Phenomenon , 2024, Vol. 14 (No. 1), pp. 63-84
Phenomenon : Jurnal Pendidikan MIPA
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Mapping Research Trends In Teaching And Learning Trajectories In Science Learning

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Abstract

One of the success factors of science learning is decided by the teacher's role in designing learning. A good learning design has at least three mutually sustainable aspects: teaching trajectory, learning trajectory, teaching and learning trajectories, and authentic assessments. This study aims to map research trends related to teaching and learning trajectory and authentic assessment in science learning. The method used was bibliometric analysis. The sample of articles used amounted to 662 Scopus-indexed articles within the last five years. The analysis results were then mapped using VOSviewer to show the connections, patterns, correlations, and density of research on the topics studied. The mapping results show that little research has been conducted on teaching and learning trajectories and authentic assessment in science learning over the past five years. Thus, the results of this study are expected to provide a comprehensive picture of the development of research on teaching trajectory, learning trajectory, teaching and learning trajectory, and authentic assessment and its implications for educators and or future researchers in designing more effective and innovative science learning designs in the future.

Keywords: Authentic assessment, Bibliometric, Learning trajectory, Science learning.

Pemetaan Tren Riset Lintasan Belajar Mengajar Pada Pembelajaran Sains

Abstrak

Salah satu faktor keberhasilan pembelajaran sains ditentukan oleh peran pendidik dalam mendesain pembelajaran. Desain pembelajaran yang baik setidaknya memuat tiga aspek yang saling berkesinambungan yaitu *teaching trajectory*, *learning trajectory*, *teaching and learning trajectory* dan *authentic assessment*. Penelitian ini bertujuan untuk memetakan tren riset terkait lintasan belajar mengajar dan penilaian autentik dalam pembelajaran sains. Metode yang digunakan adalah analisis bibliometrik. Sampel artikel yang digunakan berjumlah 662 artikel terindeks *Scopus* dalam kurun waktu lima tahun terakhir. Hasil analisis kemudian dipetakan menggunakan *VOSviewer* untuk menunjukkan koneksi, pola, korelasi dan densitas penelitian pada topik yang diteliti. Hasil pemetaan menunjukkan belum banyak penelitian yang dilakukan pada riset lintasan belajar mengajar dan penilaian autentik dalam pembelajaran sains selama kurun waktu lima tahun terakhir. Dengan demikian, hasil kajian ini diharapkan dapat memberikan Figurean yang komprehensif tentang perkembangan riset *teaching trajectory*, *learning trajectory*, *teaching and learning trajectory* dan *authentic assessment* serta implikasinya bagi pendidik dan atau peneliti selanjutnya dalam merancang desain pembelajaran sains yang lebih efektif dan inovatif di masa mendatang.

Kata kunci: Asesmen autentik, Bibliometrik, Lintasan pembelajaran, Pembelajaran sains.

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Email: rohmann111.edu@gmail.com
ISSN: 2088-7868, e-ISSN 2502–5708

INTRODUCTION

Science learning has an essential role in developing students' critical thinking, creativity, and problem-solving skills (Aninnas et al., 2022; Astari et al., 2023; Karlina Muzianti et al., 2024; Novak & Krajcik, 2007). Through science, learners are invited to understand fundamental theories and concepts and participate in a scientific process involving observation, experimentation, and data analysis. The main goal of science learning is to enable learners to understand science concepts through a series of scientific processes (Kurniawati et al., 2021; Suparsawan, 2020). For this reason, educators need to design innovative and effective learning designs so that learning becomes more interesting, relevant, and oriented toward achieving learning objectives.

In recent years, teaching and learning trajectories have been applied to facilitate learning that focuses more on learners' processes and learning outcomes (Khoerunisa et al., 2023; Rochman et al., 2018; Shofiah et al., 2023). Teaching trajectory refers to a planned and systematic teaching trajectory to achieve specific competencies while learning trajectory describes the stages of student knowledge development that occur gradually and progressively in the learning process (Gravemeijer, 1994; Rochman et al., 2018). This structured learning requires assessments to ensure the teaching and learning process aligns with the expected goals.

Authentic assessment evaluates learner competencies based on the teaching and learning trajectory between educators and learners. This assessment provides a clear and comprehensive picture of the extent to which learners can understand the material that educators have provided. Applying teaching and learning trajectory and authentic assessment positively affects learners' understanding and learning outcomes. A study by Khoerunisa et al., (2023) and Shofiah et al., (2023) indicates that applying teaching and learning trajectories with authentic assessment can improve students' understanding of science concepts and learning outcomes.

Currently, only a few researchers have examined these three aspects of learning. The research differs from some earlier studies because this research integrates teaching and learning trajectory and authentic assessment in science learning. Most researchers only focus on each aspect of the teaching and learning trajectory (Carlson et al., 2019; Darling-Hammond et al., 2020; Fauth et al., 2019; Felder & Brent, 2024; Lombardi et al., 2021) and authentic assessment (Malik et al., 2023; Meilina et al., 2023; Mulhayatiah et

al., 2023; Rochman et al., 2022). Therefore, a comprehensive analysis of the integration of these three aspects in science learning needs to be conducted.

