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A BIBLIOMETRIC ANALYSIS OF RESEARCH TRENDS ON CONTEXTUAL LEARNING IN SCIENCE EDUCATION

Ika Hasanah[1], Sjaeful Anwar[2], Iqbal Musthapa[3]
[1,2]Chemistry Education Department, Universitas Pendidikan Indonesia, Indonesia
[3]Chemistry Department, Universitas Pendidikan Indonesia, Indonesia
ikahasanah@upi.edu[1], saefulanwar@upi.edu[2], iqbalm@upi.edu[3]

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ABSTRAK

Abstrak: Penerapan pembelajaran kontekstual telah menjadi tren dominan dalam pendidikan di berbagai negara. Metode pembelajaran ini telah berkembang dengan beragam pendekatan yang menekankan kerjasama lintas disiplin, domain, dan wilayah. Penelitian ini bertujuan untuk memberikan kontribusi signifikan bagi peneliti dan pendidik dalam Pendidikan Sains dengan melakukan analisis bibliometrik global tentang pembelajaran kontekstual, menggunakan karakteristik publikasi sebagai dasar. Penelitian ini menggunakan metode analisis bibliometrik dengan mengambil database Scopus dan berhasil mengumpulkan 782 artikel yang diterbitkan dari tahun 2010 hingga 2022. Analisis bibliometrik yang dilakukan menggunakan alat seperti VOSviewer dan Microsoft Excel. Hasil penelitian menunjukkan bahwa Bialocerkowski, A. dan Olson R., adalah penulis yang paling banyak dikutip dalam penelitian tentang pembelajaran kontekstual dalam Pendidikan Sains. Artikel yang paling banyak dikutip adalah *"Interprofessional Education in Allied Health: A Systematic Review".* Berdasarkan peta kolaborasi antar negara, Amerika Serikat tampaknya menjadi pusat kolaborasi paling signifikan dalam penelitian tentang pembelajaran kontekstual dalam Pendidikan Sains. Selain itu, jurnal "Journal of Research in Science Teaching" terlihat menonjol dalam publikasi Pembelajaran Kontekstual dalam Pendidikan Sains, berdasarkan jumlah kutipan dan kuartil (Q1). Studi bibliometrik ini juga menemukan korelasi antara kata kunci yang digunakan oleh penulis, antara lain "Pendidikan Profesional", "Pendidikan Sains", "Pendidikan", "Konteks", dan "Pembelajaran Kontekstual". Temuan-temuan ini menyoroti pentingnya penelitian multidisiplin dan interdisiplin dalam memahami pembelajaran kontekstual dalam konteks pendidikan dan mengadvokasi untuk memasukkan konteks geografis yang lebih luas dalam penelitian tentang pembelajaran kontekstual.

Abstract: *Implementing contextual learning has become a dominant trend in education across various countries. This learning method has evolved with diverse approaches emphasizing collaboration across disciplines, domains, and regions. This research aims to contribute significantly to researchers and educators in Science Education by conducting a global bibliometric analysis of contextual learning, using publication characteristics as the basis. This research uses bibliometric analysis method by taking the Scopus database and successfully collecting 782 articles published from 2010 to 2022. Bibliometric analysis is conducted using tools such as VOSviewer and Microsoft Excel. The analysis results show that Bialocerkowski, A. and Olson, R., is the most cited author in research on contextual learning in Science Education. The most cited article is "Interprofessional Education in Allied Health: A Systematic Review". Based on the map of collaboration between countries, the United States appears to be the most significant center for collaboration in research on contextual learning in Science Education. Furthermore, the journal "Journal of Research in Science Teaching" stands out in the publication of Contextual Learning in Science Education, based on the number of citations and quartile (Q1). This bibliometric study also found a correlation between the keywords used by authors, including "Professional Education," "Science Education," "Education," "Context," and "Contextual Learning". These findings highlight the importance of multidisciplinary and interdisciplinary research in understanding contextual learning in the educational context and advocating for including broader geographic contexts in research on contextual learning.*

