JPF | Volume 11 | Number 1 | 2023 | 13 - 23

p - ISSN: 2302-8939
e - ISSN: 2527-4015

Jurnal Pendidikan Fisika

https://journal.unismuh.ac.id/index.php/jpf

DOI: 10.26618/jpf.v11i1.9207

Investigating STEM Career Content in Indonesian Science Junior High School Textbooks

Riski Amalia[1)*], Remanda Arya Wisutama[2)], Nurul Fitriyah Sulaeman [3)], Riskan Qadar [4)]

[1,2,3,4)] *Departemen of Physics Education, Mulawarman University, Samarinda, 75119, Indonesia*

**Corresponding author: riskiamalia4989@gmail.com*

Received: October 30, 2022; Accepted: December 27, 2022; Published: January 27, 2023

Abstract *– This study aims to analyze the STEM career content in science junior high school textbooks commonly used for the seventh grade students in Indonesian schools. This research was qualitative descriptive research with content analysis. The analysis was carried out on five books that are widely used in the school. Reports and activities were analyzed using content analysis through an assessment rubric based on Social Cognitive Career Theory (SCCT) which are awareness, relevance, engagement and self-efficacy. The analysis showed that the STEM career content in science junior high school textbooks were still lacking. The books were not sufficient in presenting content about careers in the STEM field. These results indicated that none of the five textbooks had fulfilled the four aspects of STEM career. The aspect most commonly found in the textbooks was self-efficacy, and the most observed STEM career content was found in the earliest chapter, which is Nature of Science. These findings highlight the importance of career oriented in science lesson that illustrated in the textbook to enhance students' perception and enthusiasm in pursuing STEM career in the future.*

Keywords: *junior high school; science textbook; stem career content*

I. INTRODUCTION

STEM (Science, Technology, Engineering and Mathematics) should be integrated into global science learning trends in order to develop students' 21st century competencies (Putra et al., 2021; Sulaeman et al., 2021; Nuangchalerm et al., 2020). Therefore, science teachers are motivated to improve their alignment to this integration (Sulaeman et al., 2022). STEM education helps learners to have necessary learning skills through the integration of STEM disciplines. Previous research showed that it leads learners to meet innovations in science and technology (Sulaeman et al., 2022).

The approach of learning, STEM could combine science, mathematics, engineering, and technology principles with real world problem (Sukmawijaya et al., 2019). STEM learning can be use to elevate everyday problems into knowledge that leads to more meaningful learning (Laila & Anggaryani,

2021). Therefore, students could have authentic learning experiences. STEM learning has been empirically proven to improve various soft skills that are needed that work in STEM career, such as Higher Order Thinking Skills (HOTS) (Yusuf et al., 2018), problem solving (Sarican & Akgunduz., 2018), collaboration, critical and creative thinking, reasoning and making decision (Altan et al., 2018; Putra et al., 2021). Students' attitudes and interests towards science subjects affect their success, improve students' learning outcomes, and affect students' achievement (Zurweni et al., 2021). The integration of STEM approach in science learning is very important and has a positive impact on students. Furthermore, the beneficial impact of the STEM approach on the learning process might affect and raise student's enthusiasm in continuing their education and/or professions in the STEM sector after they graduate from high school. The use of STEM in learning can be applied in models, teaching materials, and student's worksheet (Chien & Lajium, 2016).

As global needs, STEM career need to be increased and STEM specialists are in high demand (Christensen & Knezek, 2017). STEM career are the fastest growing and highest paying jobs and have great potential for fast growth (Sya'bandari et al., 2021). However, Some facts showed that interest in STEM Career seems to be decreasing (Christensen & Knezek, 2017). Several research showed that junior high school student's perceptions of STEM careers tend to be low (Christensen et al., 2014; Mangu et al., 2015). As a result, it is important to foster a good attitude toward STEM careers among junior high school students (Vela et al., 2020).

In Social Cognitive Career Theory (SCCT), it is explained that a person's interests and career choices are influenced by the results of two levels of interaction, the first level is the interaction between people and beliefs (self-efficacy), expectations of outcomes, and personal goals. Then the second level is one's interactions with other people and the environment that can facilitate the development of interest in career choices (Lent et al., 2000). Therefore, it is necessary to create a learning environment that supports students' career choices in the STEM career, one of which is by including information about STEM career in classroom learning through textbooks especially in science subjects.

