Journal of Law and Bibliometrics Studies
Homepage : https://journal.i-ros.org/index.php/JOLABIS
Email : jolabis@i-ros.org

e-ISSN 3109-3310
Vol. 1, No.3, November 2025

Bibliometric Analysis: Trends and Potential of Self-Regulated Learning (SRL) in Physics and SDGs

Rahmatta Thoriq Lintangesukmanjaya[1*], Binar Kurnia Prahani[1], Dwikoranto[1], Hidayatul Latifah[1], Neisya Azaria Adinda Putri[2]

[1]Universitas Negeri Surabaya, Surabaya, Indonesia
[2]Sivas Cumhuriyet Universitesi, Turkey

Check for updates OPEN ACCESS

DOI : https://doi.org/10.63230/jolabis.1.3.112

Sections Info

Article history:
Submitted: September 28, 2025
Final Revised: November 27, 2025
Accepted: December 5, 2025
Published: December 8, 2025

Keywords:
Bibliomteric;
Learning;
Physics;
SDGs;
SRL.

ABSTRACT

Objective: *This study aims to determine potential future research directions that can strengthen the integration between SRL and physics education in order to support the achievement of Sustainable Development Goals (SDGs), especially goal 4 on Quality Education.* ***Method:*** *This research was conducted using a quantitative descriptive approach, a bibliometric analysis study used data from the Scopus database to map trends and focuses on Self-Regulated Learning (SRL) research in international literature.* ***Results:*** *There is a global research trend in SRL and physics learning that supports the SDGs. The number of documents and citations increased from 2020 to 2025, resulting in 123 Scopus documents, with the highest number of citations in 2024, reaching 185.* ***Novelty:*** *The findings of the bibliometric analysis identified three main aspects of SRL research on physics materials and their influence on the SDGs, including the use of AI technology, relevant learning models, and learning processes. Future research directions hold great potential for integrating technologies such as AI and IoT devices into SRL to support the achievement of the Sustainable Development Goals (SDGs). This finding is in innovative learning planning focused on self-satisfaction in the era of technology adoption.*

INTRODUCTION

This research is expected to align with the demands of 21st-century education, which emphasize critical, creative, and independent thinking skills for students (Masjudin, 2024). Through this research, learning strategies will emerge that can foster these three abilities, enabling students not only to receive information but also to process, evaluate, and apply knowledge innovatively in real life (Nilimaa, 2023). Therefore, the results of this research are expected to make a tangible contribution to improving the quality of learning that is adaptive to global challenges.

Furthermore, the importance of the Self-Regulated Learning (SRL) approach is expected to shape students who can regulate and direct their own learning processes (Ng et al., 2024), from planning and implementation to evaluation of learning outcomes (Kramarski & Heaysman, 2021). Through the application of SRL, students are expected to develop metacognitive awareness, intrinsic motivation, and a sense of responsibility for their learning progress (Ambaryani & Putranta, 2022). Thus, this research is expected to contribute to the implementation of learner-centered learning strategies and support independent learning in various educational contexts.

Furthermore, the implementation of Self-Regulated Learning (SRL) is expected to contribute to achieving the Sustainable Development Goals (SDGs) (Demir, 2024;

Lintangesukmanjaya et al., 2025), particularly Goal 4: Quality Education. This approach is believed to encourage the realization of an inclusive, effective education system oriented towards the development of 21st-century competencies that support sustainable development (Imara & Altinay, 2021; Lintangesukmanjaya et al., 2025). Integrating SRL principles into learning will help students not only excel academically but also develop social awareness and a sense of responsibility for advancing society and the environment.

The reality is that the application of Self-Regulated Learning (SRL) in physics learning remains limited to narrow contexts (Heryani, 2023), such as a specific grade level or school. However, this approach has great potential to improve students' independent learning, critical thinking (Öz & Şen, 2021), and problem-solving skills (Kumar et al., 2023). This limited widespread application of SRL indicates the need for further efforts to develop, disseminate, and adapt SRL strategies so that they can be applied to various levels of education and a wider variety of physics learning environments.

Furthermore, studies on SRL in physics have been partial and not integrated with global issues (Molenaar, 2023), such as the Sustainable Development Goals (SDGs). Many studies discussing SRL focus solely on pedagogical aspects without linking them to broader sustainable education goals. Consequently, there is no complete picture of how SRL can support achieving quality education that meets the demands of the 21st century. This situation indicates a research gap that requires a more comprehensive and targeted analysis.

Therefore, a bibliometric study is needed to map the development, direction, and potential of research on SRL (Sulistiawati et al., 2023) in the context of physics learning and its relationship to the SDGs. Through a bibliometric approach, publication trends, researcher collaborations, dominant topics, and areas that have received less attention can be identified (Hamdam & Alsuqaih, 2024). The results of this study are expected to serve as a basis for developing further research that is more focused, integrative, and impactful in improving the quality of physics education and its contribution to sustainable development.

The main objective of this research is to address the limited understanding of the potential and direction of future research on Self-Regulated Learning (SRL) in physics education that aligns with sustainability principles. Currently, the discourse on SRL development in physics is not widely linked to long-term goals such as sustainable education and holistic human development. Therefore, this research seeks to provide a more in-depth mapping of the position and relevance of SRL in the context of physics education, thereby providing a conceptual foundation for the development of learning strategies that support self-regulated learning abilities while being oriented towards sustainability.

