Indian Journal of Information Sources and Services
ISSN: 2231-6094 (P) Vol.14, No.2, 2024, pp.63-69

DOI: https://doi.org/10.51983/ijiss-2024.14.2.10

Science Education in Indonesia: A Bibliometrics Study in Terms of Science Teachers' and Students' Perspectives

Ni Putu Sri Ratna Dewi[1], I Made Citra Wibawa[2], Ni Nyoman Parmithi[3] and I Wayan Eka Mahendra[4]

[1]Lecture, Biology and Marine Fisheries, Faculty of Mathematica and Natural Science, Universitas Pendidikan Ganesha, Indonesia
[2]Lecture, Primary School Teacher Education Study Program, Faculty of Education, Universitas Pendidikan Ganesha, Indonesia
[3]Lecture, Biology Education, Universitas PGRI Mahadewa Indonesia, Indonesia
[4]Lecture, Tourism Management, Institut Pariwisata Dan Bisnis Internasional, Indonesia
E-mail: [1]ratna.dewi@undikhsa.ac.id, [2]imadecitra.wibawa@undiksha.ac.id, [3]nyomanparmithi@gmail.com, [4]ekamahendra@ipb-intl.ac.id
ORCID: [1]https://orcid.org/0009-0008-0039-291X, [2]https://orcid.org/0009-0003-9042-4463, [3]https://orcid.org/0009-0004-8407-3203, [4]https://orcid.org/0000-0001-6085-943X
(Received 07 April 2024; Revised 30 April 2024; Accepted 20 May 2024; Available online 17 June 2024)

Abstract - **In recent years, Science Education (SE) in Indonesia has grown into a dedicated focus for all stakeholders in scientific education. All players in the field of education unanimously agree to enhance the prominence of SE among all stakeholders, particularly teachers and learners. The research analyzed the students' attitudes regarding Science Education and the impact of Science Education by SE teachers in higher educational institutions. Science Education outcomes are analyzed using a survey and descriptive evaluation. To gather details, a survey includes closed-ended and open-ended questions developed and controlled on SE teachers' and students' viewpoints and knowledge. This research assessed Indonesian Science Education teachers' perspectives and experiences with Science Education teaching focused on Socio-Scientific Issues (SSI). The students were asked how they integrated relevant SSI methods into their Science Education and their difficulties. Teachers were asked what subjects they learned would be best for SSI-based learning, and most students replied that subjects like technology or environmental sciences would be good for the learning. Despite many hurdles, most Science Education teachers continued to be interested in using SSIs in their classrooms.**

Keywords: **Science Education, Bibliometrics, Indonesia, Teachers' and Students' Perspectives**

I. Introduction to Science Education

Science Education (SE) is crucial in helping future citizens with the necessary skills and making informed options related to science-related studies in today's world (Arifin & Anas, 2021). Students should be provided with an environment that helps them to use their skills to engage in science-related studies and understand the scientific details related to any issues. SE educators must consider the environment in which learners are exposed to science in school. Nevertheless, SE instructors sometimes convey scientific issues with only indirect allusions to the daily experiences of their pupils. Socio-Scientific Issue (SSI)-based learning allows students to engage with and make decisions about real-life challenges related to science and technology they may encounter daily (Ram, 2024). SSI-based education is a context-based learning that focuses on scientific education. It also serves as a framework for developing basic educational abilities that prepare students to participate fully in the democratic system (Selvaprabu et al., 2024). This includes the ability to make sound decisions on SSIs. Several nations often need to pay more attention to the connection between these socioeconomic challenges and their immediate impact.

Given Indonesia's substantial size, extensive natural resources, and human capital, the nation must advance science and technology significantly (Kalogiannakis et al., 2021). SE is used across many scientific disciplines by using the fundamental principles of science as a foundation for instruction and maximizing the potential of learners (Chukwusa, 2021). Many longstanding issues, including the disorganized development of the elementary school curriculum, plague Indonesia's education system. Research has shown that science and math instructors in Indonesia need more pedagogical understanding and effectiveness in teaching science (Veysi & Salari-Aliabadi, 2021). According to research by the National Science Foundation (NSF), there are claims that just a handful of mathematics and science instructors have practical expertise in scientific teaching. Teachers might need a formal degree in science. The NSF found that 30% of elementary school science teachers need professional training (Marbun et al., 2020). Teachers' perspectives on SE are very significant since they can shape the progress of SE in Indonesia. This research aims to ascertain the teachers' perceptions of SE in Indonesia, particularly their grasp of the definition of science, to promote SE.