Textbooks are a collection of lesson materials created based on the curriculum content that students must attain in learning activities and presented in a systematic manner to create an environment/ atmosphere that helps students to learn (Sihotang & Sibuea, 2015). School textbooks have a direct impact on students' learning when students interact with textbook, and indirectly influence students' learning through their effects on teachers during the teaching process (Papakonstantinou & Skoumios, 2021a). Learning using STEM-based teaching materials is effective and can make students

think creatively (Ahmad et al., 2021; Rahman et al., 2021). There has been various research on STEM in the science books (Triwulandari et al., 2022; Papakonstantinou & Skoumios, 2021b), but few have explored the content of the STEM career in books. Therefore, exploration of the new components in the textbooks are essential in learning science.

We argue that students that are able to learn about STEM Career will have positive perceptions of STEM career if the content of STEM Career is included in their textbooks. Our future needs for students pursuing STEM careers may be satisfying if this positive impact on students' enthusiasm can be sustained and supplemented in class procedures. Therefore, it is essential to explore the content of the STEM career in five junior high school science textbooks that are commonly used in the classroom.

II. METHODS

This research is a descriptive research with content analysis. This research conducted with the intention of describing the content of the STEM career in junior high school science textbooks. The subject of the research is the science textbooks for the seventh-grade junior high school which were selected based on the science books that are widely used in schools. List of books can be seen in Table 1

Table 1. Identity of Indonesian science junior high school textbook

Code	Book title	Author	Year	Publisher	Number of chapters	Number of pages
Book 1	IPA Terpadu	Tim Abdi Guru	2016	Erlangga	11	405
Book 2	IPA Terpadu	V. K. Sally, dkk.	2017	Yudhistira	11	320
Book 3	Ilmu Pengetahuan Alam	Inabuy, V., dkk.	2021	Pusat Kurikulum dan Perbukuan	7	280
Book 4	Ilmu Pengetahuan Alam	Widodo, W., dkk.	2016	Pusat Kurikulum dan Perbukuan	6	234
Book 5	IPA Terpadu 1A	Widjajanti, R. dan Sri S.	2019	Erlangga	6	265

The STEM career content was examined using the STEM career analysis rubric, which is based on four factors developed from literature scan on the cognitive-behavioral building blocks of career development, namely awareness, relevance, engagement, and self-efficacy (Patterson, 2011), as shown in Table 2.

Table 2. Cognitive-behavioral building blocks of career development

Construct	Definition
Awareness	Expanding career awareness Contents that can develop students' understanding and appreciation of a variety of STEM careers (for example: knowledge of required skills, education, work/life issues).
Relevance	Seeing the relevance of the subject matter to their lives Content that can help students find meaningful activities (for example, information or assignments that are relevant to everyday experiences or being in the student's environment).
Engagement	Engaging with the subject matter and STEM careers Contents that help students demonstrate an interest in learning and experiencing more (for example: giving assignments to practice active participation in assignments and discussions, asking questions that go beyond the content present).
Self-Efficacy	Feeling comfortable using the tools of science Contents that can develop a sense of self-efficacy of students doing STEM learning such as doing scientific tasks and mastering the tools used by real scientists.

Source: (Patterson, 2011)

This research is divided into 4 stages. The first is to find five science junior high school textbooks for the seventh grade that are used by students in learning at school. Second, the researcher looked at the book as a whole and analyzed the STEM career content based on 4 aspects. The data obtained in this study used an analytical instrument sheet for science junior high school textbooks for seventh grade which consisted of 4 aspects. Each aspect is given a tick whether or not that aspect is in the selected textbook. If there is this aspect in the textbook, the score is 1 and if it is not found the score is 0. Third, two researchers from authors have observed whether the five science textbooks contain STEM career content or not and discussed together to reach agreement. Moreover, the result then discussed by all authors to reach the final agreement. Fourth, the results of the analysis were then calculated using descriptive statistical analysis. The observations were processed in the form of scores and were analyzed using Microsoft Excel. The following are the equations that were used (Arikunto, 2021):

