Exploring Students’ Perceptions of Science, Technology, Engineering, and Mathematics (STEM) in Education and Future Careers Fields

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Abstract. Student’s understanding of STEM was a successful key in improving student achievement and STEM employment in the next ten years. This research was aimed to describe students' perceptions of STEM education and career. We used explanatory mixed method design. This research involving 315 senior high school students in Bandar Lampung. We adopted Perception of STEM Education and Career (PSEC) Questionaire, interview protocol, and voice recording devices. We analyzed the data by categorizing, tabulating, and validating the data. The result showed that students’ perceptions about STEM education, based on the school location indicated positive perceptions, but based on the comparison of male and female students’ perception, male students preferred to express negative responses in STEM learning interest, and based on the comparison of learning style (audio, visual, and kinesthetic) students perceptions, kinesthetic students perceptions, kinesthetic students prefered to express negative responses in STEM learning interest. Furthermore, the students’ perceptions about STEM careers, based on the school locations, gender, and differences in learning styles indicated positive perceptions.

1. Introduction
Majors’ selection (science/social) have been done since grade 10, based on their desire or interest. The learning process needs to be integrated with scientific approach. In learning, scientific approach is a characteristic and becomes a strength for the existences of 2013 curriculum [1], and there needs to be the development of STEM-based teaching material to support 2013 learning that is designed to the maximum [2]. One of scientific approach is STEM approach. STEM is an effective approach because of it combines from four disciplines, including science, technology, engineering, and mathematics [3]. The success and effectiveness of the STEM approach has been widely studied in many research. STEM affects the increase in scientific literacy because it can increase the students’ learning interest [4, 5]. Improving students understanding of STEM is the success key to increasing students achievement in California [6]. Using STEM integration is proven to increase students’ interest in learning at school [7, 8, 9], however the challenges in STEM education are not only technology, but teachers must be prepared to using the STEM approach [10, 11]. So that, success in using STEM integration is not only from the ability of students, but also the readiness of teachers [12, 13].

STEM education has closely related to STEM careers. Career planning is needed by students as a step towards to career goals [14, 15, 16, 17, 18, 19]. Careers in the STEM field in the next 10 years
will increase and believed to be able to create the next generation that is able to compete at the global level [20, 21], however as much as 30% girls aged 17-19 years said that they wouldn’t pursue a career in STEM even if they studied the subject [22]. On the other hand, female students in United States have more positive perceptions about STEM [23].

Preliminary research has been conducted at Bandar Lampung 5 Senior High School. The results of these preliminary research difference from the theories or people perceptions above about STEM. The results can be found problems ranging from majors, learning, to career planning. Therefore, we try to present a complete and in-depth description of students’ perceptions of STEM and careers. Through this research, students’ problems in science learning and career planning in STEM have been identified, that will encourage them to have a career in STEM that is reliable to be more competitive at the global level.

2. Method
This research used quantitative and qualitative (mixed method). We used explanatory design [24]. The sample that we chose were 315 students from nine Senior High School in Bandar Lampung which we had categorizing as the table below:

| No. | School Location | School Name               | Male | Female | Audio | Visual | Kinesthetic |
|-----|-----------------|---------------------------|------|--------|-------|--------|-------------|
| 1   | Center Area     | SMAN 2 Bandar Lampung    | 17   | 18     | 6     | 24     | 5           |
| 2   | SMAN 9 Bandar Lampung | 13 | 22     | 5     | 25     | 5           |
| 3   | SMAN 9 Bandar Lampung | 13 | 22     | 17    | 17     | 1           |
| 4   | Middle Area     | SMAN 5 Bandar Lampung    | 14   | 21     | 9     | 20     | 6           |
| 5   | SMA YP Unila    | 12   | 23     | 10    | 23     | 2           |
| 6   | Middle Area     | SMA Gajah Mada           | 9    | 26     | 12    | 20     | 3           |
| 7   | Remote Area     | SMAN 4 Bandar Lampung    | 22   | 13     | 12    | 22     | 1           |
| 8   | SMAN 15 Bandar Lampung | 12 | 23     | 8     | 26     | 1           |
| 9   | SMAN 17 Bandar Lampung | 11 | 24     | 17    | 14     | 4           |

The sampling technique that we have used to classify schools is purposive sampling, while to determine the sample we used random sampling. The instruments that we used are perceptions questionnaire sheets, that use a scale of 1 (strongly disagree), 2 (disagree), 3 (agree), and 4 (strongly agree). We used questionnaire that has been adopted and adapted from [25, 26], then we used interview sheets, and documentation tools. We analyzed the data in 3 steps, those are categorizing data, tabulating data, and visualizing data.

