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Bibliometric Analysis: Global Research Trends on Students' Epistemic Beliefs in Educational Process in the Last Decade

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ABSTRACT

Purpose – Student epistemology can be understood as an intrinsic aspect that influences student success in learning activities. Therefore, teachers need to innovate learning methods based on the level of understanding and needs of students in order to conduct and engage them in learning activities within the school environment.

Methodology – The research aims to map the trend of research development related to student epistemic in the learning process based on the Scopus database. There are 890 metadata records of Scopus-indexed journal articles from the period 2013-2022, which are analyzed bibliometrically using the VOSviewer software to identify trends in student epistemic research.

Findings – The study's results revealed that research publications related to student epistemic development from 2013 to 2022, with the highest Scopus index in 2022, comprised 184 articles (20.44%). Bibliometric mapping also shows that student epistemic research with the themes "epistemic access, epistemic access, epistemic practices, epistemological beliefs, and epistemic tools" has a novelty to research. This can provide an opportunity for further research related to student epistemic studies.

Significance – The implications of this research are expected to make a significant contribution to academics, researchers, and educational practitioners in understanding the field of student epistemic studies, as well as providing recommendations for researchers to conduct further research related to students' epistemic abilities in learning activities at school.

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INTRODUCTION

The ideal learning process for students should be based on the results of diagnostic analyses related to their epistemic beliefs in the field of study being learned. Students' epistemic knowledge is considered to influence the growth of interest and motivation to learn (Lonka, K. et al., 2021; Noroozi, O., 2022). This condition

can be observed in the reflections of some students who still consider learning mathematics difficult to understand and complicated, involving a significant amount of memorization of addition, multiplication, and division formulas. This has formed a pessimistic attitude in students, which has implications for their achievement in the learning process. This is where the importance of a teacher's position to build and generate positive suggestions for students through learning innovations that are not only focused on the achievement of the cognitive domain but also emphasize the formation of students' epistemic beliefs within the scope of education units (Bernholt, A., 2021; Nieminen, J. H., 2021).

The concept of student epistemic generally emphasizes the domain of individual beliefs in constructing knowledge. Examination of the student's epistemic theory base also illustrates that each student has diverse potential in interpreting knowledge (Lonka, K. et al., 2021; Miguel-Revilla, D., 2022; Sendur, K. A., 2022). It is in this context that teachers are expected to form students' epistemic beliefs as the basis for explorative prior knowledge in students. The teacher's position is also considered to play a crucial role in facilitating organized learning for students within the scope of the education unit (Bernholt, A., 2021; Ioannou, K., 2020). Discussing students' epistemic knowledge and its relevance to the teaching process reflects teachers' instructional moves to build knowledge, translate ideas to one another, and make connections to students' lives. Responsive instruction that recognizes and builds on students' intellectual curiosity and enthusiasm will contribute to the formation of epistemic knowledge (Brocos, P., 2022; Merikko, J., & Kivimäki, V., 2022; Reiser, B. J. et al., 2021)

Regarding this, Jo Lunn Brownlee identifies three primary factors that shape students' epistemic formation during the learning process. Firstly, belief absolutism involves the view that knowledge is comprised of facts that can be transmitted through direct instruction. Second, belief multiplicity reflects that knowledge is constructed based on one's personal opinions. Competing opinions have equal value, so individuals who hold such beliefs tend to listen to and value the opinions of others in the classroom. Third, valuation beliefs refer to the perspective of knowledge based on the results of judgments made after evaluating various sources of evidence. Jo Lunn Brownlee also thinks that students' epistemic beliefs can be developed through innovative learning models that provide space for students' creativity to take real action in emphasizing themselves (Lunn Brownlee, J., 2017; Jin, Q., & Kim, M., 2021).

Several previous studies have illustrated the importance of understanding student epistemic aspects in the learning process, including Brocos' research, which shows that socio-cognitive tension factors influence student epistemic development. He also revealed that students possess epistemic abilities, characterized by high socio-cognitive skills, which enable them to construct arguments and solve learning problems (Brocos, P., 2022). The same point was made by Chen Y.C., who outlined the epistemic uncertainty of students as a pedagogical resource that teachers should consider through knowledge-construction efforts. So that students have the opportunity to show skills as a collaborative epistemic resource to develop knowledge that can be accepted (Chen, Y.-C., 2020; Baytelman, A. et al., 2020); other studies also describe several main things related to the importance of students' epistemic positions in the learning process within schools such as Tzung-Jin Lin's position, revealing the position of students with good epistemic in the learning process, such as science learning has a different impact and shows participatory behavior in various learning processes carried out at school. Meanwhile, the condition of students reveals a highly uncertain orientation toward epistemic abilities about scientific knowledge, which can hinder their engagement in science learning (Lin, T.-J., 2021). The same point was made by Aidha Azizah Amatullah, who believes that the existence of students' epistemic beliefs is closely related to their critical thinking skills and academic achievement. In other words, the higher the level of epistemic belief, the better the students' critical thinking and the better the students' achievement during the learning process at school (Amatullah, A. A., et al., 2021)