$$R = \frac{f}{n} x\ 100\% \quad \text{..... 1)}$$

R = score percentage

f = score of aspect values

n = maximum score of aspect val

III. RESULTS AND DISCUSSION

1. A Glance of Science Junior High School Textbook

The science junior high school books selected are books for seventh grade that use the curriculum 2013. There are 2 books, which are book 3 and book 4 published by the government (teacher's team) and 3 other books, which are book 1, book 2 and book 5 published by private book publishers. The

average of the selected books is commonly used by students in learning for 1 academic year. List of chapter material in science junior high school textbook which is analyzed could be seen in Table 3. From our analysis, the most observable STEM career content is in chapter 1 which related to Nature of Science.

Table 3. List chapter and materials in science junior high school textbook

Chapter	Material
1	Nature of Science
2	Classification of Living and Non-Living Things
3	Substance, Things of Substance and Its Change
4	Temperature, Expansion and Heat
5	Energy
6	Organization of Life
7	Ecosystem
8	Environmental Pollution
9	Global Warming
10	Earth's Structure
11	Solar System

2. Analysis of STEM Career Content in Science Textbook

As our result the identification of the STEM career content in five science junior high school textbooks could be seen in Table 4.

Table 4. Identify the STEM career content

Aspect	Book 1	Book 2	Book 3	Book 4	Book 5
Awareness	1	1	1	1	0
Relevance	0	0	1	0	0
Engagement	0	0	0	0	1
Self-Efficacy	1	1	1	1	1

Information: (1): Available in the book, (0): Not available in the book

Awareness

Awareness to STEM career content is aspects that display information to increase student's knowledge about STEM careers. The aim of awareness is to develop students' understanding and appreciation of various STEM careers (for example: knowledge of required skills, education, work/life issues). The awareness aspect is critical to be included in textbooks, because students' interest in science learning activities comes from a combination of interest in the activity and also in the content presented (Habig et al., 2018). STEM career knowledge provided in an engaging and diverse manner helps pique student's interest in the field (Drymiotou et al., 2021). One of the contents that can be presented in textbooks is to provide readings that can help students see scientists as real people and connect them to relate STEM careers (Cohen et al., 2012). The results of the analysis that have been obtained in science

junior high school textbooks with the awareness aspect appearing in four of them which are book 1, book 2, book 3 and book 4. Awareness to STEM career content could be seen in Figure 1, 2 and 3. The awareness aspect that is shown in the 4 books is only information about scientists, it is only mentioned but not explained further. Therefore, the awareness aspect was still incomplete in the textbooks that weer analyzed.

