about careers that can be pursued in the STEM field, low self-efficacy of students to engage in STEM fields, student orientation which focuses more on current activities than future plans, and lack of external support from educational and family environment.

Career counseling programs that focus on overcoming problems based on the causal factors mentioned above are expected to increase students' interest in STEM careers. Career counselors can increase the intensity of students' career exploration, especially in the STEM field. In addition, school counselors need to provide support services that can have a positive impact on student self-efficacy. Furthermore, counselors can work closely with various parties who have direct contact with students to form an environment that motivates students to have a career in the STEM field.

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