

Investigating STEM Career Content in Indonesian Science Junior High School Text Book

by Nurul Sulaeman

Submission date: 19-Dec-2022 08:46AM (UTC+0700)

Submission ID: 1984152285

File name: 9207-29160-1-RV.docx (1.42M)

Word count: 3713

Character count: 21065



Investigating STEM Career Content in Indonesian Science Junior High School Text Book

Riski Amalia^{1)*}, Remanda A. Wisutama²⁾, Nurul F. Sulaeman³⁾, Riskan Qadar⁴⁾

^{1,2,3,4)} Departemen of Physics Education, Mulawarman University, Samarinda, 75119, Indonesia

*Corresponding author: riskiamalia4989@gmail.com

Received: Month XX, 20XX; Accepted: Month XX, 20XX; Published: Month XX, 20XX

Abstract – This study aims to analyze the STEM career content in science junior high school textbooks for seventh grade commonly used 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. STEM career content was still lacked in textbooks. The most commonly found aspect was self-efficacy and the most observed STEM career content was found in earliest chapter, which is Nature of Science. These findings highlight the importance of career oriented in science lesson that illustrated on the textbook for enhancing student's perception and enthusiasm in pursuing STEM career in the future.

Keywords: Junior High School, Science Textbook, STEM Career Content,

© 2020 Physics Education Department, Universitas Muhammadiyah Makassar, Indonesia.

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 motivate 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. Former research showed that it advantages also make learners to meet innovations in science and technology (Sulaeman et al., 2022).

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 Mita, 2021). Therefore, student 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 et al., 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 student learning outcomes, and affect student 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 (Lajium, 2016)

As global needs, STEM career need to be increase and STEM specialists are in high demand (Christensen & Knezek, 2016). 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, 2016). Some research showed that junior high school student's perceptions of STEM careers are 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 influence 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 student learning when students interact with textbook, and indirectly influence student learning through their effects on teachers during the teaching process (Papakonstantinou

& Skoumios, 2021). Learning using STEM-based teaching materials is effective and can make students think creatively (Ahmad et al., 2021; Rahman. M et al., 2021). There has been various research on STEM in the science books (Triwulandari et al., 2021; Papakonstantinou & Skoumios, 2021), 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 able to learn about STEM Career and 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 student enthusiasm can be sustain and supplement with 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 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 widely use in schools. List of books can be seen in Table 1.

Table 1. Identity of Indonesian Science Junior High School Text Book

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 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 were analyzed using Microsoft Excel. The following are the equations that were used (Suchayanti et al., 2018):

$$R = \frac{f}{n} \times 100\%$$

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 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 Tabel 3. From our analysis, the most obsevable STEM career content is in chapter 1 which related to Nature of Science.

Table 3. List Chapter of Material 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

The percentage results of each aspect that analyzed in the science junior high school textbooks could be observed in Figure 1.

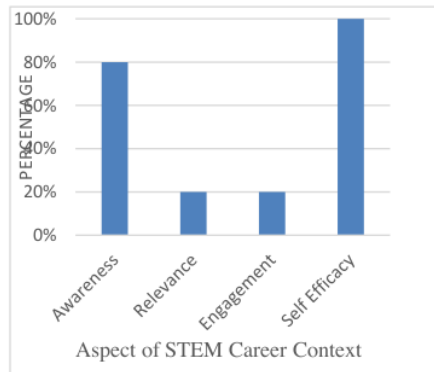


Figure 1. Percentage of Aspect of STEM Career Content in Textbook

Awareness

Awareness to STEM career content is aspects that display information to increase student's knowledge about STEM careers. The aim of awareness is students can develop an 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 content 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 2, 3 and 4. 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 we analyzed.



Figure 2. Example of Awareness in Book 3 Page 4

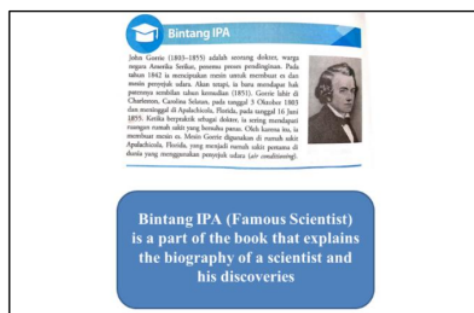


Figure 3. Example of Awareness in Book 1 Page 180

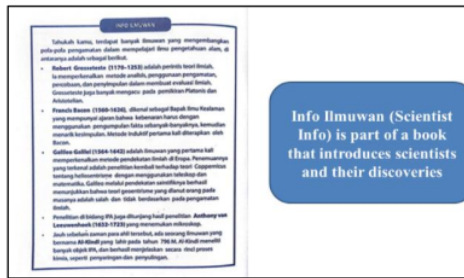


Figure 4. Example of Awareness in Book 4
Page 28

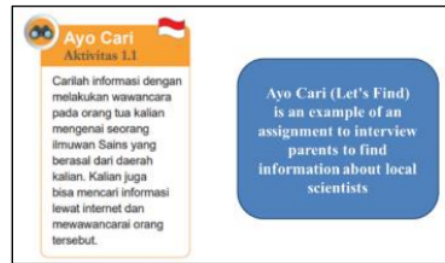


Figure 5. Example of Relevance in Book 3
Page 4

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 5 and 6.