An initial analysis of research published in international scientific journals suggests a need for further studies that record SE in Indonesia (Zidny et al., 2021). This study aims to improve readers' understanding of the research environment in Indonesia's social entrepreneurship field.

Undertaking research in the Indonesian environment is of utmost importance. Indonesian academics may use this benchmark to evaluate their recent progress and provide recommendations on areas of research and development that need improvement to influence society as a whole (Indrawati & Kuncoro, 2021). The research findings might aid Indonesian educational officials in formulating enduring strategies to tackle significant challenges, particularly in the scientific classroom (Arora, 2024). The research results will be crucial information for scholars in the international environment as they establish and develop international partnerships and networks to promote SE worldwide. SE is primarily a global endeavor that involves the active involvement and contribution of many governments worldwide.

II. Background to Science Education

The Indonesian government has made notable progress over the past three decades by improving access to education and increasing funding for school operations, resulting in a high student enrollment rate. Indonesia is presently the fourth largest nation in the world in terms of population, behind China, India, and the United States (Anwar, 2023).

Between 1970 and 2010, the population increased twice, from 135 million to over 240 million individuals. Projections indicate that the population will continue to expand, reaching 306 million by 2030. In 2019, education data indicated that Indonesia had achieved a universal gross participation ratio for elementary school students at 9% and for junior high school students at 91% (Gust et al., 2024). There was an upward trend in admission rates for senior secondary school pupils at 76% and for university education at 24%. The current gross enrollment percent levels are among the greatest ever recorded, surpassing any preceding time.

The number is anticipated to increase further as the government actively implements the 2018 law that mandates extending compulsory schooling from 8 to 13 years (Fan, 2020). Delivering education to 54 million K-12 students in a nation severely damaged only two generations ago due to the failure of the post-war and post-colonial economy and government is an impressive accomplishment (Prema et al., 2022). The government had to prioritize developing the ability to accommodate a more significant number of pupils in the education system (Heleta & Bagus, 2021). The government is prioritizing the enhancement of educational standards for both instructors and pupils. Training and hiring about 3.7 million teachers, who operate in over 3 million schools, is under the responsibility of the governing body and private companies (Batra, 2022). The significant disparity between the number of pupils and educators in the Indonesian educational system compared to the population of several nations is a considerable obstacle for policymakers and elected officials striving to implement effective measures to guarantee a top-notch education for all children in the country.

Efforts centered on enhancing the national curriculum, refining teacher development and training programs, and advancing educational studies are propelling transformation in the education system, influencing SE and learning (Luo, 2023). The research will provide a detailed account of the current condition of the Indonesian educational system (Anđelko & Radomir, 2023). The research uses relevant instances to illustrate the obstacles and advancements in science education in Indonesia. The research outlines creating a national science curriculum and establishing science research (Guest & Martin, 2021). The research offers a background to comprehend teachers' difficulties when implementing a standardized curriculum across various schools, with pupils from diverse backgrounds and in different classrooms.

All pupils are taught fundamental scientific concepts at the primary and junior secondary levels. At these educational levels, science is offered as a cohesive and interconnected topic with a clear distinction between physics, chemistry, and biology content (Roehrig et al., 2021). Science is covered at the primary level four times per week, with a total allocated time of around 107 minutes each week. At the junior high school level, pupils must attend five scientific lessons each week, each subject lasting around 210 minutes. Pupils who choose the scientific track at senior high school get separate instruction for every science topic, with around 142 minutes allocated to each subject weekly. Students attend three sessions each week for each subject: biology, physics, and chemistry.

Given Indonesia's substantial size, extensive natural resources, and human capital, the nation must advance science and technology significantly (Napier et al., 2020). SE is used across many scientific disciplines by using the fundamental principles of science as a foundation for instruction and maximizing the potential of learners. Many longstanding issues, including the disorganized development of the elementary school curriculum, plague Indonesia's education system. Research has shown that science and math instructors in Indonesia need more pedagogical understanding and effectiveness in teaching science (Christensen & Lombardi, 2020). According to research by the NSF, there are claims that just a handful of mathematics and science instructors have practical expertise in scientific teaching.

It is suggested that teachers might not have a formal degree in science. The NSF found that 30% of elementary school science teachers do not have training specifically in their profession (Mambrey et al., 2022). SE teachers' perspectives on scientific education are very significant since they can potentially shape the progress of science education in Indonesia (Mahendra et al., 2022). This research aims to ascertain the teachers' perceptions of scientific education in Indonesia, particularly their grasp of the concept of science, to promote science education.