Furthermore, this study aims to analyze scientific publication trends related to the application of Self-Regulated Learning (SRL) in physics learning using a bibliometric approach. Through this analysis, research development patterns, collaborative networks among researchers, primary publication sources, and dominant and under-explored themes will be identified. This approach is an important innovation because it provides

a quantitative, visual overview of the SRL research landscape, helping academics and education practitioners understand the direction of scientific development in this field.

In addition, this study aims to identify potential future research directions to strengthen the integration of SRL and physics education and support the achievement of the Sustainable Development Goals (SDGs), especially goal 4 on Quality Education. Thus, the innovation of this study lies not only in bibliometric mapping but also in its efforts to design strategic recommendations that connect the development of SRL theory, physics education practices, and the global vision of sustainable development. This article is the first bibliometric study to specifically link Self-Regulated Learning (SRL) in physics to the Sustainable Development Goals (SDGs).

RESEARCH METHOD

Types of research

This research used a quantitative descriptive approach, a type of research that systematically and measurably describes or explains a phenomenon using numerical data (Barroga et al., 2023). The research focuses on the findings and analysis of phenomena based on data. A bibliometric analysis study used data from the Scopus database to map trends and focus on Self-Regulated Learning (SRL) research in international literature (Lintangesukmanjaya et al., 2025). The search included sources, document counts, trends, and the relationships among keywords focused on research topics related to Self-Regulated Learning (SRL) in physics and the Sustainable Development Goals (SDGs).

Through a process consisting of analyzing, mapping, and evaluating scientific developments based on scientific publication data, such as journal articles, proceedings, or books. The bibliometric approach focuses on quantitative measurements of bibliographic information, such as the number of publications, citations, author collaborations, keywords, and research topic trends (Mejia et al., 2021). Through bibliometric analysis, researchers can identify the direction of development in a scientific field, identify the most influential researchers and journals, and assess future research connections and potential. Thus, bibliometric research not only objectively depicts the knowledge map but also helps determine more targeted and impactful research strategies and scientific policies (Pessin et al., 2022).

Figure 1. Research flowchart

Research Samples

Sample selection was aided by the use of PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). In bibliometric research, PRISMA helps ensure transparency, clarity, and accuracy in the selection of publications for analysis (Pakdel & Erol, 2025). Through the PRISMA process, researchers can systematically demonstrate the stages of search, screening, eligibility, and the number of articles ultimately used in bibliometric analysis.

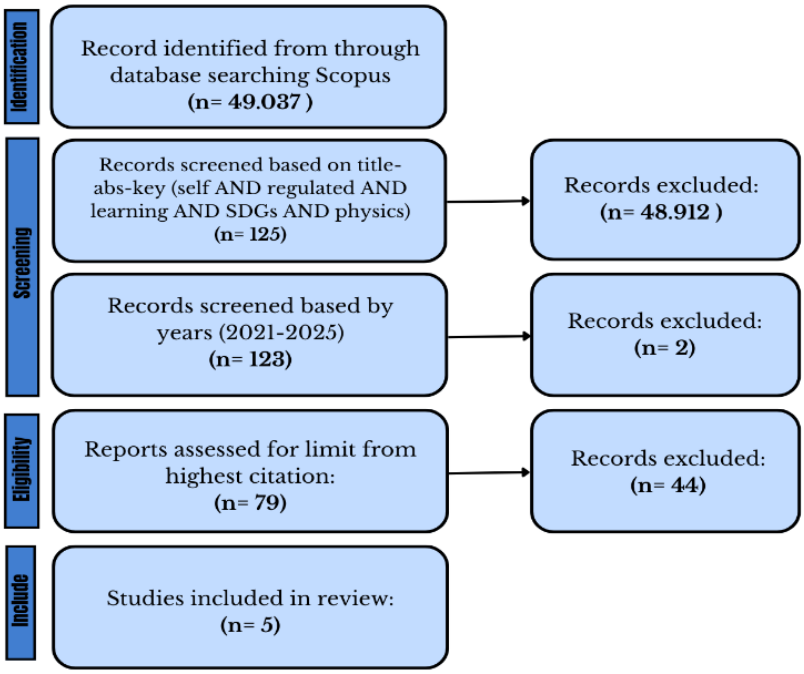

Figure 2. PRISMA diagram

A PRISMA diagram helps readers understand how data are obtained and filtered from databases such as Scopus or Web of Science, and the reasons for excluding certain documents. Thus, implementing PRISMA ensures that the data collection and selection process in bibliometric research is structured, reproducible, and free from selection bias (Pham & Le, 2024; Lintangesukmanjaya et al., 2025).

Analysis Techniques

The data analysis technique used in this study is a quantitative descriptive research approach. Data analysis techniques in bibliometric research involve quantitatively processing scientific publication data to describe trends, patterns, and relationships among knowledge elements such as authors, institutions, journals, keywords, and citations (Kumar et al., 2023). In the bibliometric context, the analysis was conducted using VOSviewer software to produce visualizations of collaboration networks, research topic maps, and publication distribution (Cheng et al., 2021). The results of this analysis then describe scientific phenomena measurably and descriptively, for example, increasing research trends in a particular field or relationships between topics, thus providing a deeper understanding of future research developments and directions.

RESULTS AND DISCUSSION

Results

A preliminary study used bibliometric analysis of documents from the Scopus database over the past five years (Wang et al., 2022). This analysis used the keywords "self AND regulated AND learning AND SDGs AND physics." The results show research trends in Self-Regulated Learning (SLR) related to physics in achieving the Global Development Goals (SDGs). This study found the highest number of citations in 2024, totaling 185 and 15 documents.

