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Inovation In History Learning Through The STEAM Approach: Systematic Literature Review

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Abstract*: The research focuses on analyzing the effectiveness of the STEAM approach in history learning as well as learning strategies that are compatible with the STEAM approach. The purpose of this study is to find out whether the integration of the STEAM approach can improve students' history learning. To analyze this, the research method used is the Systematic Literature Review (SLR) developed by Zawacki-Richter. The following are the stages, namely: developing research questions, determining selection criteria, developing the search strategy, the study selection process, and appraising the quality of studies. The selection process is carried out through inlusion and exclusion activities with predetermined criteria. A total of 50 articles in 2020-2025 were then identified regarding abstracts, research objectives, methodological background, and research results. The data collected revealed 10 relevant articles. The results of this study are to prove the effectiveness of the STEAM approach in learning through previous research. The analysis of the results of previous research shows consistent results of increasing history learning assisted by learning strategies. This study highlights the integration of STEAM elements in history learning as an interdisciplinary science capable of producing positive impacts. The STEAM approach allows students to explore the concept of history by integrating other sciences so that they are relevant to historical sciences that cannot stand alone. The implication of this study is that educators should consider incorporating the STEAM learning approach in their history teaching, as this approach is able to support the understanding of history.*

Keywords— STEAM, History Learning, Learning Outcomes

1. INTRODUCTION (*Heading 1*)

Studying material about history is important because it is useful in life. History learning has an important role in the educational curriculum to foster national identity (Sopacua et al., 2020). The definition of history learning is as a science that studies human objects in the dimensions of space and time, a dialogue between the past, present, and future. (Kochar, 2008). In the era Globalization encourages students to have competence in the 21st century. So that learning is designed to prepare students to have 4C skills in the form of: (1) *critical thinking and problem solving*, (2) *creativity*, (3) *collaboration*, and (4) *communication* (Mahumot et al., 2020). History learning in the 21st century has an important role because it is able to foster 4C skliss skills (Umamah et al., 2021; Ma'rifatullah et al., 2021;Farizi S. F et al., 2023). Therefore, learning history is needed to understand the values contained in important events in the past and cultivate the skills needed today. History learning will be more optimal if educators integrate technology in the 21st century.

Generation-Z tends to use technology to make their lives easier. Births in 1995 to 2012 are categorized as Generation Z (Chan & Lee, 2023). Generation Z is a generation that is technologically literate, so educators must innovate so that students can learn effectively and efficiently. Students' innovative abilities can be improved if educators use technology (Umamah et al.,2020.; Umamah et al., 2021). In line with history learning, educators are obliged to innovate so that learning runs optimally. Integrating technology with history materials makes learning History more meaningful(Nur Aeni Marta et al., 2023). Technology helps students in improving adaptive abilities in learning so as to improve learning outcomes (Sholehah et al., 2023). Integrating technology in history learning helps educators in teaching.

However, in fact, the results of previous research stated that the level of thinking in history subjects is still low. Based on research observations from Herlinatus Sholelah, it was concluded that as many as 48.8% of the thinking ability in the subject of History was relatively low (Sholehah et al., 2023). History learning should ideally not only memorize historical facts, but students must be able to memorize these events (Sumardi et al., 2024). This situation needs to be studied by updating and improving learning strategies. Educators need to plan learning that helps improve historical understanding (Kamza et al., 2023). In fact, there are still obstacles faced by teachers in optimizing history learning. A similar phenomenon due to the inherent teacher-centered teaching method also creates obstacles (Kesuma et al., 2020). The low achievement of learning outcomes in history is due to the fact that the learning approach has not been able to encourage students' understanding.

After analyzing the importance of learning history and the various obstacles that are encountered. This study recommends innovation in history learning using the STEAM approach. The STEAM approach in the past five years has begun to be widely applied in learning. STEAM is a cross-disciplinary approach that integrates Science, Technology, Engineering, Arts, and Mathematics (Bozkurt Altan & Tan,

2021)(Conradty et al., 2020). The STEAM approach is one of the educational strategies that is considered able to answer the challenges of the 21st century (Mustoip et al., 2024; Yeomans et al., 2025; Ozkan & Umdu Topsakal, 2021). Role *Art* or art in STEAM encourages creative and innovative thinking in learning through engagement, imagination and communication (Conradty et al., 2020; Aguilera & Ortiz-Revilla, 2021; Filipe et al., 2024). The Technology component helps students to innovate in the rapid globalization. STEAM in history learning is able to improve historical thinking and learning outcomes (Lestari et al., 2023; Amanova et al., 2025) , History teachers are one of the pillars to continue to understand the STEAM approach because educators must realize that the science of history does not stand alone, but is also related to other sciences such as STEAM (Adifta et al., 2022)(Adifta et al., 2022) . Thus, the STEAM approach is able to have a positive impact on history learning.