III. Science Education in Indonesia

This section analyses the participants, survey details, and methods used to assess the students and teachers in science education in Indonesia.

3.1. Participants

This research surveyed 110 scientific students in East Java, Indonesia. 100 science professors from junior high schools participated in the survey. Targeted surveys were conducted with particular instructors. After doing an initial assessment of the surveys, we chose a group of 21 teachers. The decision was based on the variety of their personal information and the quality of their replies to the research. Interviews were done a fortnight following the survey to elucidate further the results obtained from the study.

Participants were instructed to provide details about their personal histories in the survey, which included their teaching degrees, teaching organizations, and experience as educators. A hundred educators were employed across 74 distinct educational institutions, each with diverse academic qualifications. A portion of those involved were employed as educators in public high schools. Some individuals were used in the private education industry. Nine instructors did not indicate any affiliation.

3.2. Methods

Utilizing bibliometrics and the systematic review approach separately in SE investigations has advantages and disadvantages. Despite their need for human labor, systematic examinations are proficient at detecting the research methodology employed in sample articles. Bibliometrics has the advantage of automated text analysis, which alleviates several challenges associated with human labor. It cannot describe the study methods. Employing a singular classification system in a methodical examination could exclude numerous crucial keywords not encompassed by that system.

It could result in the possibility of reaching divergent conclusions when analyzing identical examples of work using an alternative system. Considering these advantages and disadvantages, it integrated both approaches to tackle the research inquiries in the present investigation. Figure 1 presents a summary of the investigation design.

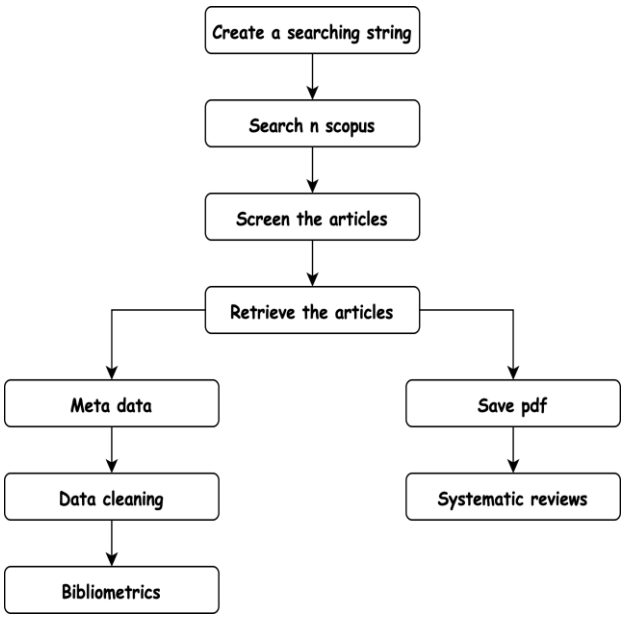

Fig. 1 Study Model for Retrieval of Papers and Assessment Models

The search string was derived from pertinent sources, which encompassed (1) a compilation of research issues, (2) the analytical sections, and (3) a compendium of science-related keywords found in the research. The Language of Science Schooling: An Increased Glossary of Key Fields and Ideas in SE and Studying. It obtained sample papers from the Scopus repository using the Preferred Reporting Items for Systematic Meta-Analyses and Assessments (PRISMA) technique. This resulted in 290 chosen articles, as shown in Figure 2. It specifically chose articles that have appeared only in Scopus-listed journals to ensure their availability to the worldwide science education industry. These articles were only written in English to facilitate comprehension for science instructors worldwide.