This research gap shows that there are opportunities for further research related to integrating teaching trajectory, learning trajectory, teaching and learning trajectory, and authentic assessment in science learning. This study aims to bridge the gap by mapping research trends related to teaching and learning trajectories and authentic assessment in science learning over the past five years. The expected result of this research is a comprehensive mapping of the relationship between teaching trajectory, learning trajectory, teaching and learning trajectory, and authentic assessment, which will be a foundation for educators or future researchers to develop effective science learning designs. Recent research has shown that integrating teaching and learning trajectory and authentic assessment significantly increases learner engagement, resulting in better learner-learning outcomes (Main, 2020; Salinas-Navarro et al., 2024).

RESEARCH METHOD

This study uses bibliometric methods to map research trends related to teaching trajectory, learning trajectory, teaching and learning trajectory, and authentic assessment in science learning. This research uses Publish or Perish (PoP) and VOSViewer software. PoP was used to collect the metadata of the articles to be mapped. VOSViewer is used to map the metadata of PoP output articles. The 662 PoP articles used in this study comprised 131 teaching trajectory articles, 200 learning trajectory articles, 131 teaching and learning trajectory articles, and 200 authentic assessment articles. All PoP articles were not categorized by continent or country. This aims to focus research analysis globally. All articles are from the Scopus database. The following is information on the software used in the research (Eck & Waltman, 2023; Harzing, 2007).

Table 1. General Information of Research Software

Software	Version	Year	Developer
Publish or Perish	v8.12.4612.8838	2024	Tarma Software Research Ltd
VOSviewer	v1.6.20	2023	Leiden University's

The research flow can be seen in the following figure

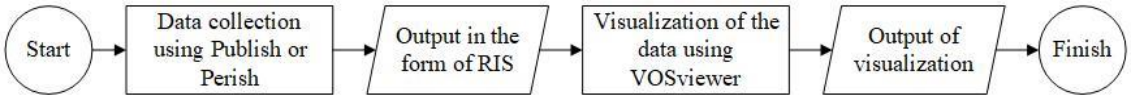


Figure 1. The research flow

This research began with data collection through Publish or Perish (PoP) software. The metadata search on PoP was conducted four times. Each used the keywords teaching trajectory science learning, learning trajectory science learning, teaching-learning trajectory science learning, and authentic assessment science learning. The search used the 2019 - 2023 interval filter. This is to see research trends in these keywords over the past five years. PoP outputs are stored as RIS (Research Information System). RIS data is processed using VOSviewer. Data processing in VOSviewer is carried out using binary counting to know the extent to which research topics have been researched without emphasizing the frequency of the appearance of a keyword.

The results of VOSviewer processing were then analyzed using network, overlay, and density mapping. Network analysis is used to group articles based on related topics. Density analysis finds the most often researched topics within a certain period. Overlay analysis displays a track record of research development, separating research topics widely discussed from emerging research topics with the potential for further development (McAllister et al., 2022; Sood et al., 2021).

RESULTS AND DISCUSSION

Teaching Trajectory Science Learning

Citation metrics	Help
Publication years:	2019-2024
Citation years:	5 (2019-2024)
Papers:	131
Citations:	698
Cites/year:	139.60
Cites/paper:	5.33
Cites/author:	698.00
Papers/author:	126.99
Authors/paper:	0.97
h-index:	13
g-index:	23
hI,norm:	13
hI,annual:	2.60
hA-index:	8
Papers with ACC >= 1,2,5,10,20:	54,31,13,4,0

Figure 2. Citation Matrix of Teaching Trajectory Science Learning

Based on Figure 2, the PoP output results on teaching trajectory science learning using the search query "Teaching AND Trajectory AND Science AND Learning" in the keywords section taken from Scopus in the 2019-2023 search period found 131 articles. The PoP output citation matrix for the keyword teaching trajectory science learning resulted in 131 published articles. The number of citations is 698 citations. The average number of citations per year is 139.6, with the number of citations per article 5.33. This finding indicates an interest in research on teaching trajectories in science learning, which is essential to perfect learning effectiveness. This suggests that teaching trajectories design developmentally appropriate learning for learners (Clements & Sarama, 2020).

Table 2. Number of Publication Teaching Trajectory Science Learning 2019 – 2023

Year	Number of Publication
2019	17
2020	25
2021	21
2022	27
2023	33
Total	**131**

Table 2 shows the distribution of the number of articles over the last five years is shown in Table 2. The highest number of publications in 2023 was 33 articles. The lowest number in 2019 was 17 articles. The number of publications has been increasing from 2019 – 2023. This increase reflects the high interest and need for teaching trajectory science learning studies (Inchaustegui & Alsina, 2020; Othman et al., 2021).