A. INTRODUCTION

Contextual learning is a highly effective teaching approach that emphasizes understanding the material in real-life situations or students' personal experiences (Afriani, 2018; Hasnidar & Elihami, 2020; Pratama et al., 2019; Regmi & Jones, 2020; Schwartz & Tilling, 2023) . It is considered a vital component of modern education, as it encourages learners to delve deeper into concepts by applying their knowledge in the context of their immediate environment (Hasnidar & Elihami, 2020; Regmi & Jones, 2020). This is because events that occur in everyday life are more relevant and provide a solid foundation for effective learning (Lestari et al., 2023; Serino et al., 2024; Xiao, 2024). To ensure that the learning process is active, productive, and meaningful for students, the contextual approach emphasizes cognitive aspects and students' affective and psychomotor aspects (Nursiami, 2021). In practice, contextual learning focuses on the practical application of knowledge in real-world situations, promotes higher-order thinking, encourages student participation, fosters critical and creative attitudes, and facilitates problem-solving. This approach also stresses the significance of creating enjoyable, engaging, and diverse learning experiences using various resources (Anggraini, 2017).

Implementing contextual learning in Indonesia faces several challenges, including teacher readiness, limited facilities, and a lack of support for developing appropriate learning media (Balakrishnan, 2022; Hasnidar & Elihami, 2020; Situmorang et al., 2019). However, there is hope in implementing contextual learning through school culture to enhance students' character (Amelia & Ramadan, 2021) and improve students' understanding and abilities in solving mathematical problems (Melasevix et al., 2021). Therefore, further research is needed to identify effective strategies for overcoming these obstacles and enhancing the implementation of contextual learning in the Indonesian education environment.

Systematic bibliometric analysis of science education is crucial and has been widely conducted. It would therefore be beneficial to conduct a systematic bibliometric analysis of global research related to contextualized learning in Science Education. Aristovnik et al. (2020) conducted a bibliometric analysis research on the landscape of science learning. In the study, articles published in the Scopus database were examined and focused on the landscape of Science Education during the COVID-19 pandemic which was carried out on publications in the first half of 2020. Arici et al. (2019) scanned the Web of Science (WOS) database and made a bibliometric analysis of technology-based Science Education studies between 2013-2018. On the other hand, Hidaayatullaah et al. (2021) conducted bibliometric analysis research related to ethnoscience-based learning in Science Education between 2011 and 2020 by using the Scopus and Google Scholar databases.

All of these studies provide valuable information concerning the subject and the span of years they cover. However, among all the studies mentioned, none has specifically addressed contextualized learning in Science Education. Thus, a more comprehensive, detailed and in-depth study covering the most recent year was needed. Based on this need, this study decided to examine recent studies related to contextualized learning in Science Education scanned in the Scopus database from 2010 to 2022. The objectives of this research are (i) to evaluate significant contributions to contextual learning in science education, (ii) to identify current research centres and development trends in this field, and (iii) to formulate future research directions with potential in this field. Therefore, this research aims to review papers on contextual learning in Science Education from an international perspective and to reveal the trend of contextual learning in Science Education in terms of various variables using the bibliometric mapping method.

B. METHODS

This research applies bibliometric analysis to investigate scholarly works on Contextual Learning in Science Education, considering various variables. An important step in this process is bibliometric mapping conducted to uncover research themes related to "contextual learning," how the direction and trends of such research evolve, and the identification of authors and affiliations that have significant influence. The bibliometric method consists of three main stages: the data mapping stage, the creation of publication maps on the contextual learning stage, and the refinement stage of contextual learning publication data, as depicted in Diagram 1.