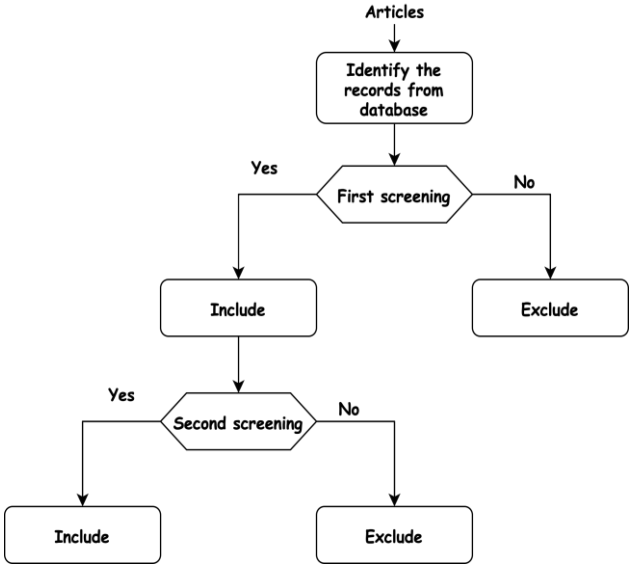

Fig. 2 Process of Retrieval of a Research Article

The document presents the specific analytical methodologies and tools for investigating each study issue. It used an interceding approach to enhance the internal reliability of the systematic evaluation findings. This included two researchers separately classifying the sample articles based on a predetermined categorization scheme. They convened to determine the consensus on their classifications. The inter-coders reached a consensus of 87% for the key research themes, 93% for the primary investigation methodologies, and 87% for the sub-methodologies used in the present investigation.

3.3. Questionnaire

The survey primarily examined the teachers' viewpoints on science education based on Socio-scientific Issues (SSI). The survey thoroughly elucidates SSI-based learning by offering a description and a case study for illustration. SSI-based learning is an instructional approach focusing on complex and controversial subjects in science and technology. The issue requires rigorous scientific and ethical examination, is scrutinized from several perspectives, and offers various viable resolutions. SSI-based education involves instructing students in comprehending the scientific principles of a particular subject and engaging in social discourse. This entails analyzing the benefits and drawbacks, assessing possible hazards and benefits, and providing information to

facilitate decision-making. Based on the explanation and instance of SSI-based education, the students had a similar understanding of the purpose of SSI-based training.

Before the research, the survey underwent a pretest with 35 instructors to ensure the tool was easily understandable. The final study of ten topics, mainly including open-ended questions (questions 4, 5, 6, and 8), as well as Likert-type questions (with a 5-point scale that ranges from "not at all or never" to "a great extent or always"), based on the specific subject (questions 3, 7, 10). Additional question styles included binary responses (question no.1) and multiple-choice questions with many possible solutions (questions no. 2 and 9).

The first three questions in the survey inquired about instructors' personal experiences with SSI-based instruction. The following seven elements pertained to their perspectives on the related methods. The survey included the following elements:

(1) The teachers' level of knowledge and experience with SSI-based teaching methods, (2) The resources or references they used to learn about SSI-based teaching, (3) The frequency at which they have used SSI-based teaching in their classrooms, (4) Any difficulties or obstacles that they have encountered when implementing SSI-based teaching, (5) Any student abilities that can be enhanced by using SSI-based teaching, (6) Any professional skills that instructors can improve through SSI-based teaching. (7) How much can SSI-based instruction give to personality formation? (8) Which elements of personality creation can be substantially accepted by the majority? (9) What are some indicated science subjects useful for implementing SSI-based instructing? (10) How intrigued was the instructor in carrying out SSI-based teaching despite any indicated difficulties?

IV. Results and Discussions

Figure 3 illustrates the portrayal of pupil viewpoints on SE via scientific instruction based on handling study data. The graph is a composite of three metrics about SE subjects. The graph is derived from comprehensive data collected from all metrics aligned with their relevance and subject matter. Therefore, it is evident that most pupils have a favorable outlook on their interest in SE, accounting for 65% of the total. Approximately 79% of the kids have a favorable view of SE vocations. Most students have a good view of SE material, with 61% expressing this sentiment.