Table 1. Number of documents and citations in 5 years

Years	Doc	Citation
2021	9	15
2022	11	88
2023	21	208
2024	39	593
2025	43	806

SLR studies are most frequently found in international literature sources, primarily in articles, totaling 26 documents. Independent learning, particularly within the SLR approach, has been shown to improve the quality of education significantly. The relevance of the keywords in this study has the potential to enhance SLR research, particularly in physics. This is because physics is a highly challenging subject that requires students to adopt an independent approach to become accustomed to it. Another finding from the Scopus database analysis is that several countries consistently review research on SLR and the SDGs in physics. The following map shows the top 10 countries contributing to research and discussion on SLR and the SDGs in physics.

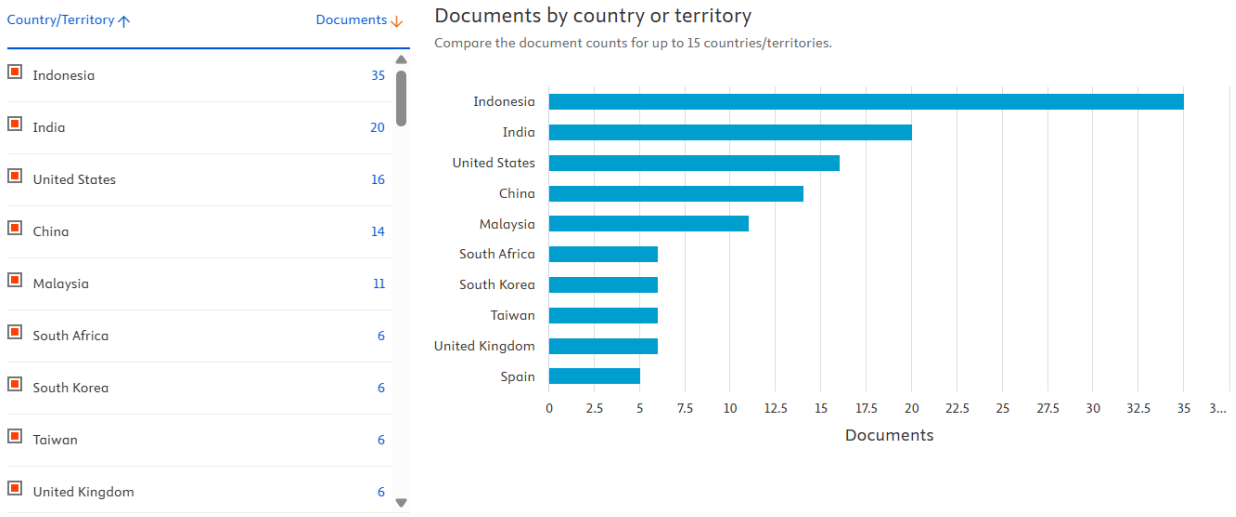

Figure 4. Distribution of TOP 10 countries in research

In developed countries, Self-Regulated Learning (SRL) is considered crucial because it lays the foundation for developing independent and adaptable learners who can adapt to rapid changes in science and technology. The country that contributes the most is

country n. Cultivating SRL from an early age trains the education system in developed countries to foster sustainable learning independence. This demonstrates the highly relevant relationship between each keyword in the trends and the potential of Self-Regulated Learning (SRL) in Physics and the SDGs.