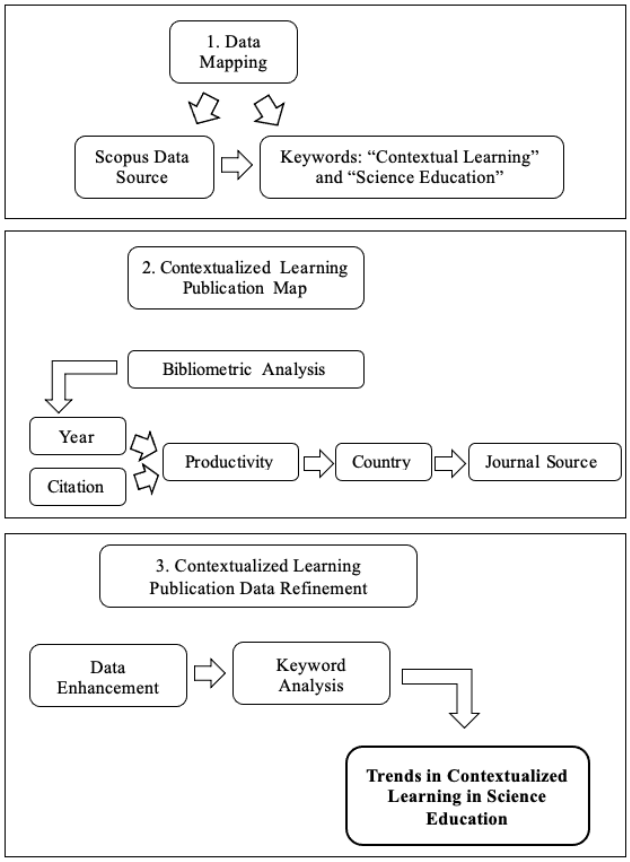

Figure 1. Bibliometric analysis method

The initial stage of this research involves data mapping by retrieving data from Scopus using the keywords "Contextual Learning" and "Science Education," resulting in a total of 782 documents. The document search was conducted on July 13, 2023. Bibliometric analysis is performed on the year, number of citations, author productivity, countries and journal sources, thematic trends, and evolution (keyword analysis). Additionally, researchers apply inclusion and exclusion criteria to select relevant documents. The inclusion and exclusion criteria are shown in Table 1.

Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Published in the period 2010 to 2022	Articles or proceedings not indexed by Scopus
Articles are peer-reviewed journals	Content not related to contextual learning in Science Education
Articles fall within the field of Education	
Content written in English	

Only articles from high-reputation international journals were used as the basis for this research. This study did not include other document types such as conference papers, reviews, book chapters, conference reviews, books, letters, editorials, data papers, errata, notes, and unspecified publications. After applying the inclusion and exclusion criteria, 248 documents were selected for use in the research. Metadata from these 248 documents was then downloaded in CSV format. The next step involved bibliometric analysis using VOSviewer and Microsoft Excel. Factors considered included annual publication trends, citations, author productivity, country productivity, and journals publishing articles on Contextual Learning. Annual publication trends and citations were analyzed based on total publications (TP) and total citations (TC). The third step involved identifying keywords from the database and refining the analysis of Contextual Learning research. This identification was done by examining the frequency of keyword usage and the relationships between keywords. This research refinement analysis aims to determine the thematic evolution and current research trends related to Contextual Learning. This information is expected to benefit empirical researchers seeking research gaps and innovations.

C. RESULT AND DISCUSSION

1. Characteristics of Contextual Learning Publications in Science Education

This study examines research topics related to contextual learning at the global level using publication characteristic analysis. Based on bibliometric analysis, it was found that 782 articles obtained from the Scopus database and distributed from 2010 to 2022 were used as data sources in this study. Overall, Table 2 presents important information regarding the database used.

Table 2. Key information from the database

Criteria	Explanation
Time range	2010-2022
Source	118
Documents	248
Authors	247
Author keywords	893
References	11625

Data in Table 2 show that 248 scientific works have been published in 118 international journals with a total collaboration of 247 authors. Furthermore, 893 keywords have been identified from all documents, with a total of 11,625 references. The evolution of publication themes on contextual learning was analyzed using the

total publications (TP) and total citations (TC). The progress of publications is illustrated in Figure 2.