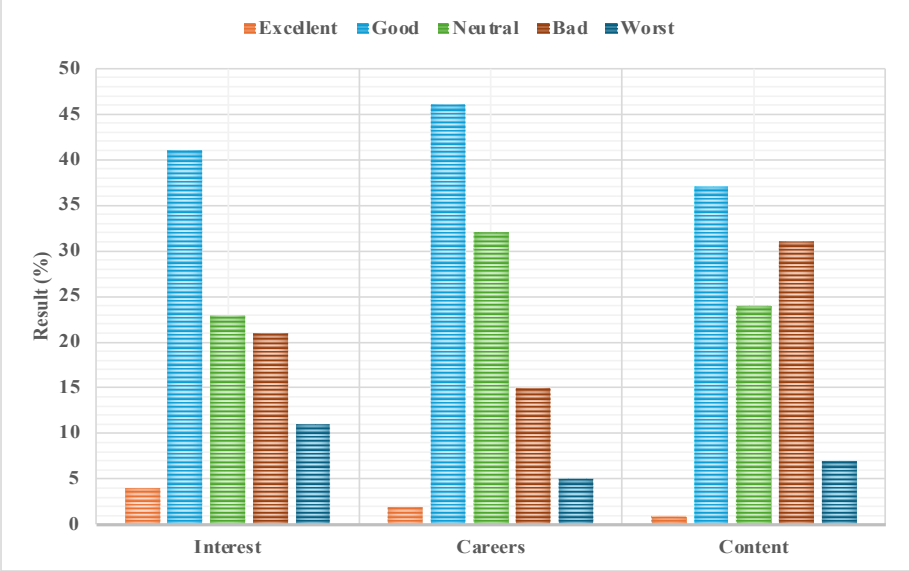

Fig. 3 Students' Perspective on Science Education

According to this research, most pupils had a favorable outlook on SE interests, professions, and material. Students' perceptions of SE interest fell into the less favorable group, including 21%. Only 18% of pupils had good opinions on SE jobs, while a more significant proportion of 37% had reservations about SE curriculum. Curiosity considerably impacts the selection of SE studies and careers and students' academic achievement in SE fields. Children with enthusiasm for SE would be able to excel in SE. The level of interest an individual has in a specific topic, such as mathematics, physics, or English, is directly linked to their academic performance. Pupils with a keen interest in computers tend to get higher scores compared to those who do not have the same skills.

The average score of students in scientific lectures altered when the results of daily assessments were evaluated before and after SE instruction. Implementing SE learning has resulted in a noticeable improvement in pupils' average scores on daily assessments, as shown by the proof of daily results and the outcomes of interviews with the instructor. Thus, pupils were strongly inclined towards and enthusiastic about their academic pursuits, professional prospects, and SE-related subjects. Each result will be explained clearly, including the study results and pupils' viewpoints on SE passions, jobs, and material.

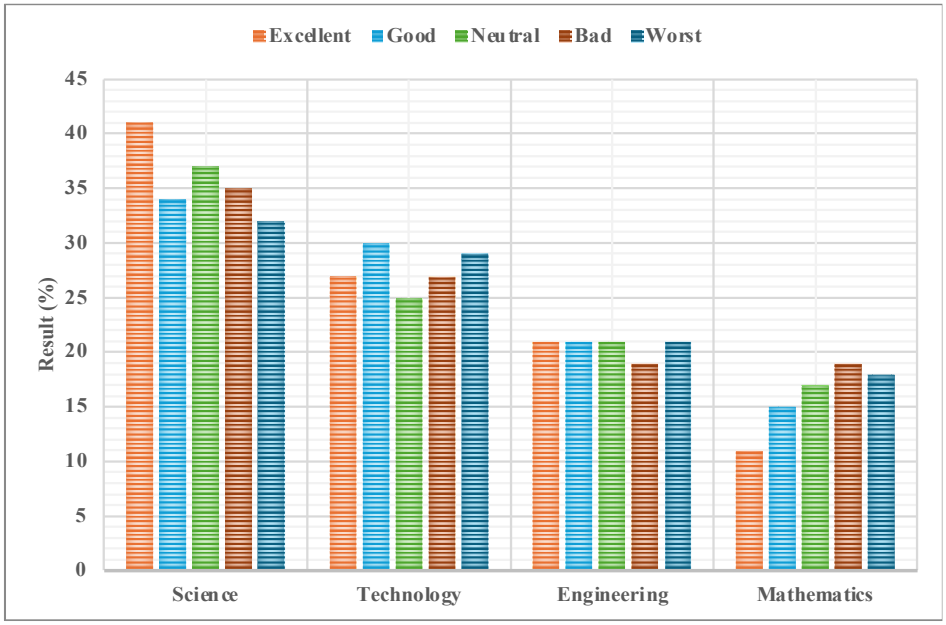

Fig. 4 Science Education Interest Analysis

Figure 4 displays the outcomes of analyzing and processing information related to interest in SE. The graph depicts the percentage distribution of student interest in SE among 90 pupils. Overall, the study findings on each indication of interest in science indicate that most pupils are interested in science. A total of 31% of pupils exhibit a solid motivation to further their knowledge in science. Their family's inclination towards science influences 36% of pupils, while 39% have family members with a genuine interest in the subject. 34% of students possess an inherent internal curiosity towards science, and a significant majority of 43% express a fondness for the subject.

According to the statistics shown on the graph, most pupils have a predominant interest in science. Technology is the primary motivation for 30% of pupils, while 22% of students are driven by their family's passion for technological advances. 21% of students come from families with a general interest in technology. 30% of pupils are interested in technology, and 27% enjoy it. Pupils are more inclined towards science, followed by a preference for technology over engineering and mathematics. This is attributable to their families providing the most support and motivation for pursuing SE fields.