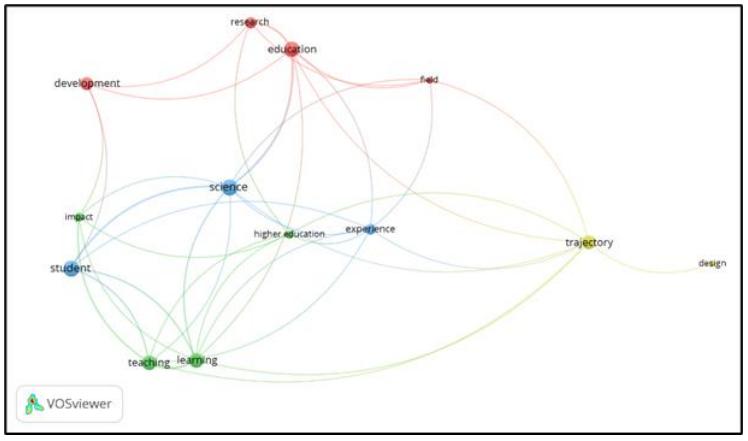


Figure 3. Network Visualization of Teaching Trajectory Science Learning

The visual network mapping of teaching trajectory science learning research topics can be seen in Figure 3. There are 4 main clusters. Cluster 1 consists of 3 items (development, education, and field). Cluster 2 consists of 4 items (higher education, impact, learning, and teaching). Cluster 3 consists of 3 items (experience, science, and student), and Cluster 4 consists of 2 items (design and trajectory). Based on the 4 clusters, the research topic of teaching trajectory science learning is designing and planning lessons that impact students' learning experience. This is supported by research by Sari et al., (2021), which states that good learning design can attract students' interest in learning so that the learning experience of students increasess.

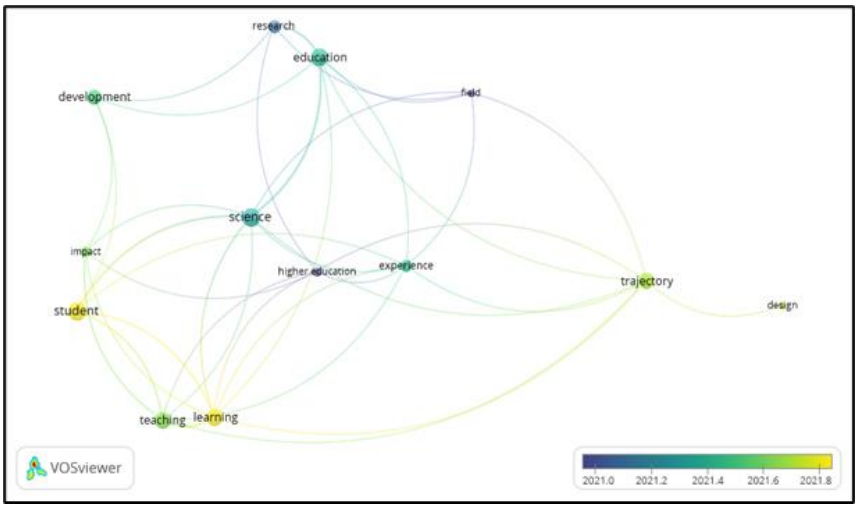


Figure 4. Overlay Visualization of Teaching Trajectory Science Learning

In the visual overlay mapping, blue items show research that researchers have discussed for a long time. Conversely, the yellow items show research that researchers are still debating. Based on Figure 4, the blue items consist of research, field, and higher education. The yellow items comprised students, learning, and trajectory. Thus, the research topic of teaching trajectory science learning that research is still discussing is the design of educators' teaching flow centered on students. Student-centered learning is a suitable learning model for science learning. This is because this learning model can improve critical thinking skills (Widyanto & Vienlentia, 2022), creative thinking (Medriati & Risdianto, 2020), collaboration and (Saenab et al., 2019) science process skills (Junaid et al., 2021).

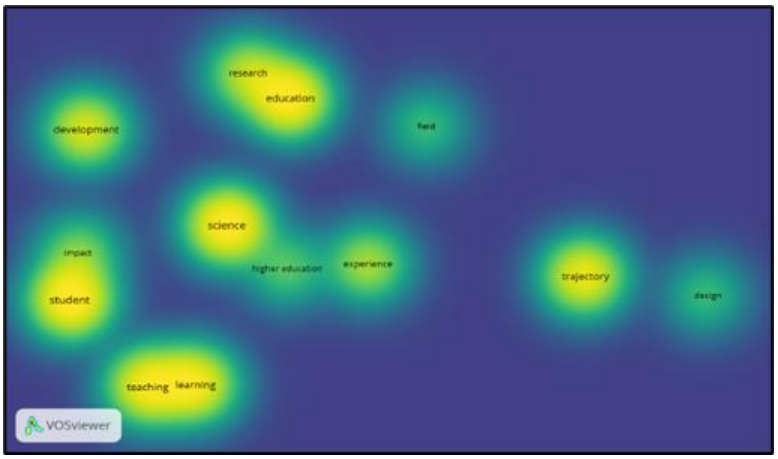


Figure 5. Density Visualization of Teaching Trajectory Science Learning

In visual density, the lighter the item's color, the more the item is researched. In Figure 5, the most researched items in the last five years are education, science, teaching-learning, student, and trajectory. Meanwhile, the items that have yet to be researched are higher education, field, and design. This means that the research topic of teaching trajectory science learning that has yet to be widely researched is the teaching flow of educators at the higher education unit level. Most researchers examine the teaching trajectory of educators at the basic education unit level (Ragin et al., 2020), secondary education (Siahaan et al., 2020) and higher education (Agung Rinaldy Malik et al., 2020).