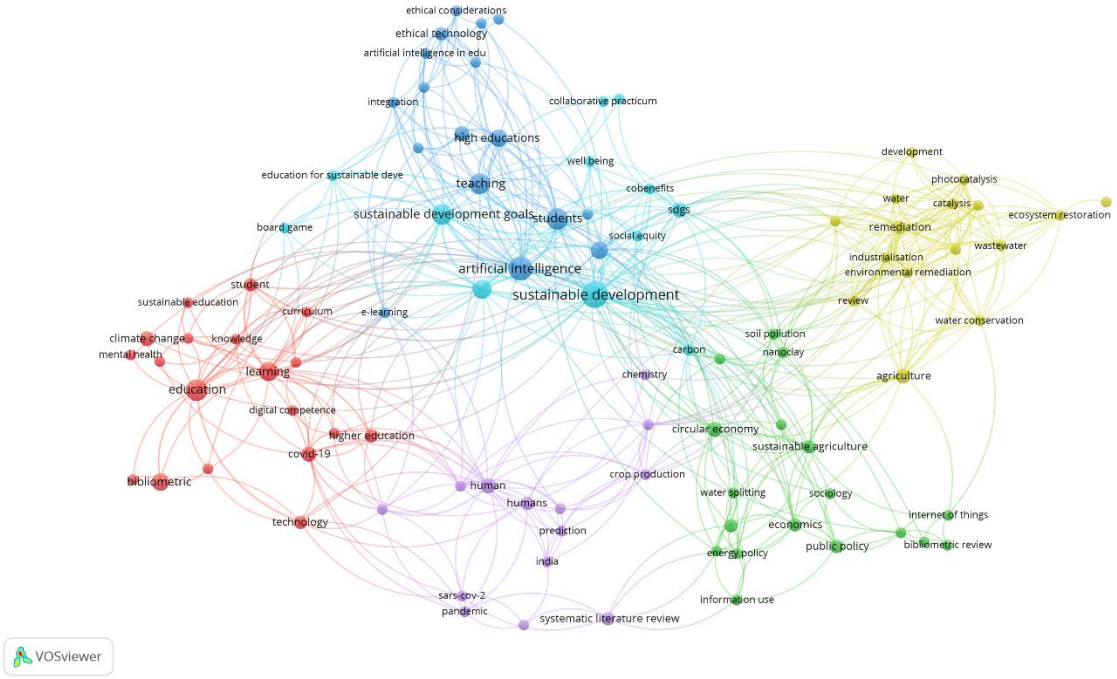

Figure 5. Keywords overview

Bibliometric analysis shows that each keyword is interrelated. This is particularly evident in the relationship between SRL and the SDGs, particularly SDG 4, as shown in Figure 5. The relationship between Self-Regulated Learning (SRL) and the Sustainable Development Goals (SDGs), particularly in the learning and technology integration aspects, lies in efforts to realize quality and sustainable education (SDG 4) that encourages students' independence, creativity, and digital literacy. SRL helps students actively set learning goals, choose appropriate strategies, and utilize technology effectively in the learning process. The integration of technologies such as online learning, interactive platforms, and learning analytics strengthens the role of SRL by providing a flexible, adaptive learning space tailored to individual needs (Citation). Through this synergy, learning not only becomes more personalized and meaningful but also fosters lifelong learners who can contribute to sustainable development in the digital era.

Table 1. Keyword distribution

Keyword	Occurrence	Total link strength
Sustainable development	12	56
Artificial intelligence	10	37
Sustainable development goal	6	37
Sustainable development goals	7	32
Students	8	30

Keyword	Occurrence	Total link strength
Learning	6	29
Teaching	7	29
Remediation	3	27
Education	8	25
Agriculture	4	24

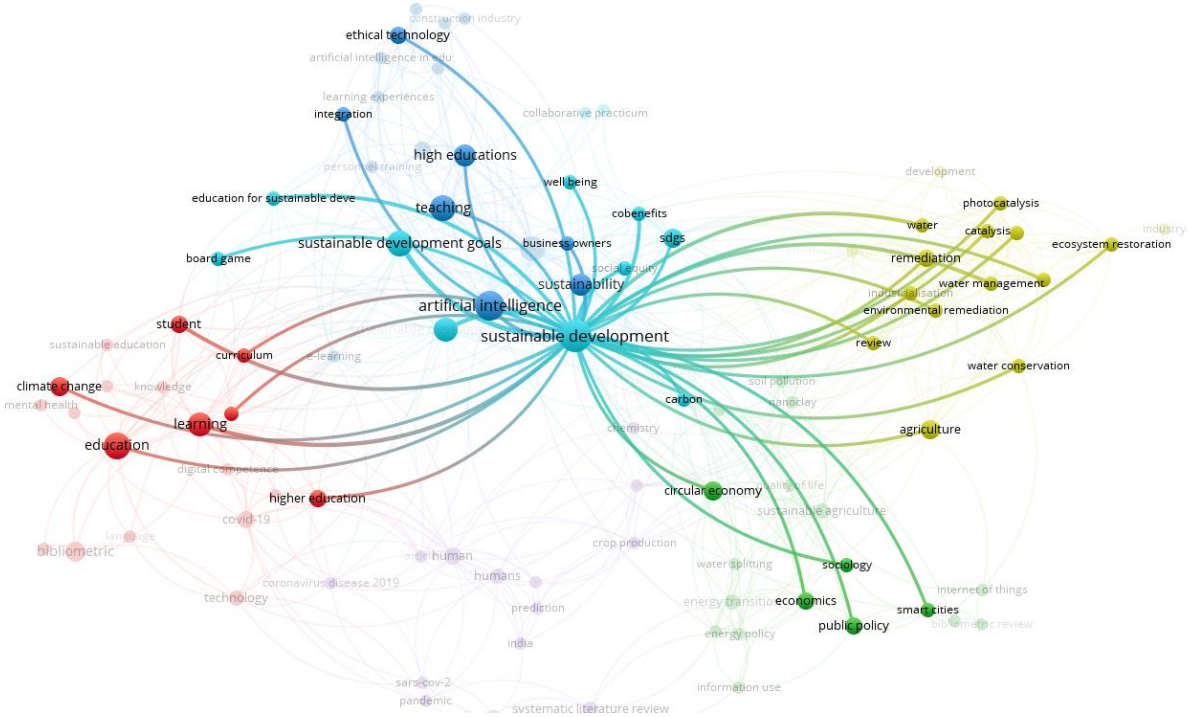

Figure 6. The relationship between SLR and SDGs

Self-Regulated Learning (SRL) is closely linked to physics learning because both emphasize active, reflective, and problem-solving thinking processes. Physics, as a science that demands conceptual understanding and application skills, requires students to be able to regulate their own learning strategies, such as planning how to understand difficult concepts, monitoring calculation errors, and evaluating experimental results (citations). By applying SRL principles, physics students can develop metacognition to understand natural phenomena in depth. Furthermore, SRL helps students adapt to inquiry-based and technology-based learning approaches, which are now widely used in modern physics. Thus, the integration of SRL in physics learning not only improves learning outcomes but also shapes the profile of young scientists who are independent, reflective, and ready to face the challenges of 21st-century science.