3. Result and Discussion
Research has been conducted by distributing questionnaires about students' perceptions and careers about STEM in two months at nine high schools in Bandar Lampung. Students' perceptions about STEM education based on differences in school locations (center area, middle area, and remote area), gender (male and female), and learning styles (audio, visual, kinesthetic) was shown in Table 2:

| No | Indicator of STEM Education | Based on School Location | Based on Gender | Based on Learning Style |
|----|-------------------------------|--------------------------|-----------------|-------------------------|
|    |                               | Center | Middle | Remote | Male | Female | Audio | Visual | Kinesthetic |
| 1  |                               |        |        |        |      |        |       |        |             |
| 2  |                               |        |        |        |      |        |       |        |             |
| 3  |                               |        |        |        |      |        |       |        |             |
| 4  |                               |        |        |        |      |        |       |        |             |
| 5  |                               |        |        |        |      |        |       |        |             |
| 6  |                               |        |        |        |      |        |       |        |             |
| 7  |                               |        |        |        |      |        |       |        |             |
| 8  |                               |        |        |        |      |        |       |        |             |
| 9  |                               |        |        |        |      |        |       |        |             |
The differences school locations in Bandar Lampung don’t indicated different perceptions, but it has same perceptions about STEM education, which is positive perception. For example, in the STEM learning motivation indicator, about 99% students who attend school from center area expressed that science is an important subject and about 100% students expressed that they want to get a good grades in science subjects, then about 99% students who attend school in the middle area expressed that science is an important subject and about 100% students expressed that they want to get a good grades in science subjects, then as much as 97% students who attend school in the remote area expressed that science is an important subject and about 100% students expressed that they want to get a good grades in science subjects. We can see from the differences school locations that the majority have positive perceptions of STEM learning motivation, so it can be said that the differences in school location don’t make a difference in students' perceptions about STEM education.

Students' perceptions about STEM education based on gender differences can be seen in the figure below:

![Figure 1. Graph of STEM learning interest based on gender](image)

Figure 2 shows that the indicator of STEM learning interest indicated negative perceptions, as much as 48% of male students expressed that they are re-studying science subjects at home, while as much as 81% of female students expressed that they are re-studying science subjects at home. This shows that male students in Senior High School of Bandar Lampung have a relatively low interest in
studying STEM. The results of interviews conducted with male students that 8 from 10 male students revealed that the eight students only liked some scientific subjects, not totality. The statement was expressed by students cause several reasons, such as too many formulas to remember, memorize theories, only focus on one science subject that he likes, and how to teach teachers who are rated 'less cool'.

Students' perceptions about STEM Education also can be seen on differences in student learning styles. On STEM learning motivation indicators, students’ mindset towards STEM, student learning methods, environmental conditions or situations, and the availability of school facilities and infrastructure indicate positive perceptions. However, in the STEM learning interest indicator, there are different perceptions, such as the graph presented below:

The STEM learning interest indicator indicated negative perceptions, as much as 64% of audio students expressed that they studied science before the subject began, 61% of visual students expressed that they studied science before the subject began, and 46% of kinesthetic students expressed that they studied science before subjects began. This shows that students with kinesthetic learning styles in class 10 in Bandar Lampung have a relatively low interest in learning STEM. The results of interviews conducted with kinesthetic students revealed that these students prefer biology subjects only, because these students have aspirations and career planning as a doctor, so it can be said that student learning styles (auditory, visual, and kinesthetic) affect student learning interests. This is in line with the results of [27] showing that audio, visual, and kinesthetic learning styles have a positive relations with student achievement.

The following are students' perceptions about STEM Careers based on differences in school locations (center area, middle area, and remote area), gender (male and female), and learning styles (audio, visual, and kinesthetic):

| No | Indicator of STEM Career | Based on School Location | Based on Gender | Based on Learning Style |
|----|--------------------------|--------------------------|----------------|------------------------|
| 1  | Career desires in the STEM field | + | + | + | + | + | + | + |
| 2  | Career planning | + | + | + | + | + | + | + |
in the STEM field

3 Career pride in the STEM field + + + + + + + +

4 Career challenges in the STEM field + + + + + + + +

Based on the differences in school locations, gender, and learning styles on the indicators of career desires in the STEM field, career planning in the STEM field, career pride in the STEM field, and challenges in a career in the STEM field produce the same perception, indicated positive perception.

Students' perceptions about STEM Careers based on the differences in school locations indicated positive perceptions. For example, on the indicator of career desire in STEM fields, as much as 75% of students who attend school in the center area expressed that they want a career in science, then as much as 72% of students who attend school in the middle area expressed that they want a career in science, then as much as 73% of students who attend school in the remote area expressed that they want a career in science.

Students' perceptions about STEM Careers, based on gender differences indicated positive perceptions. For example, the indicator of career desires in the STEM field as much as 63% of male students expressed that they want a career in science, then as much as 81% of female students expressed that they want a career in the field of science. Furthermore, based on the differences in student learning styles, the career desire indicator in the STEM field resulted in 74% of audio students expressed that they want a career in science, then 73% of visual students expressed that they want a career in science, and as much as 75% kinesthetic students expressed that they want a career in science. The study has not been justified by previous studies. In line with [23] which expressed that female students have more positive perceptions of STEM careers compared to male students.

4. Conclusion
Based on the research and discussion that has been presented, it can be conclude that students' perceptions about STEM education based on differences school locations indicated positive perceptions, but based on gender differences and different learning styles indicate negative perceptions. Furthermore, students' perceptions about STEM careers based on differences in school locations, gender, and learning styles indicated positive perceptions.

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