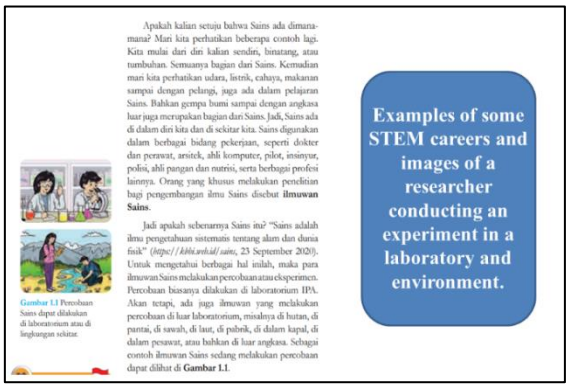

Figure 1. Example of awareness in book 3 page 4

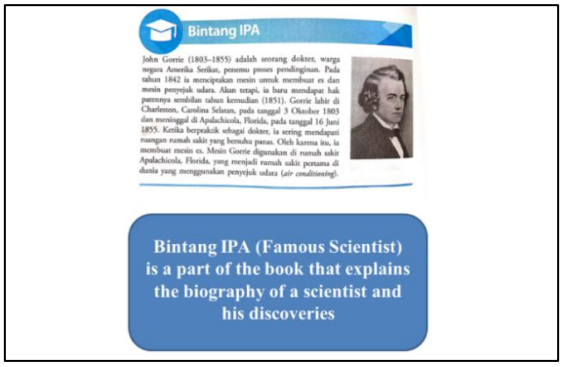

Figure 2. Example of awareness in book 1 page 180

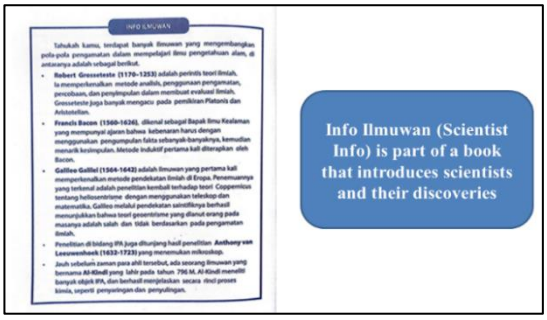

Figure 3. Example of awareness in book 4 page 28

Relevance

Relevance to STEM career content is aspect that students can find meaningful content, for example providing material for careers that are relevant in student's daily lives or assignments for students to look for information related to STEM Careers or scientists around them. Such information or assignments can be considered by students to be a future career choice. Relevance to STEM career content that raised is the task given to students to find information about scientists, both local scientists and international scientists. The results of the analysis that have been obtained in science junior high school textbooks for seventh grade, the aspect of relevance can be seen in only 1 book which is book 3. Therefore, it can be said that this aspect is still very less visible. Awareness to STEM career content that has been analyzed from book 3 could be seen in Figure 4 and 5.

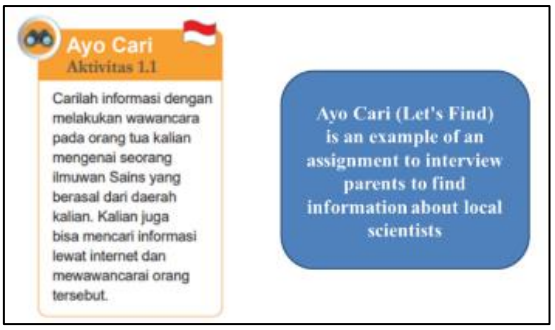

Figure 4. Example of relevance in book 3 page 4

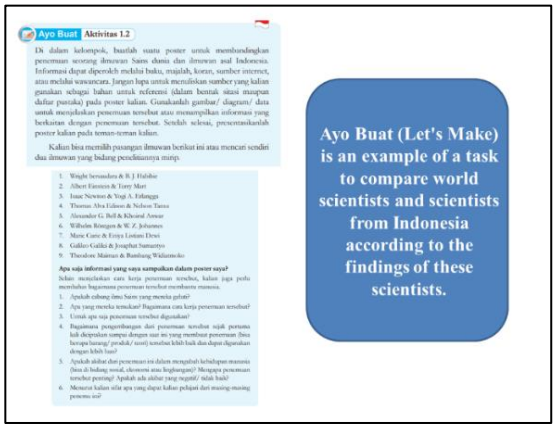

Figure 5. Example of relevance in book 3 page 6

Engagement

The engagement aspect is an aspect to train student's involvement with STEM subject matter and careers. The engagement aspect can show student's interest in learning and experiencing more. For example, giving assignments to practice active participation in assignments and discussions, and asking questions that go beyond the content presented. An example is an assignment that involves students by giving assignments to act as people who work in the STEM career. As an example, obtaining information directly from STEM professionals. STEM career based scenarios could enhance student interest in science and their understanding of STEM career (Drymiotou et al., 2021). From the result, engagement aspect is only seen in one book which is book 5, so it can be said that this aspect is still very less visible. Engagement to STEM career that has been analyzed from book 5 could be seen in Figure 6.

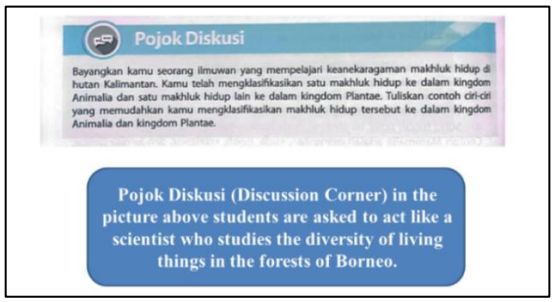

Figure 6. Example of engagement in book 5 page 80

Self-Efficacy

Interestingly, the results of the analysis obtained for aspects of self-efficacy is visible in all books. Self-efficacy is an aspect that can develop a sense of self-efficacy in carrying out scientific tasks and mastery of tools used by real scientists. This aspect is seen quite a lot in the textbooks analyzed. For example, giving assignments, namely doing science activities that involve students using science tools. From these activities, students can find out and develop their skills to use the tools in the laboratory. To enhance positive perceptions in students about careers in the STEM career, STEM activities is suitable for junior high school students (Sulaeman et al., 2020). The STEM activity in question is learning that provides opportunities for students to design and make a prototype of tools that exist in everyday life by applying the principles of