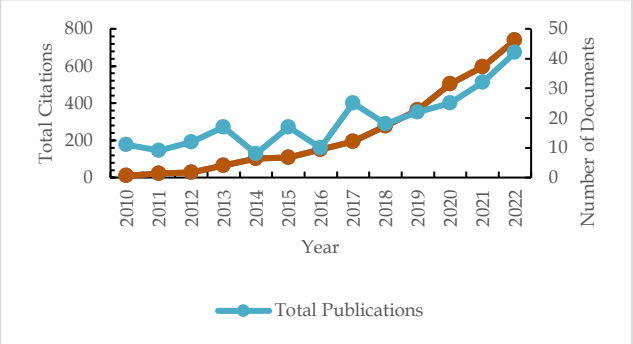

Figure 2. Distribution of TP and TC Trends in Contextual Learning Publications

The Scopus search between 2010 and 2022 found 248 articles on "Contextual Learning". Over the past decade, there has been a significant increase in the total number of publications. This development can be seen in the illustration in Figure 2. The most noticeable increase in publications occurred between 2017 and 2018. With the increasing innovation of contextual learning as the foundation of modern education, a positive transformation in students' learning experiences becomes more apparent. This approach, which emphasizes understanding concepts and integrates knowledge into real-world situations, transforms the role of teachers into facilitators guiding students in connecting lesson materials with their everyday experiences. With the increasing innovation in contextual learning, academic interest in this topic has experienced a significant surge. This phenomenon reflects the recent accelerated development of contextual knowledge and research in Science Education. Initially, the total publications (TP) fluctuated yearly until 2019, but from 2019 to 2022, TP showed an increasing trend. Meanwhile, although TP fluctuated from 2010 to 2019, each year's total citations (TC) consistently increased. In 2010, there were 10 citations from 11 published articles. The highest number of citations was recorded in 2022, with a total of 738 citations. These findings reflect the increasing interest in conducting research in the field of contextual learning in Science Education in recent years.

2. Characteristics of Contextual Learning Publications in Science Education Based on Author Productivity and Number of Citations

Based on the analysis results, the top 10 authors with the highest number of citations on contextual learning in science education are displayed in Figure 3.

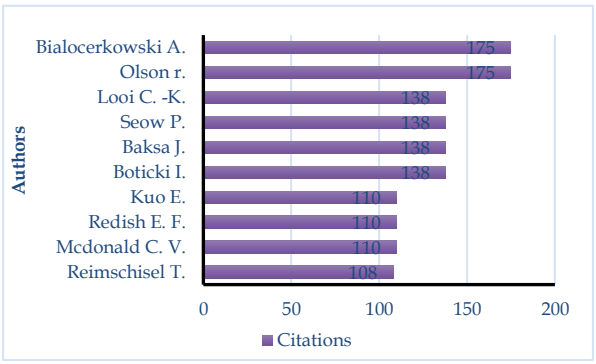

Figure 3. Top 10 Authors with the Highest Number of Citations

Based on Figure 3, Bialocerkowski A. and Olson R. have 175 citations, making them the most influential authors in research on contextual learning in Science Education. Looi C.-K., Seow P., Baksa J., and Boticki I., with 138 citations, are the second most cited authors after Bialocerkowski A. and Olson R. Furthermore, information about authors with the highest number of documents can be found in the illustration in Figure 4.

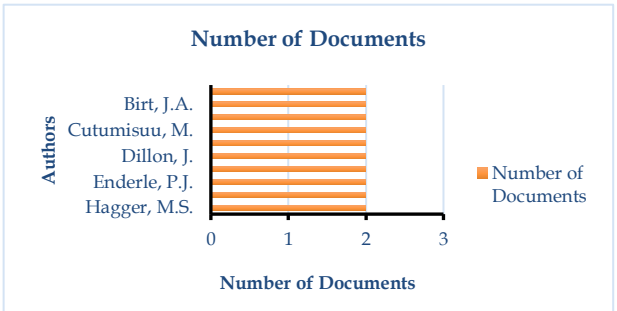

Figure 4. Top 10 Authors with the Highest Number of Articles

Figure 4 shows that 10 authors have an equal number of publications in the field of contextual learning research in Science Education, each with 2 documents. Table 3 shows the top ten articles with the highest citations in Contextual Learning in Science Education.

Table 3. Top 10 Articles with the Highest Number of Citations

Title	Authors	Sources	Cit.
Interprofessional education in allied health: A systematic review	(Olson & Bialocerkowski, 2014)	Medical Education	175
Usage of a mobile social learning platform with virtual badges in a primary school	(Boticki et al., 2015)	Computers and Education	137
Language of Physics, Language of Math: Disciplinary Culture and Dynamic Epistemology	(Redish & Kuo, 2015)	Science and Education	112
The influence of explicit nature of science and argumentation instruction on preservice primary teachers' views of nature of science	(McDonald, 2010)	Journal of Research in Science Teaching	110
A systematic review of the published literature on team-based learning in health professions education	(Reimschisel et al., 2017)	Medical Teacher	109
A person-in-context approach to student engagement in science: Examining learning activities and choice	(Schmidt et al., 2018)	Journal of Research in Science Teaching	85
Professional Development and Teacher Change: The Missing Leadership Link	(Whitworth & Chiu, 2015)	Journal of Science Teacher Education	73
Teaching and Learning About Complex Systems in K–12 Science Education: A Review of Empirical Studies 1995–2015	(Yoon et al., 2018)	Review of Educational Research	71
Infusing creativity into Eastern classrooms: Evaluations from student perspectives	(Cheng, 2011)	Thinking Skills and Creativity	63
Teaching as Assemblage: Negotiating Learning and Practice in the First Year of Teaching	(Strom, 2015)	Journal of Teacher Education	59