Learning Trajectory Science Learning

Citation metrics	Help
Publication years:	2019-2024
Citation years:	5 (2019-2024)
Papers:	200
Citations:	7751
Cites/year:	1550.20
Cites/paper:	38.76
Cites/author:	7737.00
Papers/author:	198.99
Authors/paper:	1.00
h-index:	37
g-index:	80
hI,norm:	37
hI,annual:	7.40
hA-index:	17
Papers with ACC >= 1,2,5,10,20:	200,186,102,41,12

Figure 6. Matrix Citation of Learning Trajectory Science Learning

The results of the PoP output on learning trajectory science learning using the search query "Learning AND Trajectory AND Science AND Learning" in the keywords section taken from Scopus in the 2019-2023 search period found 200 articles. The PoP output citation matrix for the keyword learning trajectory science learning resulted in the

number of published articles of 200 articles. The number of citations is 7,751 citations. The average number of citations per year is 1,550, with the number of citations per article 38.76. This high number of citations shows the high relevance and contribution of the topic of learning trajectory in science learning to the development of educational research over the past five years. This shows the importance of understanding learning trajectories for designing more effective and learner-centered learning (Clements & Sarama, 2020).

Table 3. Number of Publication Learning Trajectory Science Learning 2019 – 2023

Year	Number of Publication
2019	51
2020	57
2021	40
2022	35
2023	16
Total	**200**

The distribution of articles over the last five years is shown in Table 3. The highest number of publications in 2020 was 57 articles. The lowest of publications in 2023 was 16 articles. This trend shows the significant impact of these studies in shaping the understanding and development of science learning, although there are fluctuations in the number of publications from year to year (Clements & Sarama, 2020; Darling-Hammond et al., 2020).

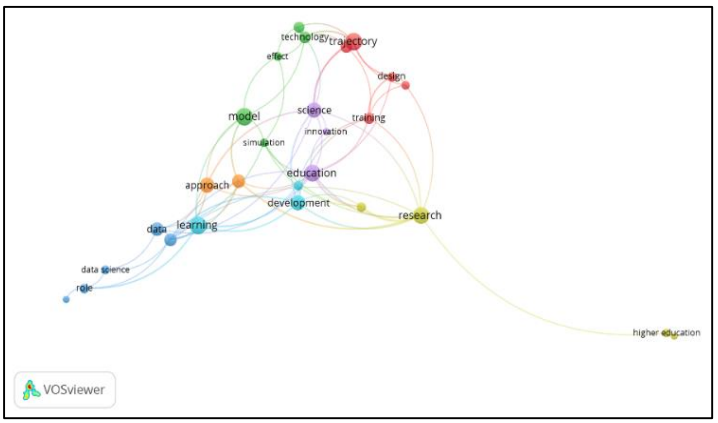


Figure 7. Network Visualization of Learning Trajectory Science Learning

The visual network mapping of science learning trajectory research topics can be seen in Figure 7. There are 7 main clusters. Cluster 1 consists of 5 items (assessment, design, student, training, and trajectory). Cluster 2 consists of 5 items (effect,

environment, model, simulation, and technology). Cluster 3 consists of 5 items (data, data science, knowledge, role, and stem career). Cluster 4 consists of 4 items (bibliometric review, higher education, impact, and research). Cluster 5 consists of 3 items (education, innovation, and science). Cluster 6 consists of 3 items (development, learning, and systematic review), and Cluster 7 consists of 2 items (approach and review). Based on the 7 clusters, science learning trajectory research topics that tend to attract researchers are 1) the approach, design, and planning of learner learning trajectory assessment, 2) the impact of implementing a learning model on learner abilities, and 3) science learning innovations based on the results of learner learning trajectories. A learning trajectory is a dynamic guide tailored to learners' needs and learning progress. This is supported by research by Simon, (1995), which highlights the importance of learning based on learners' needs and learning progress.

Learning trajectory can be used as an evaluation material for educators in the learning process. With the output of students' learning trajectories, educators can decide the effectiveness of the learning models and strategies. Research by Virawanti, (2022) supports this. In addition, understanding the learning trajectory will enable educators to find areas that need improvement and adapt teaching approaches to meet learners' individual needs. In addition, understanding the learning trajectory allows educators to identify areas that require improvement and adjust teaching approaches to meet the individual needs of learners (Lukman, 2024). Thus, this evaluation not only aids in assessing learner performance but contributes to developing more effective learning designs.