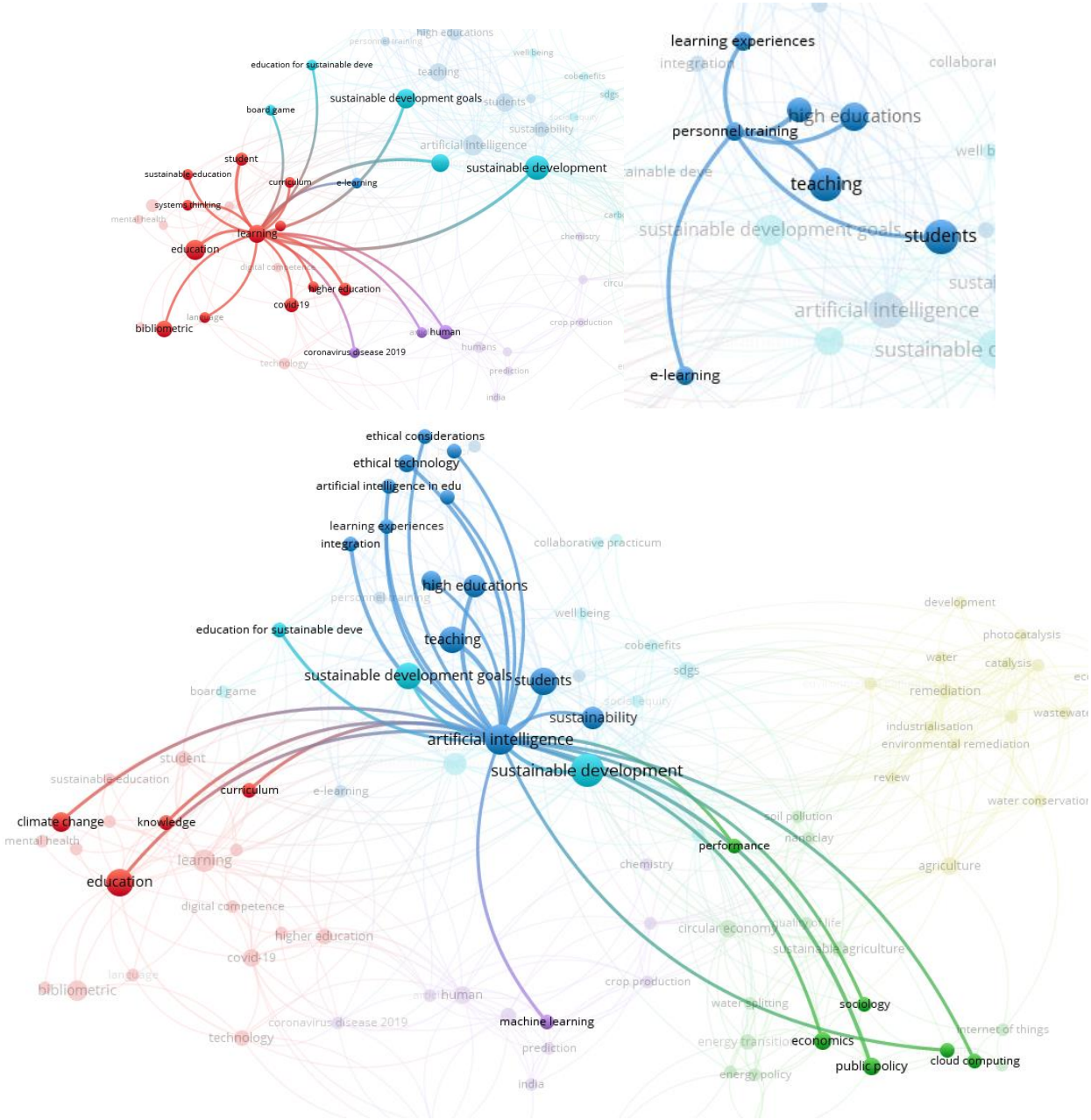

Figure 7. The relationship between learning through technology and physics

Based on the results obtained in the bibliometric analysis, a systematic literature review was conducted using the top five most cited articles. The findings were analyzed based on the need for and depth of SLR and SDGs material in physics topics.

Table 2. Top 5 Articles with the Highest Citations

Author (Years)	SJR; Citation	Findings
Delmotte et al., 2022	87.38 (Book); 426	The importance of scientific understanding of climate change aligns with the direction of Physics learning development, which encourages Self-Regulated Learning (SRL), thereby strengthening students' ability to understand, analyze, and make decisions based on scientific data regarding global issues such as 1.5°C warming.

Author (Years)	SJR; Citation	Findings
Matthias et al., 2021	3.463 (Q1); 192	Gully erosion is a significant form of land degradation that remains under-recognized in environmental policy and management. This study emphasizes the importance of an integrated scientific and policy approach to understanding, predicting, and sustainably controlling gully erosion globally. It emphasizes the importance of scientific skills, data analysis, and evidence-based decision-making, which are also core competencies for Self-Regulated Learning (SRL) in Physics.
Najmul et al., 2023	0.849 (Q1); 149	The integration of Internet of Things (IoT) and Wireless Sensor Networks (WSNs) technologies has been shown to increase efficiency. This study highlights the importance of implementing wireless networking protocols such as Zigbee, Wi-Fi, Sigfox, and LoRaWAN for real-time data collection. It emphasizes the need for innovative, adaptive strategies to realize efficient, sustainable intelligent systems. Mastery of physics and technology concepts that encourage independent learning in developing innovative, sustainable solutions in accordance with the SDGs targets.
Chunfei et al., 2024	2.097 (Q1); 112	Various approaches, such as chemical absorption, solid sorbents, and membrane technology, show great potential but still face challenges in energy efficiency, high costs, and industrial-scale implementation. Therefore, further research is focused on improving material performance, regeneration efficiency, and economic analysis so that these technologies can significantly contribute to the net-zero emissions target. The link to Self-Regulated Learning (SRL), technology, and the SDGs lies in mastering the scientific concepts and critical thinking skills needed to understand and develop innovative carbon capture technologies..
Akshay et al., 2023	3.394 (Q1); 90	The findings of this study indicate that the Problem-Based Learning (PBL) model is effective in developing students' critical thinking skills, particularly in the social sciences. Most of the research was conducted at universities in Asia, with Indonesia as the most significant contributor, and used a quantitative approach. The literature review also revealed that implementing PBL not