Previous research from South Korea has succeeded in integrating history learning by combining historical narratives with STEAM analysis so that learning is more meaningful (Park & Cho, 2022a). STEAM encourages creativity and problem-solving (Perales & Aróstegui, 2024; The Bedewy et al., 2024). The application of this approach by integrating elements of STEAM in the history material, provides students with a holistic understanding. The implementation of STEAM through PjBL has proven to be effective in increasing students' creativity, collaboration, and communication skills (Nur Aeni Marta et al., 2023). The application of RBL-STEAM with the help of VR technology media is also able to increase historical thinking (Sumardi et al., 2024). Thus, the STEAM approach in history learning has proven to be effective. However, until now there has been no systematic literature review on STEAM in history learning to assess its effectiveness.

Based on this background, this study aims to compile a systematic literature review on the STEAM approach in history learning and analyze its effectiveness at the primary and secondary school levels. This research was carried out as an initial step to analyze the STEAM approach that is able to face challenges in the 21st century with a focus on history learning.

2. RESEARCH METHODS

The research emphasizes the importance of learning History for students by examining the STEAM approach as a solution approach to overcome these problems, the research uses qualitative and quantitative approaches through the Systematic Literature Review (SLR), which refers to the stages developed by Zawacki-Richter et al. (2020), includes: developing research questions, setting selection criteria, developing the search strategy, the study selection process, and appraising the quality of studies, so that the research design is systematic and based on analysis document. The first stage is Database Selection, which is selecting a credible literature search source. Articles are searched through search engines such as Google Scholar and in a variety of accredited international journals. By entering relevant keywords with the research title in the form of: "STEAM*" and "History*" and "Historical*" and "Learning*" and "Art*". At the Paper Screening stage, inclusion criteria are applied in the form of articles that discuss the STEAM approach in History learning at the secondary and secondary education levels, published between 2020–2025, and available in accessible or *Open Access*. The exclusion criteria include articles that are not relevant to the topic, published before 2020, or are inaccessible so the article is locked. After that, Data Extraction and Synthesis is carried out, which is the retrieval and interpretation of information that has been collected which focuses on studying the STEAM approach in learning History. At this stage, the author compiles data in the form of methods, population stamps, research results, and the form of intervention used. Furthermore, at the Data Presentation stage, the data that has been collected is arranged in a table format and descriptive narrative to facilitate the mapping of the main findings of each study. Finally, Data Analysis and Interpretation was carried out by synthesizing all findings, evaluating the quality of the study based on the reputation of the journal, the clarity of the problem formulation, and the suitability of the research method to the purpose of effectiveness and impact of the STEAM approach in learning History at the secondary and higher education levels to lectures.

3. RESULTS AND DISCUSSION

The results and writing in this paper are presented in the form of a systematic review developed by Zawacki-Richter et al. (2020), including: the formulation of research questions (develop research questions), the determination of selection criteria (developing the search strategy), the study selection process (the study selection process), and appraising the quality of studies (appraising the quality of studies) thus the author is able to sort and analyze the data of the article that is revealed with the title of the research. The following are the results and discussion of this research:

1. Develoving the Search Strategy

At this stage, the author conducts a process of identifying and selecting sources in the Systematic Literature Review (SLR) methodology. The source search in writing this article was carried out through international journal platforms such as Spinger, ERIC, and Google Scholar. The author's reason for using Google Scholar is to find out the conditions for the implementation of the STEAM approach in Indonesia. The process of searching article data produces 50 articles that match the title, so in the next stage of the screening process, the number of valid articles remains as much as 50 arikel.