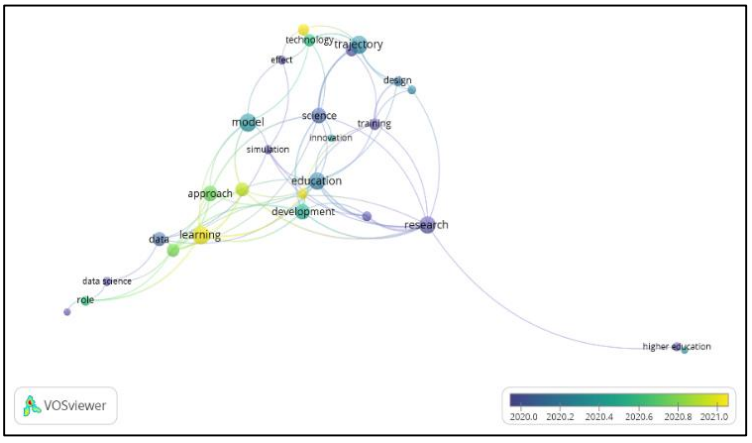


Figure 8. Overlay Visualization of Learning Trajectory Science Learning

In Figure 8, science, trajectory, training, research, and higher education items are items with research that researchers have long discussed. Meanwhile, researchers have

been discussing learning, systematic reviews, and the environment in recent years. This shows that research related to systematic and comprehensive reviews of students' learning trajectories, especially in learning based on sustainability topics. The topic is interesting to research. This is because sustainability education is included in "The 17 Goals Sustainable Development" program. The topic tends to be researched from elementary to upper secondary education units (Ardoin & Bowers, 2020; Davis & Elliott, 2023).

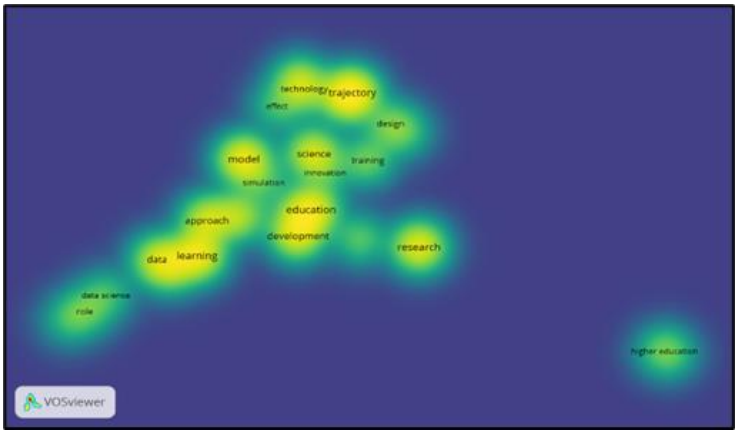


Figure 9. Density Visualization of Learning Trajectory Science Learning

In Figure 9, education, development, data, learning, and trajectory are brightly lit items. The research topics of these items have been widely researched. Meanwhile, the dimmest items are role, data science, and higher education. Thus, researchers rarely conduct research on the topic of students' learning trajectories in upper secondary education units. This is supported by Chen et al., (2021). In their research on bibliometric analysis of student learning trajectories in recent years, researchers tend to examine learning trajectories in primary to secondary education units.

Teaching and Learning Trajectory Science Learning

Citation metrics	Help
Publication years:	2019-2024
Citation years:	5 (2019-2024)
Papers:	131
Citations:	698
Cites/year:	139.60
Cites/paper:	5.33
Cites/author:	698.00
Papers/author:	126.99
Authors/paper:	0.97
h-index:	13
g-index:	23
hI,norm:	13
hI,annual:	2.60
hA-index:	8
Papers with ACC >= 1,2,5,10,20:	54,31,13,4,0

Figure 10. Matrix Citation of Teaching and Learning Science Learning

The PoP output results on teaching and learning trajectory science learning using the search query "Teaching AND Learning AND Trajectory AND Science AND Learning" in the keywords section taken from Scopus in the 2019-2023 search period found 131 articles. The PoP output citation matrix for the keywords teaching and learning trajectory science learning resulted in 131 published articles. The number of citations is 698 citations. The average number of citations per year is 136.90, and the number of citations per article is 5.33. This shows a significant interest in research on learning and teaching trajectories in science education. The focus on teaching and learning trajectories seeks to understand how learners learn progressively, and educators can customize learning models, methods, and tools according to learners' needs(Clements & Sarama, 2020).

Table 4. Number of Publication Teaching and Learning Trajectory Science Learning 2019-2023

Year	**Number of Publication**
2019	17
2020	25
2021	21
2022	27
2023	33
Total	**131**

The distribution of articles over the last five years is shown in Table 4. The highest number of publications in 2023 was 33 articles. The lowest number of publications in 2019 was 17 articles. This trend shows an increase in interest and research on the topic of teaching and learning trajectory science learning, which is not only on the development of theory and practice in science education but also the potential for further research and practical applications (Mulhayatiah et al., 2024; Nindyatami et al., 2024).