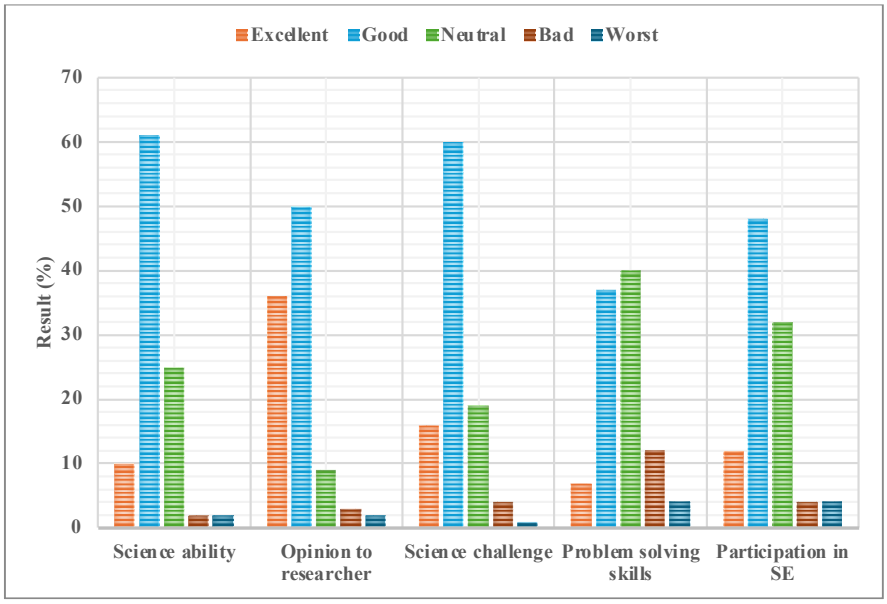

Fig. 5 Science Education Career Analysis

Figure 5 displays the outcomes of the processing and analysis of information related to SE career statements. The study findings indicate that most students agreed with pursuing a career in SE. 61% of students expressed that their proficiency in science facilitates their ability to collaborate with others. In comparison, 50% of pupils acknowledged that their perception of researchers can significantly impact the world. 61% of pupils recognized that science poses a challenge in their future endeavors, and 34% concurred that they encounter difficulties in resolving natural disaster issues. A majority of 58% of students expressed their want to increase their involvement in SE.

According to the results, most pupils generally agreed with assertions 1, 2, 3, and 5.

In contrast, 47% of pupils disagreed with the statement, "I find it challenging to solve the issue of catastrophes if they occur." Based on the survey responses, students said they did not see problem-solving as challenging. Researchers discovered that pupils faced challenges in problem-solving during SE learning, as shown by the data provided by the instructor throughout the learning exercise. This happened due to the pupils' need for self-evaluation. Self-evaluation evaluates progress and abilities in specific disciplines using established requirements or standards.