2. Selection Criteria

Articles at this stage will investigate the selection criteria for inclusion and exclusion from 50 articles. The results of the analysis showed that 10 articles met the inclusion criteria, which included: (1) research topics in accordance with the

title of the discussion, namely about the STEAM approach in learning History, (2) the publication period within 2020-2025, (3) articles can be accessed (4) in English and Indonesian. As for the criteria (exclusion) include: (1) articles that are not relevant to the research topic according to the title of the discussion, namely regarding the STEAM approach in learning History, with a total of 28 (2) articles published outside the range of 2020–2025 with a total of 3, (3) limited access as many as 10, (4) not in English and Indonesian 5. Therefore, 10 scientific articles can be obtained that examine the STEAM approach in learning History.

3. The Study Process

Articles that have passed the selection are analyzed again regarding abstracts and research results to assess suitability. The results of the review showed that there were 10 articles that met the criteria, with no articles eliminated.

4. The Quality of Studies

There are 10 scientific articles that have met the criteria that have been created, so the answer is "yes" in the following questions, namely: (QA1) whether the article was taken through a reputable journal, (QA2) whether the research results are in accordance with the author's topic variables, (QA3) whether the method used is able to develop STEAM research in learning History. With demiikan, articles collected through a rigorous process produce accurate data

5. Synthesis Result

The last stage is data synthesis, which aims to integrate findings from selected studies to answer research questions. This study asks two main questions, namely: (Q1) How effective is the STEAM approach in history learning implemented? (Q2) What learning strategies are suitable to be integrated with STEAM in history learning? The following questions of the researcher and their answers resulting from this systematic study are presented as follows:

4.1 Q1: How is the effectiveness of the STEAM approach in history learning implemented?

Based on a systematic literature review of 10 aerticels that examined the STEAM approach in learning History, a positive impact was obtained in the article. Reviewed through the results of the study, there was an increase in students' skills after the implementation of STEAM. The explanation in more detail, namely;

The first article researched by (Lestari et al., 2023) with the title "*STEAM: Science, Technology, Engineering, Art, and Mathematics on History Learning in the 21st Century*". The results of the study found that STEAM was able to improve 21st century learning in History learning. The method used is qualitative by conducting observations and interviews. The application of STEAM in History learning provides a holistic understanding through learning experiences in the 21st century.

Second article of (Sumardi et al., 2024) with the title "*The implementation of RBL-STEAM with pictorial riddle and augmented reality in improving students' historical thinking skill*". This article integrates the RBL-STEAM approach into History learning using the Assemblr-Edu (AR) medium to enhance History thinking. The method used is Pictoral Riddle by combining qualitative and quantitative approaches. The results obtained showed a positive impact as evidenced by the analysis of pretest and posttest data from the SPSS application with an Independent T test. The results of the test showed a significant Sig value of 0.015 (<0.05).

The third article of (Pratama et al., 2022) with the relevant title which is "*Integration of STEM education in history learning*". The results of the study explained that educators are able to foster new innovations through STEAM learning in History subjects. The method used is qualitative with techniques and case studies taken through 4 schools. The findings in the article are that teachers are able to cultivate historical skills, namely historical thinking by integrating the STEAM approach in their learning.

The fourth article of (Boice et al., n.d.) entitled "*Exploring teachers' understanding and implementation of STEAM: one size does not fit all*". This article focuses on the development of professional learning of History teachers. The method used is a supplement by implementing the teacher program that has been created by the researcher. The results of the study stated that after the covid-19 period, the implementation of learning switched to online. By integrating STEAM elements in learning, teachers are able to improve their understanding of STEAM and implement it in classroom learning.

The fifth article of (Nur Aeni Marta et al., 2023) The appropriate title is "*History Learning Innovation with Steam Approach*". This article discusses the problem of learning History that is too contextual so that technology-based innovation is needed, considering that educators must prepare students to face globalization. The method used is qualitative by combining the PJBL-STEAM model. The results found that the application of PJBL-STEAM in History learning has proven to be effective and able to increase students' creativity.

Sixth article belongs to (Rahayu & Umamah, 2024) with the title "*The Effectiveness of PjBL-STEAM Equipped With Augmented Reality on Student Learning Outcomes in History Subjects*". The problem raised in the article regarding the results of History learning that are not optimal due to learning History is said to be less interesting, so educators need to make efforts to create new strategies. The researcher integrates the PjBL-STEAM model and augmented reality media as an effort to solve this problem. The methods used are quantitative and qualitative. The results obtained confirm that the PjBL-STEAM approach model is able to improve history learning outcomes by analyzing paired t-test data, with t-count results of 14,464 and t-table results of 1,987.