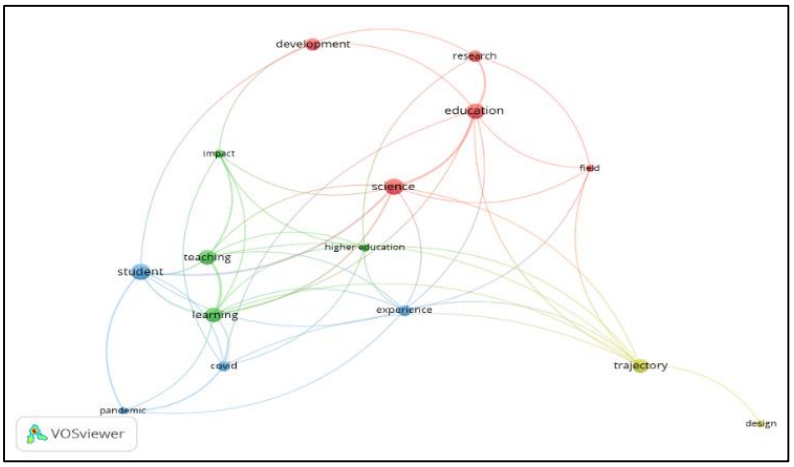


Figure 11. Network Visualization of Teaching and Learning Trajectory Science Learning

The visual network mapping of teaching and learning trajectory science learning research topics can be seen in Figure 11. There are 4 main clusters. Cluster 1 consists of 5 items (development, education, field, research, science). Cluster 2 consists of 4 items (higher education, impact, learning, teaching). Cluster 3 consists of 4 items (covid, experience, pandemic, student), and Cluster 4 consists of 2 items (design, trajectory). Based on the 4 clusters, the research topic of teaching and learning trajectory science learning is the design and planning of teaching and learning trajectories impact students' learning experience. This is based on the research results of researchers in recent years. Good learning design positively impacts learners' learning experience (Lupita & Hidajat, 2022; Rahman, 2022). Based on these four clusters, research on teaching and learning trajectories in science learning centers on the design and planning of learning trajectories that have a direct impact on learners' learning experiences.

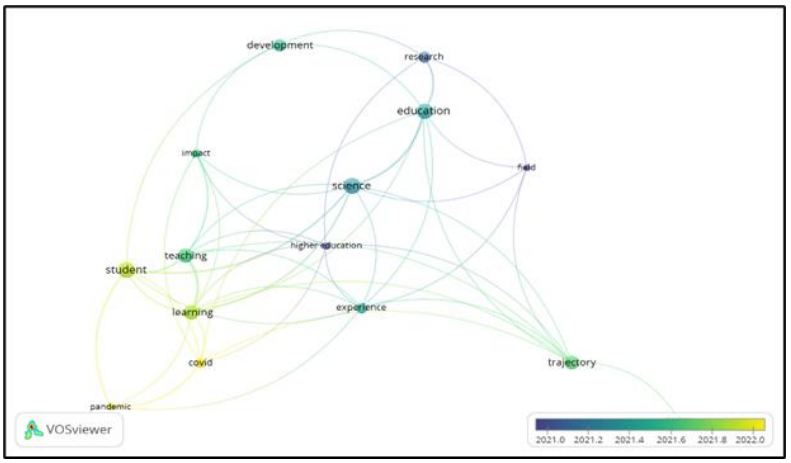


Figure 12. Overlay Visualization of Teaching and Learning Trajectory Science Learning

In the visual overlay mapping, blue items show research that researchers have discussed for a long time. Conversely, yellow items show research that researchers are still discussing. Based on Figure 12, the blue items consist of research, field, and higher education. The yellow items consist of students, learning, and trajectory. Thus, the research topic of teaching trajectory science learning that researchers are still discussing is the design of teaching and learning flows that impact students' meaningful learning experiences. A meaningful learning experience is obtained from an effective learning design that includes the teaching and learning trajectory. Teaching and learning flow is a series of interaction patterns between educators and learners (Zaifullah et al., 2021). Educators and learners must interact during the teaching and learning process. Educators can see students' learning progress in each syntax/learning step. Learners can also develop learning abilities in each syntax/step of learning. This is in line with the research results of Bakhruddin et al., (2021), which state that the flow of teaching and learning can reveal the development of students during the learning process.

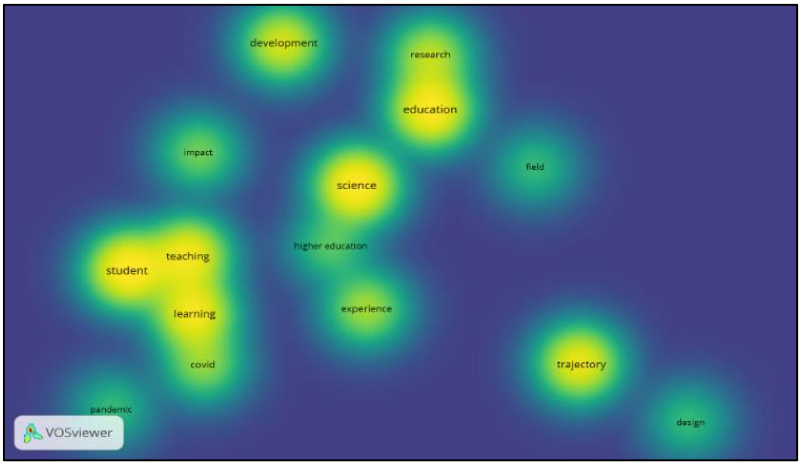
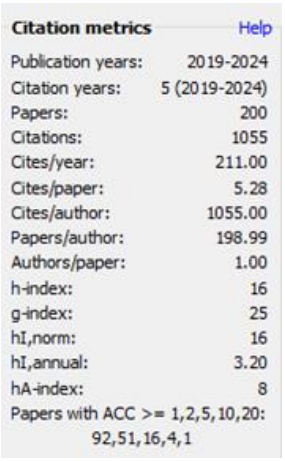