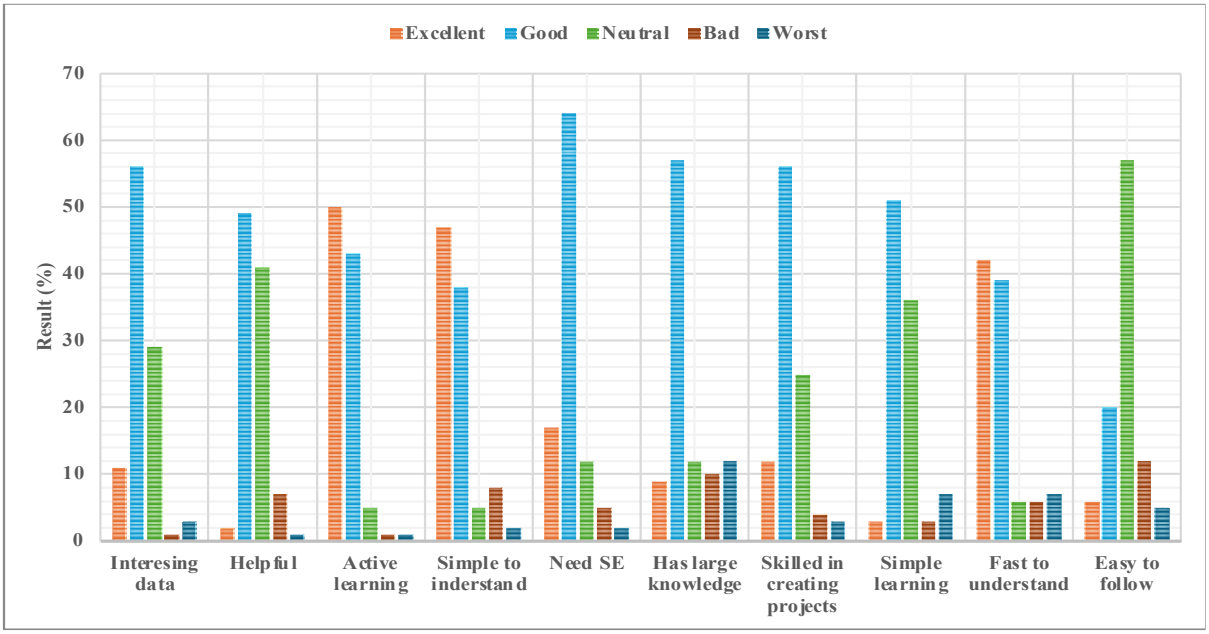

Fig. 6 Science Education Content Analysis

Figure 6 displays the outcomes of analyzing and processing SE content assertion information. The study findings for each SE content indication indicate that most pupils concurred with the SE topic assertions. According to the research, 63% of learners disagreed with the statement that "Science education is simple for me." This is evident in the process of creating a SE project. It aligns with the assertion made by their instructor that pupils need a significant amount of time to complete an assignment.

V. Conclusion

The objective of the current investigation was to depict the state of scientific and educational research in Indonesian high schools throughout the last twenty years, and notable discoveries were made. Initially, the statistics indicate that there has been a significant increase in publications related to scientific education in Indonesia, although this growth has only been seen since the year 2021. This study elucidates the effect of a federal policy that mandates foreign publishing as a criterion for tenure advancement among academics. The scarcity of Indonesian articles in esteemed international SE journals indicates a need for targeted professional development programs to enhance the writing skills of instructors, instructors of science, and graduate pupils. These programs should focus on improving their proficiency in English and enabling them to adopt suitable rhetorical styles when composing manuscripts.

The cooperation among prominent writers is often limited to those affiliated with significant organizations that have traditionally provided teacher educational courses since their establishment. Indonesian scientific educators have partnered with scientists from multiple English-speaking countries regarding international cooperation. They have yet to establish collaborations with scientists from the United States, the foremost worldwide leader in SE. Based on the analytics sections, Indonesian science teachers have shown a particular interest in research themes that revolve around classroom learning environments, traits of learners, educational technology, and the understanding of students' views and conceptual change. This conclusion indicates that research themes in Indonesian secondary institutions have mainly concentrated on investigating the effectiveness of teaching tactics and incorporating technological devices into instructional methods to enhance pupils' academic achievement.

This study is a minor part of a more extensive study that seeks to analyze the patterns of scientific studies on education in Indonesia across all levels of education. It utilizes sample articles from the Scopus and Web of Science indexes. The subsequent investigation will explore several issues that still need to be addressed in the present research. This includes recreating the present research's design but utilizing example papers from the Web of Science representing various stages of education. The study will examine whether the findings obtained will be similar.

Although the method specifies that the decision to include only works with English-written articles, which mainly ensures access for researchers from different countries, it is also essential to conduct a subsequent investigation using examples of articles produced in Indonesia. This will provide a more comprehensive understanding of SE studies in Indonesia. Since no bibliography tool can analyze

languages other than English, a systematic review approach is the only viable technique for doing such research.

REFERENCES

[1] Anđelko, C., & Radomir, F. (2023). Time Dependent Deformations of A Coupled Bridge: A Case Study. *Archives for Technical Sciences, 2*(29), 23-34.

[2] Anwar, D. F. (2023). Indonesia's hedging plus policy in the face of China's rise and the US-China rivalry in the Indo-Pacific region. *The Pacific Review, 36*(2), 351-377.

[3] Arifin, B., & Anas, T. (2021). Lessons learned from COVID-19 vaccination in Indonesia: experiences, challenges, and opportunities. *Human Vaccines & Immunotherapeutics, 17*(11), 3898-3906.

[4] Arora, G. (2024). Design of VLSI Architecture for a flexible testbed of Artificial Neural Network for training and testing on FPGA. *Journal of VLSI Circuits and Systems, 6*(1), 30-35.