The seventh article belongs to (Marta & Santosa, 2022) with the title "*The Steam Approach: Theory and Its Implementation in History Learning*". This article discusses the problem of learning History which is called memorization and is textual so it needs efforts to overcome these problems. And the problem of teachers' demands to guide students to be able to have skills in the revolutionary era 4.0. So by

integrating STEAM elements, it is hoped that it will be able to overcome this problem. The method used is quantitative and RnD by developing an e-module. The result is that the STEAM approach is able to encourage students to have critical, metacognitive, creative, and reflective thinking skills.

Eighth article (Park & Cho, 2022b) with the title "*The interaction of history and STEM learning goals in teacher-developed curriculum materials: opportunities and challenges for STEAM education*". This article discusses the integration of STEAM with the curriculum in South Korea. The method used is qualitative. The results of the study are that integrating the understanding of STEAM in learning shows a positive impact on understanding History. Activities carried out by students through explanatory activities, persuasive, and imaginative.

The ninth article entitled "*The STEAM approach: Implementation and educational, social and economic consequences*" and researched by (Perales & Aróstegui, 2024). The article implements STEAM in humanities learning into the curriculum. The method used is qualitative. In the economic aspect, rationality is needed in education, encouraging social democratic aspects, and fostering humanist awakening through History. The results obtained stated that students' understanding increased due to the STEAM element.

The tenth article entitled "*STEAM Education and the Innovative Pedagogies in the Intelligence Era*" and thorough by (Zhan et al., 2023). The article explained that digital technology such as AI is able to facilitate cultural learning in the classroom. By integrating technology, students are more interested in learning so as to encourage 21st century competence. The method carried out was a systematic review with 12 articles and obtained positive results that had an impact on students' understanding.

4.2 Q2: What strategies are able to facilitate STEAM in history learning?

The STEAM approach in its application can be integrated with various models to support history learning. The results of the article review can be presented in the following table:

Table 1: The integration of learning strategies with the STEAM approach can support learning

No.	Focus content/ Strategi	Impact	Method	Researchers
1	Project-based learning	Understand history material and 21st century capabilities	Case study	Lestari et al, (2023), (Marta et al., 2023)
2	RBL-STEAM learning	Historical Thinking	Pictorial Riddle	(Sumardi et al., 2024)
3	Project Based Learning (PjBL)	Creative, problem-solving and understanding of the material	Research and Development	(Marta et al., 2022), (Pratamar tal., 2022)
4	Educational Curriculum	Enhancing historical understanding and interdisciplinary understanding	qualitative methods	(Park & Hohee, 2022)
5	Project Based Learning (PjBL)	Problem-solving and learning outcomes	quasi-experimental	(Rahayu et al., 2024),
6	Interdisipliner	Creativity and problem-solving	mixed-methods triangulation design	(Boice et al., 2024), (Perales & José, 2024)

The results of the study in the table show that the combination of learning strategies and the STEAM approach encourages the understanding of History learning to be more optimal. The analysis shows that the PJBL (Project Based Learning) model has been widely used by 4 researchers with different types of methods, even though this model has been proven to be able to support students' understanding. Assignments through projects are able to make students think creatively, innovatively, collaboratively, and problem-solving In addition to PJBL, there is an RBL-STEAM model that is able to facilitate students to improve historical thinking as evidenced through pretest and posttest. Implementing STEAM in an interdisciplinary discipline encourages students to know the various sciences that are integrated. Creativity and problem-solving skills can also be developed. STEAM is able to be a good curriculum to encourage holistic understanding in History subjects.

4. CONCLUSION

Based on the results of the Systematic Literature Review, this study aims to evaluate the effectiveness of the STEAM approach in History learning. Reviewed from the literature synthesis data, it is explained that the integration of the STEAM approach in History learning is able to have a positive impact on learning skills and outcomes. Students are able to understand learning, improve the 21st century syllable, be able to innovate and be able to solve problems. These findings provide suitable learning strategies to be integrated into the STEAM approach in History learning. The implications of this study show that educators can apply the STEAM approach strategy in History learning to support

students' understanding. The disadvantage of the research is that it only uses the source of articles from previous research as a literature review. Forcing suggestions for further research is the need for empirical studies using reliable quantitative data and exploring more interdisciplinary science from STEAM elements to encourage increased understanding of History.