Author (Years)	SJR; Citation	Findings
		only improves critical thinking skills but also has the potential to influence other variables that support independent and active learning.

Discussion

Self-Regulated Learning (SRL) plays a strategic role in supporting the achievement of the Sustainable Development Goals (SDGs), particularly Goal 4 (Quality Education) (Demir, 2024). The SRL approach encourages students to independently regulate, monitor, and evaluate their learning, resulting in individuals with metacognitive awareness, intrinsic motivation, and a sense of responsibility for their learning. These abilities are core 21st-century competencies, essential for realizing an inclusive, adaptive, and future-oriented education system (Sain et al., 2024).

The integration of SRL into physics learning not only improves academic achievement but also fosters creativity, critical thinking, and problem-solving skills, which are essential competencies for addressing global sustainability challenges. Physics, which presents a high level of difficulty in understanding the material, requires a Self-Regulated Learning (SRL) approach (Abtokhi et al., 2021). Thus, SRL has the potential to strengthen sustainable development efforts by developing students who are not only knowledgeable but also socially aware and responsible for advancing society and the environment. Therefore, SRL is an important foundation for building education that is relevant to the demands of the SDGs and capable of producing a generation of learners who are both competitive and sustainability-oriented.

The relevance and innovation of the SRL learning model for future research are evident in the findings of the systematic literature review presented in Table 2. The future development of Self-Regulated Learning (SRL) is closely linked to the Problem-Based Learning (PBL) and Inquiry learning models, as all three emphasize independence, investigation, and authentic problem-solving. In PBL, students actively plan problem-solving strategies, monitor progress, and reflect on solutions, thus directly activating the SRL cycle (Akshay et al., 2023). Meanwhile, inquiry learning requires students to ask questions, test hypotheses, and conclude, which aligns with the planning, monitoring, and self-evaluation processes in SRL (Dan et al., 2025). By integrating the three, future research has the potential to develop a hybrid learning model that strengthens students' metacognitive abilities, creativity, and scientific literacy, while providing a more effective and relevant physics learning approach that meets the demands of 21st-century competencies. This approach can be balanced with the use of relevant technology.

In the context of technological innovation, the integration of Artificial Intelligence (AI) and Internet of Things (IoT) systems opens new opportunities to strengthen the implementation of SRL in more adaptive and personalized ways (Najmul et al., 2023). AI can be utilized to provide automated feedback, detect learning patterns, recommend learning strategies, and facilitate student reflection through intelligent learning analytics (Chang et al., 2023). Meanwhile, IoT devices such as laboratory sensors, smart-lab kits, or

digital measuring instruments enable students to conduct physics experiments in real time while monitoring their learning process through data directly connected to the learning system. This combination of AI and IoT can create a learning ecosystem that supports more accurate planning, monitoring, and self-evaluation, thereby strengthening SRL while delivering more interactive, independent, and data-driven physics learning.

Based on the increasing trend in international research using the SRL approach in science learning, especially in physics, future research directions hold great potential to integrate technologies such as AI and IoT devices into SRL to support the achievement of the Sustainable Development Goals (SDGs). Analysis of self-awareness and learning motivation can also be included in the Self-Regulated Learning (SRL) approach through a learner-centered learning model. This is a finding in innovative learning planning focused on self-satisfaction in the era of technology adoption.

CONCLUSION

Fundamental Finding: There is a global research trend in SRL and physics learning that supports the SDGs. The number of documents and citations increased from 2020 to 2025, resulting in 123 Scopus documents, with the highest number of citations in 2024 reaching 185. The findings of the bibliometric analysis identified three main aspects of SRL research on physics materials and their impact on the SDGs: the use of AI technology, relevant learning models, and the learning process. **Implication:** Future research has significant potential in integrating technologies such as AI and IoT devices into SRL to support the achievement of the Sustainable Development Goals (SDGs). Self-awareness and learning motivation evaluation analysis can also be incorporated into the Self-Regulated Learning (SRL) approach through a learner-centered learning model. **Limitation:** Bibliographic analysis reveals that findings relevant to SRL in physics are minimal. The research reviewed has not yet identified the appropriateness and standard indicators for SRL, necessitating an in-depth study to determine more logical and relevant aspects. **Future Research:** Analysis of self-awareness evaluation and learning motivation in 21st-century learning can be a relevant topic for study and linked to modern technology-based SRL.