Based on Table 3, the most cited article was published in a Scopus-indexed Q1 journal. This indicates that the published articles are credible primary references for scientific advancement, particularly on Contextual Learning in Science Education. Using the research publication database on Contextual Learning in Science Education from 2010 to 2022, the top 10 articles with the highest citations were published between 2010 and 2018, totaling 935. Meanwhile, the year with the highest number of citations for articles published occurred in 2015, with 322 citations from 3 articles.

3. Characteristics of Contextual Learning Publications in Science Education Based on Country

The analysis of contextual learning publications in science education aims to identify the countries that have made the most significant contributions to publishing articles on this topic. Figure 5 shows the top ten countries with the highest publications in contextual learning in science education.

Figure 5. Top 10 Countries with the Highest Number of Publications

Based on Figure 5, the United States has the highest number of publications, with 91 articles. The United Kingdom follows it with 19 articles, South Africa with 17 articles, Australia with 14 articles, Sweden with 12 articles, Indonesia with 11 articles, Canada with 11 articles, Norway with 10 articles, Germany with 9 articles, and Turkey with 9 articles. Further analysis of the characteristics of contextual learning publications in science education is conducted based on the research collaboration map between countries using VOSviewer software, as shown in Figure 6.

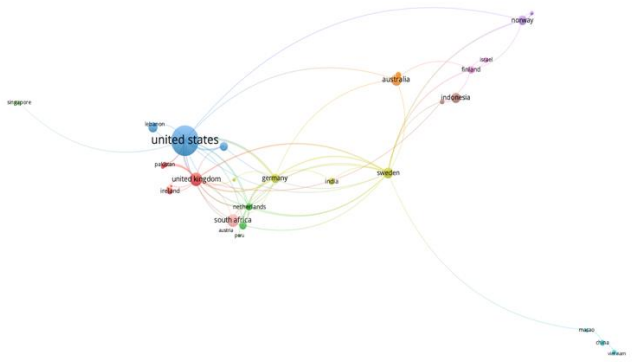

Figure 6. Publication Collaboration Among Countries in Contextual Learning in Science Education

Based on Figure 6, the analysis results show the presence of 7 clusters marked with different colors. The United States appears to be the center of the most significant collaboration in publications, as evidenced by the most extensive circle representing this country. Each circle in the figure represents a country; the more significant the circle, the more citations originate from that country. Collaboration among countries is represented by lines connecting these circles. The collaboration map indicates that cooperation between authors in Contextual Learning in Science Education is active worldwide, regardless of continent or specific geographic location. This demonstrates strong collaboration in related research worldwide, reflecting the importance of contextual learning as a relevant topic receiving widespread attention from the international education community.

4. Characteristics of Contextual Learning Publications in Science Education Based on Source

Many metrics can be used to evaluate contextual learning in science education, including the number of publications and citations per year or study, where publications reflect productivity and citations indicate impact and influence. Table 4 reviews the top 10 leading journal sources cited in research on contextual learning in science education, focusing on the h-index as the basis of assessment.

Table 4. Top 10 Most Cited Publication Sources

Sources	No. of Articles	Cit.	h-index	Quartile
Journal of Research in Science Teaching	6	296	150	Q1
Computers and Education	5	201	215	Q1
Journal of Science Teacher Education	8	184	53	Q1
Medical Education	1	175	155	Q1
Medical Teacher	4	123	131	Q1
Science and Education	3	122	55	Q1
Advances in Health Science Education	3	92	75	Q1
Research in Science Education	9	89	62	Q1
Eurasia Journal of Mathematics, Science and Technology Education	2	86	50	Q2
International Journal of Science Education	5	86	121	Q1

According to the data shown in Table 3, the "Journal of Research in Science Teaching" is recognized as a leading journal in contextual learning publications in science education, as evidenced by the number of citations and quartile (Q1). On the other hand, "Computers and Education" is also noted as a prominent journal in contextual learning publications in science education, as seen from the h-index, number of citations (which is the second highest after the Journal of Research in Science Teaching), and quartile (Q1). Journals classified in quartile 1 (Q1) indicate that in terms of quality, these journals excel compared to journals in other quartiles, as reflected by the h-index. Nine journals are classified in quartile 1 and one in quartile 2 (Q2).