5. Acknowledgment (Heading 5)

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6. References

[1] Adifta, E. D., Murni, A., & Roza, Y. (2022). Desain Perangkat Pembelajaran Daring Menggunakan Model Problem Based Learning dengan Pendekatan STEAM pada Materi Barisan dan Deret. *Prosiding Seminar Nasional Matematika*, *5*, 98–105. https://journal.unnes.ac.id/sju/index.php/prisma/

[2] Aguilera, D., & Ortiz-Revilla, J. (2021). Stem vs. Steam education and student creativity: A systematic literature review. *Education Sciences*, *11*(7). https://doi.org/10.3390/educsci11070331

[3] B, M. K., Noviana, A., Furqan, M. H., & Yusrizal, M. (n.d.). *Development of Classical Aceh History Teaching Materials Based on Heyzine Flipbooks to Increase Learning Creativity at Syiah Kuala University ' s Department of History Education* (Vol. 1). Atlantis Press SARL. https://doi.org/10.2991/978-2-38476-060-2

[4] Boice, K. L., Alemdar, M., Jackson, J. R., Kessler, T. C., Choi, J., Grossman, S., & Usselman, M. (n.d.). *Exploring teachers ' understanding and implementation of STEAM : one size does not fit all*.

[5] Bozkurt Altan, E., & Tan, S. (2021). Concepts of creativity in design based learning in STEM education. *International Journal of Technology and Design Education*, *31*(3), 503–529. https://doi.org/10.1007/s10798-020-09569-y

[6] Butson, C. R. (n.d.). *Teacher Perspective : Innovative , Adaptive , and Responsive Instructional Design Aimed at Life Skills Teacher Perspective : Innovative , Adaptive , and Responsive*. https://doi.org/10.1088/1755-1315/485/1/012083

[7] Chan, C. K. Y., & Lee, K. K. W. (2023). The AI generation gap: Are Gen Z students more interested in adopting generative AI such as ChatGPT in teaching and learning than their Gen X and millennial generation teachers? *Smart Learning Environments*, *10*(1). https://doi.org/10.1186/s40561-023-00269-3

[8] Conradty, C., Sotiriou, S. A., & Bogner, F. X. (2020). How creativity in STEAM modules intervenes with self-efficacy and motivation. *Education Sciences*, *10*(3). https://doi.org/10.3390/educsci10030070

[9] Efficiency, I., State, O., Schools, S., & Atolagbe, A. A. (2019). *Anatolian Journal of Education*. *4*(1), 13–22. http://e-aje.net/images/dosyalar/aje_2019_1_2.pdf

[10] El Bedewy, S., Lavicza, Z., & Lyublinskaya, I. (2024). STEAM practices connecting mathematics, arts, architecture, culture and history in a non-formal learning environment of a museum. *Journal of Mathematics and the Arts*. https://doi.org/10.1080/17513472.2024.2321563

[11] *European Journal of Educational Research*. (2020). *9*(4), 1689–1700. https://doi.org/10.12973/eu-jer.9.4.1689

[12] Filipe, J., Baptista, M., & Conceição, T. (2024). Integrated STEAM Education for Students' Creativity Development. *Education Sciences*, *14*(6). https://doi.org/10.3390/educsci14060676

[13] Kochhar, S. K. Teaching of History. Ahli bahasa oleh Purwanta dan Yovita Hardiwati. 2008. Jakarta: Gramedia

[14] Lestari, D., Ibrahim, N., & Iriani, C. (2023). STEAM: Science, Technology, Engineering, Art, and Mathematics on History Learning in the 21st Century. *Journal of Education Research and Evaluation*, *7*(2), 306–312. https://doi.org/10.23887/jere.v7i2.44172

[15] Ma'rifatullah, R., Umamah, N., Marjono, Sumardi, & Surya, R. A. (2021). Development of e-modules based on science technology society integrated life based learning in history learning. *IOP Conference Series: Earth and Environmental Science*, *747*(1). https://doi.org/10.1088/1755-1315/747/1/012064

[16] Mahumot, G. A., Pablo, M., & Memorial, O. L. (2020). *Journal of World Englishes and Educational Practices (JWEEP) Original Research Article Schools ' Fiscal Management , Organizational Climate and Teachers ' Morale s*. *2*(2), 81–91.