Figure 13. Density Visualization of Teaching and Learning Trajectory Science Learning

In visual density, the lighter the item's color, the more the item is researched. In Figure 13, the most researched items in the last five years are education, science, teaching and learning, student, and trajectory. Meanwhile, items that have yet to be researched are higher education, field, and design. In teaching and learning trajectory research, science learning that has yet to be widely researched is the flow of teaching and learning in upper secondary education units. Researchers focus on applying learning models to improve students' abilities and competencies (Lailatunnahar, 2021; Raihana, 2023; Tahir, 2023). Only a few researchers have focused their research on the application of learning models to student learning outcomes. Learner learning outcomes are one of the parameters to see

educators' teaching and learning flow in the classroom. This aligns with research by Khoerunisa et al., (2023); Shofiah et al., (2023), which state that the flow of teaching and learning can reveal students' learning achievements.

Authentic Assessment Science Learning



Citation metrics	Help
Publication years:	2019-2024
Citation years:	5 (2019-2024)
Papers:	200
Citations:	1055
Cites/year:	211.00
Cites/paper:	5.28
Cites/author:	1055.00
Papers/author:	198.99
Authors/paper:	1.00
h-index:	16
g-index:	25
hI,norm:	16
hI,annual:	3.20
hA-index:	8
Papers with ACC >= 1,2,5,10,20:	92,51,16,4,1

Figure 14. Matrix Citation of Authentic Assessment Science Learning

The results of the PoP output on authentic assessment science learning using the search query “Authentic AND Assessment AND Science AND Learning” in the keywords section taken from Scopus in the 2019-2023 search time found 200 articles. The PoP output citation matrix for the keyword authentic assessment science learning resulted in the number of published articles of 200 articles. The number of citations is 1,055 citations. The average number of citations per year is 211, with the number per article being 5.28. This data shows that authentic assessment in science learning has had a considerable influence in the last five years. Authentic assessment shows the importance of relevant and contextual evaluation in the learning process to increase learner engagement and encourage more meaningful learning (Ajjawi et al., 2020).

Table 5. Number of Publications Authentic Assessment Science Learning 2019 – 2023

Year	Number of Publication
2019	27
2020	32
2021	47
2022	38
2023	52
Total	**200**

Table 5 shows the distribution of the number of articles over the last five years. The highest number of publications was 52 in 2023, and the lowest was 27 in 2019. The increase in the number of publications aligns with the increasing attention to the importance of authentic assessment in science learning (Suhardi, 2021; Winasis, 2021).

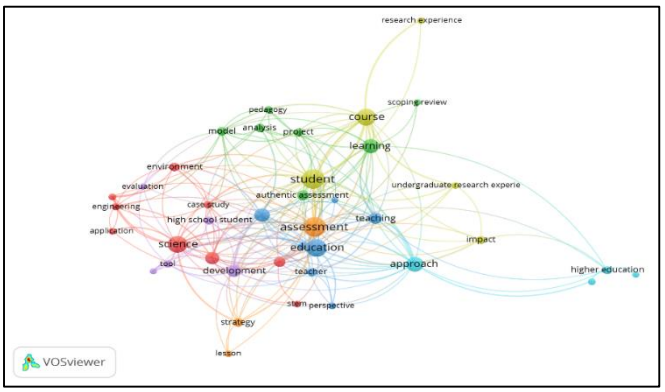


Figure 15. Network Visualization of Authentic Assessment Science Learning

The visual network mapping of science learning trajectory research topics can be seen in Figure 15. There are 7 main clusters. Cluster 1 consists of 9 items (application, case study, engineering, environment, practice, problem, science, stem, and technology). Cluster 2 consists of 7 items (analysis, authentic assessment, learning, model, pedagogy, project, and scoping review). Cluster 3 consists of 7 items (critical thinking, education, experience, inquiry, perspective, teacher, and teaching). Cluster 4 consists of 5 items (course, impact, research experience, student, and undergraduate research). Cluster 5 consists of 5 items (development, evaluation, high school student, knowledge, and tool). Cluster 6 consists of 4 items (approach, formative assessment, higher education, and information literacy), and Cluster 7 consists of 3 items (assessment, lesson, and strategy). Based on the 7 clusters, authentic assessment science learning research topics that tend to be of interest to researchers are 1) planning and designing authentic assessments, 2) analyzing the application of authentic assessments, 3) the impact of applying authentic assessments on students and 4) evaluating teaching educators based on the results of authentic assessments. Authentic assessment is effectively applied to science learning. It can reveal learners' knowledge and skills during learning (Rochman et al., 2018).