5. Map of Contextual Learning Research Distribution Based on Co-occurrence Analysis

This section will evaluate the research process related to publications on contextual learning in science education. We will analyze the

use of keywords by authors, the development of themes, and ongoing topic trends.

a. Analysis of Author Keywords

Evaluating the keywords authors use is significant in identifying the research scope and primary focus on contextual learning in science education. There are 893 author keywords recorded from 248 articles in the database. The illustration in Figure 7 visualizes the interconnection among these author keywords.

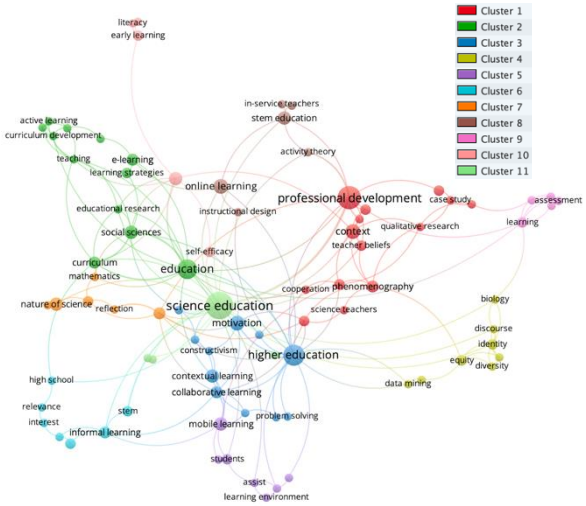

Figure 7. Visualization Map of Author Keyword Network

Figure 7 groups keywords into eleven clusters, as indicated by the colors shown in the figure. The size of the keyword bubbles indicates how frequently the keyword appears in the database, and the lines connecting each keyword indicate the relationships between them.

The most frequently occurring keyword in cluster 1 is "professional development", which appears 14 times and is connected to 11 other keywords, with a strength of the relationship of 17. Additionally, keywords such as "implementation science", "context", "phenomenography", "teacher beliefs", "teacher knowledge", "teacher motivation", "qualitative research", "case study", "cooperation", "science teachers", and "inquiry-based learning" are found in cluster 1. This indicates that contextual learning in science education impacts professional development for both teachers and students.

In cluster 2, the primary keyword that appears most frequently is "education", which appears 10 times and is connected to 15 other keywords with a relationship strength of 19. Keywords in this cluster include "curriculum", "social sciences", "educational research", "learning strategies", "e-learning", "teaching", and "active learning". This analysis shows that contextual learning in science education can comprehensively enhance the quality of education from various perspectives.

In cluster 3, the most frequently occurring keyword is "higher education", which appears 12 times and is connected to 19 other keywords, with a total relationship strength of 20. Keywords in this cluster include "motivation", "computational thinking", "game-based learning", "collaborative learning", "contextual learning", "contextual teaching," "constructivism," "react strategy," and "Pakistan." The analysis shows that contextual learning in science education can improve various skills required in the 21st century.

In cluster 4, the most frequently occurring keyword is "equity", which appears 3 times and is connected to 5 other keywords, with a total relationship strength of 5. Additionally, keywords such as "biology", "discourse", "identity", "diversity", and "data mining" also appear in this cluster. The analysis suggests that contextual learning in science education emphasizes efforts to ensure equal access and opportunities in education.

In cluster 5, the most frequently occurring keyword is "mobile learning", which appears 5 times and is connected to 7 other keywords, with a total relationship strength of 8. Additionally, keywords such as "student", "assist", "learning approaches", "deep learning", and "learning environment" also appear in this cluster. This indicates that contextual learning can enhance the quality of education through various media.

In cluster 6, the most frequently occurring keyword is "informal learning", which appears 4 times and is connected to 6 other keywords, with a total relationship strength of 6. Additionally, keywords such as "high school", "relevance", "interest", "STEM", and "environmental education" also appear in cluster 6. The analysis suggests that contextual learning can be applied in both formal and informal settings with various approaches.