AUTHOR CONTRIBUTIONS

Rahmatta Thoriq Lintangesukmanjaya contributed to the conceptual framework, research design, and validation process; **Binar Kurnia Prahani & Dwikoranto** was involved in methodology development, data analysis, sourcing references, and drafting the manuscript; **Hidayatul Latifah & Neisya Azaria Adinda Putri** handled data management, project coordination, and manuscript drafting. All listed authors have reviewed and approved the final version of this submission.

CONFLICT OF INTEREST STATEMENT

The authors confirm that there are no conflicts of interest, either financial or personal, that may have influenced the content or outcome of this study.

ETHICAL COMPLIANCE STATEMENT

This manuscript complies with research and publication ethics. The authors affirm that the work is original, conducted with academic integrity, and free from any unethical practices, including plagiarism.

STATEMENT ON THE USE OF AI OR DIGITAL TOOLS IN WRITING

The authors acknowledge the use of digital tools, including AI-based technologies, as support in the research and writing stages of this article. Specifically, Grammerly was employed for digital assistance were critically evaluated and revised to ensure academic rigor and ethical standards were upheld. The final responsibility for the manuscript rests entirely with the authors.

REFERENCES

Abtokhi, A., Jatmiko, B., & Wasis, W. (2021). Evaluation of self-regulated learning on problem-solving skills in online basic Physics learning during the COVID-19 pandemic. *Journal of Technology and Science Education*, *11*(2), 541-555. https://www.jotse.org/index.php/jotse/article/view/1205

Adow, A. H. E., Safeer, M. M., Mohammed, M. G., Alam, M. S., & Sulphey, M. M. (2024). A synthesis of academic literature on eco-spirituality. *Global Journal of Environmental Science and Management*, *10*(4), 2163-2178.

Ambaryani, S. E., & Putranta, H. (2022). Improving learners' metacognitive skills with self-regulated learning based problem-solving. International Journal of Instruction, 15(2), 139-154. https://doi.org/10.29333/iji.2022.1528a

Auwalu, F. K., & Bello, M. (2023). Exploring the contemporary challenges of urbanization and the role of sustainable urban development: A study of Lagos City, Nigeria. *Journal of Contemporary Urban Affairs*, *7*(1), 175-188. https://doi.org/10.25034/ijcua.2023.v7n1-12

Barroga, E., Matanguihan, G. J., Furuta, A., Arima, M., Tsuchiya, S., Kawahara, C., ... & Izumi, M. (2023). Conducting and writing quantitative and qualitative research. *Journal of Korean medical science, 38*(37). https://doi.org/10.3346/jkms.2023.38.e291

Chang, D. H., Lin, M. P. C., Hajian, S., & Wang, Q. Q. (2023). Educational design principles of using AI chatbot that supports self-regulated learning in education: Goal setting, feedback, and personalization. *Sustainability*, *15*(17), 12921. https://doi.org/10.3390/su151712921

Cheng, P., Tang, H., Dong, Y., Liu, K., Jiang, P., & Liu, Y. (2021). Knowledge mapping of research on land use change and food security: a visual analysis using CiteSpace and VOSviewer. *International Journal of Environmental Research and Public Health, 18*(24), 13065. https://doi.org/10.3390/ijerph182413065

Dan, Q., Yin, H., & Bai, B. (2025). Three paradigms of inquiry into self-regulated learning (SRL): a critical analysis and ways to transformative and integrated practices. *Asia Pacific Education Review*, *26*(3), 749-761. https://doi.org/10.1007/s12564-025-10035-4

Delmotte, M. V., Pörtner, H.-O., Skea, J., Zhai, P., Roberts, D., & lainnya. (2022). *Global warming of 1.5°C: An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of*

strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. Cambridge University Press. https://doi.org/10.1017/9781009157940

Demir, K. (2024). Future of undergraduate education for sustainable development goals: Impact of perceived flexibility and attitudes on self-regulated online learning. *Sustainability, 16*(15), 6444. https://doi.org/10.3390/su16156444

Hamdan, W., & Alsuqaih, H. (2024). Research output, key topics, and trends in productivity, visibility, and collaboration in social sciences research on COVID-19: A scientometric analysis and visualization. *Sage Open, 14*(4), 21582440241286217. https://doi.org/10.1177/21582440241286217

Heryani, T. P., Suwarma, I. R., & Chandra, D. T. (2023). Development of STEM-based physics module with self-regulated learning to train students critical thinking skills. *Jurnal Penelitian Pendidikan IPA, 9*(6), 4245-4252. https://doi.org/10.29303/jppipa.v9i6.3578

Imara, K., & Altinay, F. (2021). Integrating education for sustainable development competencies in teacher education. *Sustainability, 13*(22), 12555. https://doi.org/10.3390/su132212555

Kramarski, B., & Heaysman, O. (2021). A conceptual framework and a professional development model for supporting teachers'"triple SRL–SRT processes" and promoting students' academic outcomes. *Educational Psychologist, 56*(4), 298-311. https://doi.org/10.1080/00461520.2021.1985502

Kumar, M., George, R. J., & PS, A. (2023). Bibliometric analysis for medical research. *Indian Journal of Psychological Medicine, 45*(3), 277-282. https://doi.org/10.1177/02537176221103617

Kumar, T., Soozandehfar, S. M. A., Hashemifardnia, A., & Mombeini, R. (2023). Self vs. peer assessment activities in EFL-speaking classes: Impacts on students' self-regulated learning, critical thinking, and problem-solving skills. *Language Testing in Asia, 13*(1), 36. https://doi.org/10.1186/s40468-023-00251-3