science, technology, engineering and mathematics (Sukmawijaya et al., 2019). STEM self-efficacy refers to students' beliefs regarding their abilities to perform STEM learning activities (Luo et al., 2021). For this reason, this aspect of self-efficacy is essential to be included in textbooks. In the analyzed books, activities that train students to use laboratory equipment are seen in all books, but STEM-based activities are only seen in 1 book which is book 3, where students are asked to make a hot air balloon. Self-Efficacy to STEM career that has been analyzed from book 5 could be seen in Figure 7 and 8.

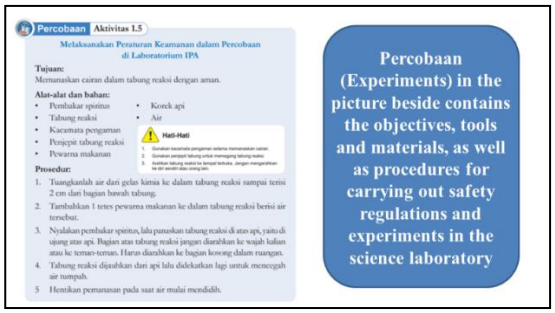

Figure 7. Example of self-efficacy on science in book 3 page 12

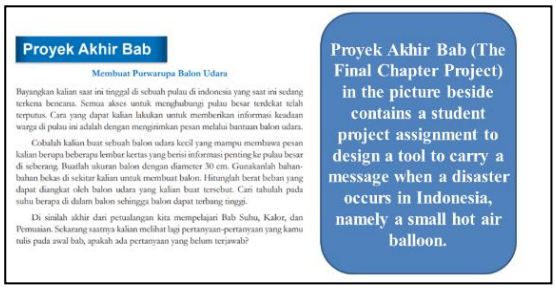

Figure 8. Example of self-efficacy on integrated STEM in book 3 page 106.

The percentage results of each aspect that is analyzed in the science junior high school textbooks could be observed in Figure 9.

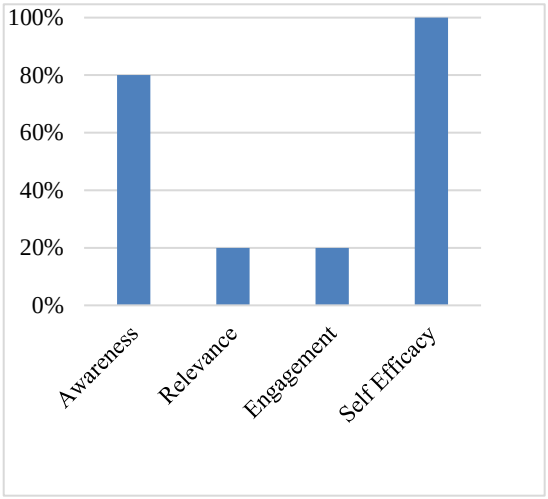

Figure 9. Percentage of aspect of STEM career content in textbook

IV. CONCLUSION AND SUGGESTION

This study concluded that STEM career content in science junior high school textbooks for seventh grade in Indonesia is still very deficient. The most commonly found aspect is self-efficacy, and the rarely found aspect is relevance and engagement. Furthermore, the STEM career content, such as relevance and engagement are only found in a few chapters. The most observed STEM career content was found in early chapter 1, which is Nature of Science. As a result, the proportion of STEM career scenarios in literature is far from sufficient, it can be seen that there is no book that has all aspects. As a result, the textbook examined were unable to encourage students to pursue STEM career. These findings highlight the importance of career oriented in science lesson that is illustrated on the textbook for enhancing student's perception

and enthusiasm in pursuing STEM career in the future

REFERENCES

Ahmad, D. W., Arsyad, M., & Helmi, H. (2021). The development of physics learning module based on creative thinking. *Jurnal Pendidikan Fisika*, *9*(3), 273–284. https://doi.org/10.26618/jpf.v9i3.5948