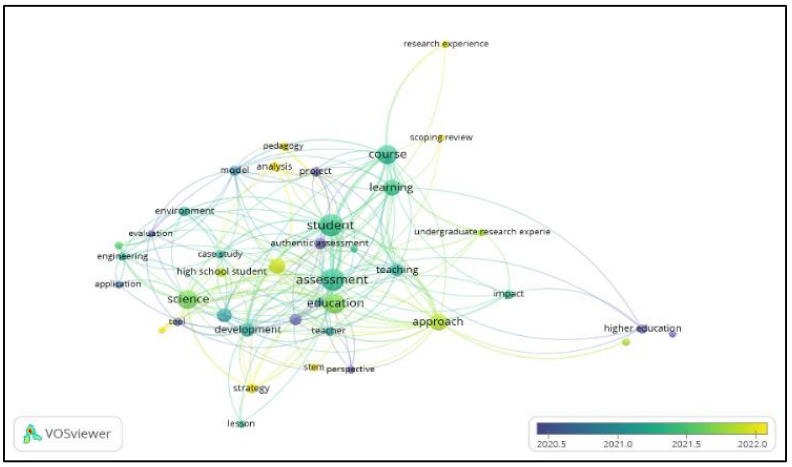


Figure 16. Overlay Visualization of Authentic Assessment Science Learning

A visual overlay of authentic assessment keywords can be seen in Figure 16. The faintly lit items are authentic assessment, project, higher education, evaluation, tool, application, and perspective. This means that authentic assessment based on students' project assignments is a topic that has been discussed for a long time. The brightly lit items, namely research experience, pedagogy, analysis, strategy, and stem, are research topics that are still being discussed by researchers today. STEM is a learning approach emphasizing the correlation of science, technology, engineering, and mathematics knowledge and problem-solving skills (Bybee, 2013). Authentic assessment can be integrated with this approach. Authentic assessment can objectively measure learners' abilities during the learning process (Nicolaou & Constantinou, 2014). Therefore, this assessment can be integrated with the STEM approach. This is supported by research by Kurniasih et al., (2020); Nurhaifa et al., (2020); Setiawan & Sa'dijah, (2017) by states that learner performance-based assessment in STEM learning.

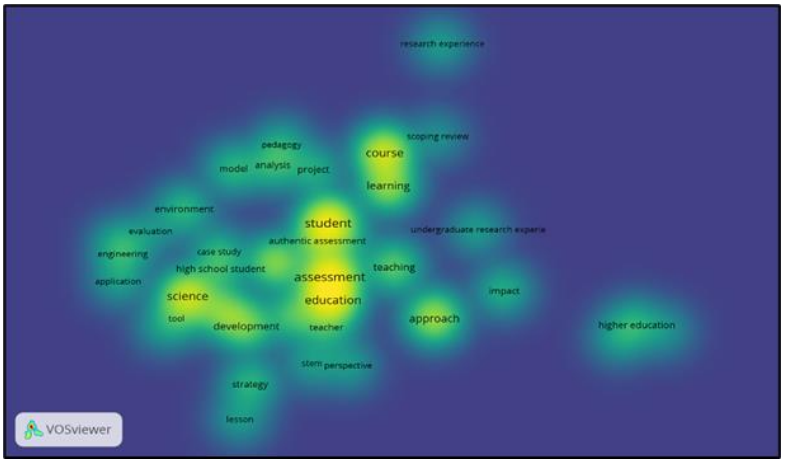


Figure 17. Density Visualization of Authentic Assessment Science Learning

A visual density of authentic assessment keywords can be seen in Figure 17. Most items are dim. Only the items assessment, education, science, course, learning, and student are brightly lit. This shows that many researchers have researched the topic of task-based assessment in science learning. Task-based assessments or formative tests are assessments that do not measure the ability of students. This assessment can only measure students' learning outcomes if they see their learning process. A good assessment can measure all learners' knowledge and skills during learning (Poerwanti, 2015). Authentic assessment can measure student learning outcomes by looking at student performance during the learning process. This is supported by research by Indriyani et al., (2023); Jayadiningrat et al., (2022); Martatiyana & Madani, (2023) that reveal learners' performance through authentic assessment in science learning.

CONCLUSION

Based on the results of VOSviewer mapping research trends in teaching trajectory, learning trajectory, teaching and learning trajectory, and authentic assessment in science learning based on the Scopus database, only a few researchers have examined these research topics. This is based on published articles and citations in the last five years. In addition, the h-index of the research topics of teaching trajectory, learning trajectory, teaching and learning trajectory, and authentic assessment in science learning still needs to be higher. This research only maps metadata sourced from Scopus. Further research must use other credible sources such as Google Scholar, Dimensions AI, PubMed, etc. In addition, research related to teaching trajectory, learning trajectory, teaching and learning trajectory, and authentic assessment is not limited to science learning.

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