Lintangesukmanjaya, R. T., Dwikoranto, D., Awwalina, D. P., Setiani, R., & Bergsma, L. N. (2025). Potential study SDGs 4 of deep learning approaches to improve problem solving with machine learning inovation: Empirical and bibliometric analysis. *In E3S Web of Conferences,* 640, 02018. EDP Sciences. https://doi.org/10.1051/e3sconf/202564002018

Lintangesukmanjaya, R. T., Prahani, B. K., Alifah, D. R. Z. Z., & Wicaksono, I. (2025). Bibliometric analysis of physics learning studies: Focus on differentiation and problem solving strategies. *Journal of Law and Bibliometrics Studies, 1*(1), 42-42. https://doi.org/10.63230/jolabis.1.1.42

Lintangesukmanjaya, R. T., Prahani, B. K., Dwikoranto, D., Alhusni, H. Z., & Kurtuluş, M. A. (2025). Technology integration for SDGs-oriented social science education: A bibliometric perspective. *In E3S Web of Conferences*, 640, 02017. https://doi.org/10.1051/e3sconf/202564002017

MASJUDIN, M. (2024). Strengthening 21st century skills through an independent curriculum in mathematics education in Indonesia: Challenges, potential, and strategies. *International Journal of Applied Science and Sustainable Development (IJASSD), 6*(2), 92-113. https://doi.org/10.36733/ijassd.v6i2.9087

Mejia, C., Wu, M., Zhang, Y., & Kajikawa, Y. (2021). Exploring topics in bibliometric research through citation networks and semantic analysis. *Frontiers in Research Metrics and Analytics, 6*, 742311. https://doi.org/10.3389/frma.2021.742311

Molenaar, I., de Mooij, S., Azevedo, R., Bannert, M., Järvelä, S., & Gašević, D. (2023). Measuring self-regulated learning and the role of AI: Five years of research using multimodal multichannel data. *Computers in Human Behavior, 139*, 107540. https://doi.org/10.1016/j.chb.2022.107540

Ng, D. T. K., Tan, C. W., & Leung, J. K. L. (2024). Empowering student self-regulated learning and science education through ChatGPT: A pioneering pilot study. *British Journal of Educational Technology, 55*(4), 1328-1353. 10.1111/bjet.13454

Nilimaa, J. (2023). New examination approach for real-world creativity and problem-solving skills in mathematics. *Trends in Higher Education, 2*(3), 477-495. https://doi.org/10.3390/higheredu2030028

Öz, E., & Şen, H. Ş. (2021). The effect of self-regulated learning on students'lifelong learning and critical thinking tendencies. *Elektronik Sosyal Bilimler Dergisi, 20*(78), 934-960. https://doi.org/10.17755/esosder.821097

Pakdel, J., & Erol, I. (2025). Scrutinizing challenges to adopting digital technologies in the mining industry: A systematic review through PRISMA and bibliometric analysis. *Resources Policy, 109*, 105713. https://doi.org/10.1016/j.resourpol.2025.105713

Pessin, V. Z., Yamane, L. H., & Siman, R. R. (2022). Smart bibliometrics: an integrated method of science mapping and bibliometric analysis. *Scientometrics, 127*(6), 3695-3718. https://doi.org/10.1007/s11192-022-04406-6

Pham, X. L., & Le, T. T. (2024). Bibliometric analysis and systematic review of research on expert finding: A PRISMA-guided Approach. *The International Arab Journal of Information Technology, 21*(4). https://doi.org/10.34028/iajit/21/4/9

Sain, Z. H., Baharun, H., Islamiyah, D. F., Prasetiya, B., & Habibu, M. L. (2024). Revolutionizing education: Building 21st-century skills for an inclusive, sustainable future. *Journal of Multidisiplinary, 1*(2), 88-94. https://ssrpublisher.com/ssrjm/

Sulistiawati, S., Kusumah, Y. S., Dahlan, J. A., Juandi, D., & Vos, H. (2023). A bibliometric analysis: Trend of studies in self-regulated learning over the past three decades. *Indonesian Journal on Learning and Advanced Education (IJOLAE),* 178-197. https://doi.org/10.23917/ijolae.v5i2.21381

*Rahmatta Thoriq Lintangesukmanjaya (Corresponding Author)
Postgraduate Physics Education,
Universitas Negeri Surabaya
Jl. Ketintang, Ketintang, Kec. Gayungan, Surabaya, Jawa Timur 60231
24031635011@mhs.unesa.ac.id

Binar Kurnia Prahani
Postgraduate Physics Education,
Universitas Negeri Surabaya
Jl. Ketintang, Ketintang, Kec. Gayungan, Surabaya, Jawa Timur 60231
binarprahani@unesa.ac.id

Dwikoranto
Postgraduate Physics Education,
Universitas Negeri Surabaya
Jl. Ketintang, Ketintang, Kec. Gayungan, Surabaya, Jawa Timur 60231
dwikoranto@unesa.ac.id

Hidayatul Latifah
Undergraduate Physics Education,
Universitas Negeri Surabaya
Jl. Ketintang, Ketintang, Kec. Gayungan, Surabaya, Jawa Timur 60231
24030184049@mhs.unesa.ac.id

Neisya Azaria Adinda Putri
Psikoloji Bölümü, Edebiyat Fakültesi
Sivas Cumhuriyet Üniversitesi
Sivas Cumhuriyet Üniversitesi 58140 KAMPÜS/SİVAS.
neisyaazaria@gmail.com