Altan, E. B., Yamak, H., Kirikkaya, E. B., & Kavak, N. (2018). The effect of design based learning on pre-service science teachers' decision making skills. *Universal Journal of Educational Research*, *6*(12), 2888–2906. https://doi.org/10.13189/ujer.2018.061224

Arikunto, S. (2021). *Dasar-dasar evaluasi pendidikan edisi 3*. Bumi Aksara

Chien, P. L. K., & Lajium, D. A. D. (2016). The effectiveness of science, technology, engineering, and mathematics (STEM) learning approach among secondary school students. *Proceedings Internasional Conference on Education and Psychology*, 95-104.

Christensen, R., & Knezek, G. (2017). Relationship of middle school student STEM interest to career intent. *Journal of Education in Science, Environment and Health*, *3*(1), 1-13. https://doi.org/10.21891/jeseh.45721

Christensen, R., Knezek, G., & Tyler-Wood, T. (2014). Student perceptions of Science, Technology, Engineering and Mathematics (STEM) content and careers. *Computers in Human Behavior*, *34*, 173–186. https://doi.org/10.1016/j.chb.2014.01.046

Cohen, C., Patterson, D. G., Kovarik, D. N., & Chowning, J. T. (2012). Fostering STEM career awareness : Emerging opportunities for teachers. *A Journal For Research, Leadership, and Practice Washington State Kappan*, 12–17.

Drymiotou, I., Constantinou, C. P., & Avraamidou, L. (2021). Enhancing students' interest in science and understandings of STEM careers: the role of career-based scenarios. *International Journal of Science Education*, *43*(5), 717–736. https://doi.org/10.1080/09500693.2021.1880664

Habig, S., Blankenburg, J., Vorst, H. V., Fechner, S., Parchmann, I., & Sumfleth, E. (2018). Context characteristics and their effects on students' situational interest in chemistry. *International Journal of Science Education*, *40*(10), 1154–1175. https://doi.org/10.1080/09500693.2018.1470349

Laila, S. I., & Anggaryani, M. (2021). The use of STEM-Based virtual laboratory (PhET) of newton's law to improve students' problem solving skills. *Jurnal Pendidikan Fisika*, *9*(2), 125–133. https://doi.org/10.26618/jpf.v9i2.5078

Lent, R. W., Brown, S. D., & Hackett, G. (2000). Contextual supports and barriers to career choice: A social cognitive analysis. *Journal of Counseling Psychology*, *47*(1), 36–49. https://doi.org/10.1037/0022-0167.47.1.36

Luo, T., So, W. W. M., Wan, Z. H., & Li, W. C. (2021). STEM stereotypes predict students' STEM career interest via self-efficacy and outcome expectations. *International Journal of STEM Education*, *8*(36), 1-13. https://doi.org/10.1186/s40594-021-00295-y

Mangu, D. M., Lee, A. R., Middleton, J. A., & Nelson, J. K. (2015). Motivational factors predicting STEM and engineering career intentions for high school students. *Proceedings - IEEE Frontiers in Education Conference (FIE)*, *1-8*.

https://doi.org/10.1109/FIE.2015.7344065

Nuangchalerm, P., Prachagool, V., Islami, R. A. Z. E., & Abdurrahman, A. (2020). Contribution of integrated learning through STEM education in ASEAN Countries. *Jurnal Pendidikan Progresif*, *10*(1), 11–21. https://doi.org/10.23960/jpp.v10.i1.202002

Papakonstantinou, M., & Skoumios, M. (2021a). Analysis of greek middle-school science textbooks about forces and motion from the perspective of three-dimensional learning. *Eurasia Journal of Mathematics, Science and Technology Education*, *17*(12), 1-12. https://doi.org/10.29333/ejmste/11309

Papakonstantinou, M., & Skoumios, M. (2021b). Science and engineering practices in the content of greek middle school physics textbooks about forces and motion. *Journal of Technology and Science Education*, *11*(2), 457–473. https://doi.org/10.3926/jotse.1286

Patterson, D. G. (2011). *Student awareness and career motivations in the STEM fields*. 1–5.