Figure 6. 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 7.

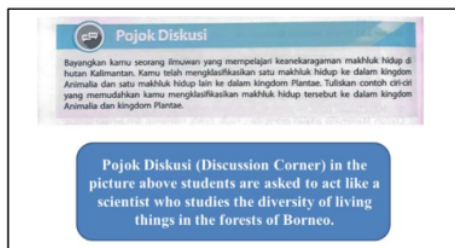


Figure 7. Example of Engagement in Book 5 Page 80

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 that 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 student (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 8 and 9.

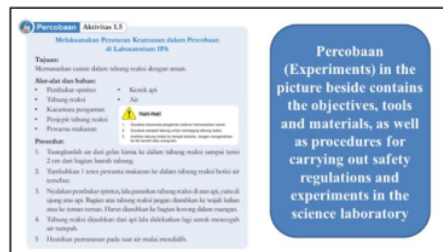


Figure 8. Example of Self-Efficacy Focused on Science in Book 3 Page 12

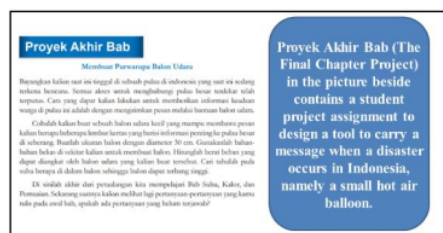


Figure 9. Example of Self-Efficacy Focused on Integrated STEM in Book 3 Page 106.

IV. CONCLUSION AND SUGGESTION

This study aims to analyze STEM career content in science junior high school textbooks for seventh grade commonly used in schools. The STEM career content is shown 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 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>
- Christensen, R., & Knezek, G. (2016). Relationship of Middle School Student STEM Interest to Career Intent. *Journal of Education in Science, Environment and Health*, 3(1), 1. <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. *Washington State Kappan*, 12–17. <https://www.researchgate.net/publication/260417345>
- 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., van Vorst, H., 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 Mita, S. I. A. (2021). The Use of STEM-Based Virtual Laboratory (PhET) of Newton's Law to Improve Students' Problem Solving Skills. *Jurnal Pendidikan Fisika*, 9(Vol 9, No 2 (2021): PENDIDIKAN FISIKA), 125–133. <https://doi.org/10.26618/jpf.v9i2.5078>
- Lajium, D. A. D. (2016). *The Effectiveness Of STEM Learning Approach Among*

- Secondary School Students' . September.*
- 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(1). <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 - Frontiers in Education Conference, FIE, 2015*. <https://doi.org/10.1109/FIE.2015.7344065>
- Nuangchalerm, P., Prachagool, V., Islami, R. A. Z. El, & 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). <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, M. A., Arsyad, M., & Arafah, K. (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., Technology, I., & Akgunduz, D. (2018). Cypriot Journal of Educational reflective thinking skills towards problem solving and permanence in. *Cypriot Journal of Educational Sciences*, 13(1), 94–107.
- 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 Program Studi Pendidikan Biologi*, 9(9), 28–43. <https://e-journal.unipma.ac.id>
- Sulaeman, N., Efwinda, S., & Putra, P. D. A. (2022). TEACHER READINESS IN STEM VOICES OF INDONESIAN PHYSICS TEACHERS. *Journal of Technology and Science Education, JOTSE*, 202. <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. <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. <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). <https://doi.org/10.1088/1742-6596/1957/1/012029>
- Triwulandari, S., Roro Dinda Althaf F Z Azizah, Muliati Syam, Putra, P. D. A., & Nurul Fitriyah Sulaeman. (2021). Exploring Science and Engineering Practices in Indonesian Physics Textbook about Heat and Temperature. *Internasional Conference for Tropical Studies and Its Application*.
- 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>

Investigating STEM Career Content in Indonesian Science Junior High School Text Book

ORIGINALITY REPORT

6%

SIMILARITY INDEX

8%

INTERNET SOURCES

0%

PUBLICATIONS

3%

STUDENT PAPERS

PRIMARY SOURCES

1

repository.ung.ac.id

Internet Source

4%

2

nwabr.org

Internet Source

3%

Exclude quotes On

Exclude bibliography On

Exclude matches < 3%