[17] Marta, N., & Santosa, F. H. (2022). *The Steam Approach : Theory and Its Implementation in History Learning*. 831–839.

[18] Mustoip, S., Lestari, D., & Purwati, R. (2024). *Implementation of STEAM Learning Methods to Develop Collaborative and Creative Characters of Elementary School Students Implementation of STEAM Learning Methods to Develop Collaborative*. *1*(2).

[19] Nur Aeni Marta, Otto Fajarianto, & C. Santi Muji Utami. (2023). History Learning Innovation with Steam Approach. *JTP - Jurnal Teknologi Pendidikan*, *25*(3), 468–476. https://doi.org/10.21009/jtp.v25i3.37059

[20] Ozkan, G., & Umdu Topsakal, U. (2021). Exploring the effectiveness of STEAM design processes on middle school students' creativity. *International*

Journal of Technology and Design Education, *31*(1), 95–116. https://doi.org/10.1007/s10798-019-09547-z

[21] Park, W., & Cho, H. (2022a). The interaction of history and STEM learning goals in teacher-developed curriculum materials: opportunities and challenges for STEAM education. *Asia Pacific Education Review*, *23*(3), 457–474. https://doi.org/10.1007/s12564-022-09741-0

[22] Park, W., & Cho, H. (2022b). The interaction of history and STEM learning goals in teacher - developed curriculum materials : opportunities and challenges for STEAM education. *Asia Pacific Education Review*, *23*(3), 457–474. https://doi.org/10.1007/s12564-022-09741-0

[23] Perales, F. J., & Aróstegui, J. L. (2024). The STEAM approach: Implementation and educational, social and economic consequences. *Arts Education Policy Review*, *125*(2), 59–67. https://doi.org/10.1080/10632913.2021.1974997

[24] Pratama, R. A., Pratiwi, I. M., Saputra, M. A., & Pratama, R. A. (2022). *Integration of STEM education in history learning*. *11*(1). https://doi.org/10.11591/ijere.v11i1.22064

[25] Rahayu, S. E., & Umamah, N. (2024). *The Effectiveness of PjBL-STEAM Equipped With Augmented Reality on Student Learning Outcomes in History Subjects*. *8*(8), 77–81.

[26] Sholehah, H., Umamah, N., Marjono, M., & Sumardi, S. (2023). *E-modul berbasis process oriented guided inquiry learning untuk peningkatan critical thinking*. *13*(2), 115–131. https://doi.org/10.25273/ajsp.v13i2.14404

[27] Sumardi, Dafik, Mursyidah, I. L., Jannah, E. S. W., & Ridlo, Z. R. (2024). The implementation of RBL-STEAM with pictorial riddle and augmented reality in improving students' historical thinking skill. *Edelweiss Applied Science and Technology*, *8*(4), 213–237. https://doi.org/10.55214/25768484.v8i4.1163

[28] Sopacua, J., Fadli, M. R., & Rochmat, S. (2020). The history learning module integrated character values. *Journal of education and learning (Edulearn)*, *14*(3), 463-472.

[29] Umamah, N., Sumardi, Marjono, Surya, R. A., & Muffida, E. (2021). Teachers' ability analysis of developing innovative instructional design. *IOP Conference Series: Earth and Environmental Science*, *747*(1). https://doi.org/10.1088/1755-1315/747/1/012070

[30] Yeomans, L., Chappell, K., Hetherington, L., Bresciani, S., Unterfrauner, E., Fabian, C. M., & Koulouris, P. (2025). Practice or Praxis? A Theoretical Classification System for STEAM Education. *Education Sciences*, *15*(2), 1–24. https://doi.org/10.3390/educsci15020164

[31] Zaawacki-Richter, O., Kerres, M., Bedenlier, S., Bond, M., & Buntins, K. (2020). Systematic Reviews in Educational Research: Methodology, Perspectives and Application. in Systematic Reviews in Educational Research: Metodology, Perspectives and Application (Issue January).

[32] Zhan, Z., Hu, Q., Liu, X., & Wang, S. (2023). *applied sciences STEAM Education and the Innovative Pedagogies in the Intelligence Era*.