Putra, P. D. A., Ahmad, N., Wahyuni, S., & Narulita, E. (2021). Analysis of the factors influencing of pre-service science teacher in conceptualization of stem education: Self-Efficacy and content knowledge. *Jurnal Penelitian Pendidikan IPA*, *7*(SpecialIssue), 225–230. https://doi.org/10.29303/jppipa.v7ispecialissue.877

Rahman, A., Arafah, K., & Arsyad, M (2021). The development of teaching material based on science, technology, engineering, and mathematics (STEM). *Jurnal Pendidikan Fisika*, *9*(1), 63–72. https://doi.org/10.26618/jpf.v9i1.4499

Sarican, G., & Akgunduz, D. (2018). The impact of integrated STEM education on academic achievement, reflective thinking skills towards problem solving and permanence in learning in science education. *Cypriot Journal of Educational Sciences*, *13*(1), 94–113. https://doi.org/10.18844/cjes.v13i1.3372

Sihotang, C., & Sibuea, A. M. (2015). Pengembangan buku ajar berbasis kontekstual dengan tema "sehat itu penting". *Jurnal Teknologi Informasi & Komunikasi dalam Pendidikan*, *2*(2), 169–179. https://doi.org/10.24114/jtikp.v2i2.3293

Sukmawijaya, Y., Suhendar., & Juhanda, A. (2019). Pengaruh model pembelajaran Stem-Pjbl terhadap kemampuan berpikir kreatif siswa pada materi pencemaran lingkungan. *Jurnal Bioeduin: Program Studi Pendidikan Biologi*, *9*(2), 28–43. https://doi.org/10.15575/bioeduin.v9i2.5893

Sulaeman, N., Efwinda, S., & Putra, P. D. A. (2022). Teacher readiness in stem education: Voices of indonesian physics teachers. *Journal of Technology and Science Education* (*JOTSE)*, *12*(1) 68-62. https://doi.org/https://doi.org/10.3926/jotse.1191

Sulaeman, N. F., Putra, P. D. A., Mineta, I., Hakamada, H., Takahashi, M., Ide, Y., & Kumano, Y. (2020). Engaging STEM education for high school student in Japan: Exploration of perception to engineer profession. *Jurnal Penelitian dan Pembelajaran IPA*, *6*(2), 194-210. https://doi.org/10.30870/jppi.v6i2.8449

Sulaeman, N. F., Putra, P. D. A., Mineta, I., Hakamada, H., Takahashi, M., Ide, Y., & Kumano, Y. (2021). Exploring student engagement in STEM education through the engineering design process. *Jurnal Penelitian dan Pembelajaran IPA*, *7*(1), 1-16. https://doi.org/10.30870/jppi.v7i1.10455

Sya'bandari, Y., Aini, R. Q., Rusamana, A. N., & Ha, M. (2021). Indonesian students'

STEM career motivation: A study focused on gender and academic level. *Journal of Physics: Conference Series*, *1957*, 1-8. https://doi.org/10.1088/1742-6596/1957/1/012029

Triwulandari, S., Azizah, R. D. A. F. Z., Syam, M., Putra, P. D. A., & Sulaeman, N. F. (2021). Exploring science and engineering practices in Indonesian physics textbook about heat and temperature. *The Proceedings Book of the Internasional Conference for Tropical Studies and Its Application*, *1*(1), 1-9.

Vela, K. N., Pedersen, R. M., & Baucum, M. N. (2020). Improving perceptions of STEM careers through informal learning environments. *Journal of Research in Innovative Teaching & Learning*, *13*(1), 103–113. https://doi.org/10.1108/jrit-12-2019-0078

Yusuf, I., Widyaningsih, S. W., & Sebayang, S. R. B. (2018). Implementation of E-learning based-STEM on quantum physics subject to student HOTS ability. *Journal of Turkish Science Education*, *15*(Special Issue), 67–75. https://doi.org/10.12973/tused.10258a

Zurweni, Z., Kurniawan, D. A., & Azzahra, M. Z. (2021). A comparative analysis of students' attitudes and interests in science subjects. *Jurnal Pendidikan Progresif*, *11*(2), 290–308. https://doi.org/10.23960/jpp.v11.i2.202112