[5] Batra, P. (2022). Teacher Education in India: Virtual Capture of the "Public". *In The Palgrave Handbook of Teacher Education Research, Cham: Springer International Publishing,* 1-19.

[6] Christensen, D., & Lombardi, D. (2020). Understanding biological evolution through computational thinking: a K-12 learning progression. *Science & Education, 29*(4), 1035-1077.

[7] Chukwusa, J. (2021). An Assessment of the Information Literacy Skills of Students in Nigerian Universities. *Indian Journal of Information Sources and Services, 11*(1), 9–15.

[8] Fan, G. (2020). Changes in Educational Institutions in China: 1978–2020: Analysis of Education Policies and Legal Texts from a National Perspective. *Handbook of Education Policy Studies: Values, Governance, Globalization, and Methodology, 1*, 111-129.

[9] Guest, O., & Martin, A. E. (2021). How computational modeling can force theory building in psychological science. *Perspectives on Psychological Science, 16*(4), 789-802.

[10] Gust, S., Hanushek, E. A., & Woessmann, L. (2024). Global universal basic skills: Current deficits and implications for world development. *Journal of Development Economics, 166*, 103205. https://doi.org/10.1016/j.jdeveco.2023.103205

[11] Heleta, S., & Bagus, T. (2021). Sustainable development goals and higher education: leaving many behind. *Higher Education, 81*(1), 163-177.

[12] Indrawati, S. M., & Kuncoro, A. (2021). Improving competitiveness through vocational and higher education: Indonesia's vision for human capital development in 2019–2024. *Bulletin of Indonesian Economic Studies, 57*(1), 29-59.

[13] Kalogiannakis, M., Papadakis, S., & Zourmpakis, A. I. (2021). Gamification in science education. A systematic review of the literature. *Education Sciences, 11*(1), 22. https://doi.org/10.3390/educsci11010022

[14] Luo, S. (2023). The current landscape and future direction of curriculum reform in China. *Future in Educational Research, 1*(1), 5-16.

[15] Mahendra, E. I. W., Parmithi, N. N., & Jayantika, I. G. A. N. T. (2022). Combining STEAM learning and performance assessment to optimize students' higher-level thinking abilities. *World Transactions on Engineering and Technology Education, 20*(4), 258-263.

[16] Mambrey, S., Schreiber, N., & Schmiemann, P. (2022). Young students' reasoning about ecosystems: The role of systems thinking, knowledge, conceptions, and representation. *Research in Science Education, 52*(1), 79-98.

[17] Marbun, D. S., Effendi, S., Lubis, H. Z., & Pratama, I. (2020). Role of education management to expedite supply chain management: a case of Indonesian Higher Educational Institutions. *International Journal of Supply Chain Management (IJSCM), 9*(1), 89-96.

[18] Napier, J. B., Luft, J. A., & Singh, H. (2020). In the classrooms of newly hired secondary science teachers: The consequences of teaching in-field or out-of-field. *Journal of Science Teacher Education, 31*(7), 802-820.

[19] Prema, M., Raju, V., & Ramya, M. (2022). Natural Language Processing for Data Science Workforce Analysis. *Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications, 13*(4), 225-232.

[20] Ram, V. (2024). Indonesia in the Indo-Pacific: The Rise of a Strategic Geopolitical Power. *In the New World Politics of the Indo-Pacific*, 194–206.

[21] Roehrig, G. H., Dare, E. A., Ring-Whalen, E., & Wieselmann, J. R. (2021). Understanding coherence and integration in integrated STEM curriculum. *International Journal of STEM Education, 8*, 1-21. https://doi.org/10.1186/s40594-020-00259-8

[22] Selvaprabu, J., Arun, R.L., Saravanan, P., Abdul, A.A.K., & Javubar, S.K. (2024). OptCatB: Optuna Hyperparameter Optimization Model to Forecast the Educational Proficiency of Immigrant Students based on CatBoost Regression. *Journal of Internet Services and Information Security, 14*(2), 111-132.

[23] Veysi, M. M., & Salari-Aliabadi, M. A. (2021). Ecological study of two sea cucumbers (Holothuria parva and Holothuria arenicola) in the Hormozgan and Bushehr provinces of Persian Gulf. *Natural and Engineering Sciences, 6*(1), 1-18.

[24] Zidny, R., Solfarina, S., Aisyah, R. S. S., & Eilks, I. (2021). Exploring indigenous science to identify contents and contexts for science learning in order to promote education for sustainable development. *Education Sciences, 11*(3), 114. https://doi.org/10.3390/educsci11030114