In cluster 7, the most frequently occurring keyword is "nature of science", which appears 5 times and is connected to 3 other keywords, with a total relationship strength of 3. Additionally, keywords such as "mathematics" and "chemistry" appear in this cluster. The analysis indicates that contextual learning in

science education can be applied across various scientific fields, such as mathematics and chemistry.

In cluster 8, the most frequently occurring keyword is "online learning", which appears 6 times and is connected to 5 other keywords, with a total relationship strength of 5. Additionally, keywords such as "in-service teachers", "STEM education", "activity theory", and "instructional design" are present. The analysis suggests that contextual learning in science education facilitates the development of technology-based learning strategies to enhance the quality of STEM education for teachers undergoing training, utilizing activity theory and practical instructional design.

In cluster 9, the most frequently occurring keyword is "learning", which appears 3 times and is connected to 7 other keywords, with a total relationship strength of 7. Additionally, keywords such as "choice", "feedback", "assessment", and "performance" also appear in cluster 9. Based on the analysis, contextual learning in science education highlights the importance of using diverse evaluation strategies, feedback, and assessments that provide students with choices in the learning process to improve their academic performance.

In cluster 10, the most frequently occurring keyword is "science", which appears 3 times and is connected to 7 other keywords, with a total relationship strength of 7. Additionally, keywords such as "literacy", "early learning", and "self-efficacy" are present in this cluster. This indicates that contextual learning in science education emphasizes the importance of early understanding of science, enhancing scientific literacy and students' confidence in facing scientific materials.

In cluster 11, the most frequently occurring keywords are "elementary education" and "teacher preparation", each appearing 2 times, connected to 2 other keywords, with a total relationship strength of 2. The analysis suggests that contextual learning can be applied across various levels, from elementary school to higher education. In this regard, contextual learning in science education highlights the importance of teacher preparation in providing effective and relevant elementary education for students at the primary school level.

b. Trends in Keywords in Contextual Learning in Science Education

Observing keyword patterns is utilized to assess the novelty of research topics. By analyzing trends, we can observe keywords frequently appearing in publications in specific years. Figure 8 provides an overview of the evolution of keywords in publications on contextual learning in Science Education from 2010 to 2022.

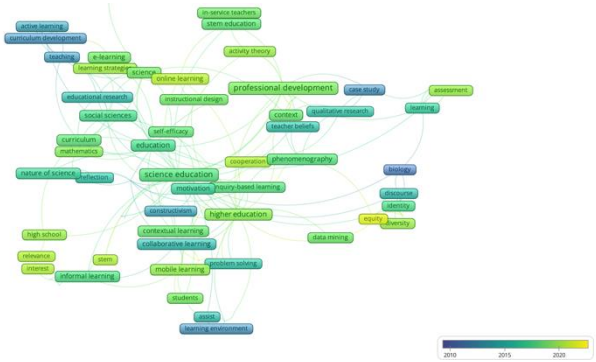

Figure 8. Author Keywords Trends

In the illustration in Image 9, the colour variations indicate the average frequency of publications from year to year. Darker shades (purplish-blue) reflect keywords commonly used in the earlier periods, while yellow indicates newer keywords in the context of contextual learning research in Science Education. Terms such as "equity," "STEM," "online learning," "cooperation," and "interest" reflect emerging fields with significant potential for further investigation in contextual learning studies in Science Education. These topics may remain popular and relevant in implementing contextual learning in Science Education. This data can guide researchers and academics in selecting appropriate research topics and ensuring their research remains relevant to current developments.

D. CONCLUSION

From 2010 to 2022, there has been an increase in articles discussing contextual learning in Science Education published annually in international journals. The total number and average citations for these articles also increased each year. Bialocerkowski A. and Olson R. are the authors with the most citations, totaling 175, related to contextual learning in science education. The most cited article is "Interprofessional Education in Allied Health: A Systematic Review", with the same number of citations, 175. Based on the map of collaboration between countries, the United States appears to be

the most significant center for collaboration in research on contextual learning in Science Education. Furthermore, the journal "Journal of Research in Science Teaching" stands out in the publication of Contextual Learning in Science Education, based on the number of citations and quartile (Q1). This bibliometric study also found a correlation between the keywords used by authors, reflecting the development of subtopics in the context of contextual learning in Science Education. These findings identify 99 subtopics with a minimum of two interconnections that become trends and can provide an overview of the topic for empirical researchers, including "Professional Education," "Science Education," "Education," "Context," and "Contextual Learning".

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