The results of other studies also mention, among others, that students' epistemic beliefs have a positive impact on the formation of participatory attitudes and student well-being during learning activities; students who have a mature epistemic perspective tend to be responsive to the use of learning strategies and have a more effective understanding of texts in the learning process at school, and epistemic uncertainty can lead to failure, and opportunities for students in Building Knowledge (Ioannou, K., 2020; Listyadi, T. et al, 2023; Tong, Y.,2023). Thus, student epistemic can be understood as an intrinsic aspect that influences student success in learning activities; therefore, teachers need to innovate learning methods based on the level of understanding

and needs of students in order to conduct and engage them in learning activities within the school environment. By understanding the background, relevance, and urgency of learner constructs based on student epistemology, teachers are better equipped to appreciate the importance of developing quality and competitive learning environments in the school. Teachers need to understand the development of learning processes based on epistemological studies of students. However, it must be realized that so far, teachers have not fully understood the scope of student epistemic as a basis for diagnostic evaluation in the learning implementation process. However, understanding students' epistemic position can help teachers address student learning problems, enhance students' literacy skills, and increase students' interest and curiosity during the ongoing learning process (Wicaksana, Y., 2017; Anggrayni, D. et al., 2021). From another perspective, students' high epistemic level also has positive implications for reducing students' anxiety levels and, at the same time, being a factor that encourages academic achievement in students during the learning process in the school environment (Sari, Y. P., 2021; Wandansari, S. A., & Hernawati, 2021; Putra, A., 2022).

In this context, bibliographic research is important to map the picture of research trends in the last 10 years related to students' epistemic beliefs in the school environment, especially their views on the source, structure, and validity of knowledge, which play an important role in determining how they learn, understand information, and form critical thinking patterns. Amid the rapid development of science and technology in education, a comprehensive understanding of the direction and development of research related to epistemic beliefs is indispensable. To date, however, there have been few studies that systematically map the global trends in research in this area. The lack of synthesis based on bibliometric data makes it difficult for education scholars and practitioners to identify advances, limitations, and new opportunities in this field. Thus, it is imperative to conduct this research to provide a comprehensive and data-driven picture of the dynamics of global research on students' epistemic beliefs.

The academic contribution of this research is also significant for the development of educational science and educational psychology. Through a bibliometric approach, this study will produce a scientific map that illustrates publication trends, collaboration between researchers and countries, major journals, and keywords that dominate academic discourse on this topic. This information is not only useful as a reference for both novice and experienced researchers but also as a valuable resource for those seeking to enhance their understanding of the topic. However, it can also identify under-explored research gaps, such as cultural differences, education levels, or specific learning approaches. In addition, the results of this study have the potential to strengthen academic collaboration across countries, expand methodological horizons through the application of bibliometrics in epistemic studies, and serve as a basis for the formulation of educational policies based on facts and empirical facts in the perspective of students in the school environment.

Based on the description above, the position of this research with bibliometrics on "Bibliometric Analysis of Global Research Trends on Students' Epistemic Beliefs in the Educational Process" needs to be carried out to obtain an overview and conduct thematic mapping related to student epistemic research trends in the learning process including; 1) Development of student epistemic research publications; 2) Journal of relevant publications in student epistemic research; 3) Productivity of relevant researchers in student epistemic; 4) Publication of student epistemic research based on institutional affiliation and contributor country; 5) Mapping the development trend of student epistemic research topics based on keywords (co-word). The results of this bibliometric research will provide an overview of the development of research related to student epistemic. The final result of this research is expected to map research opportunities related to the epistemic aspects of students as they construct their knowledge during the learning process within the scope of the education unit.

METHODOLOGY

This study used bibliometric methods to investigate research trends related to epistemic students in the learning process in schools. Bibliometric methods are used to map the research carried out in recent years in the field of epistemic studies of students. The use of bibliometric methods is also intended as an approach to understanding issues and research directions in the epistemic realm of students in the last 10 years. The database for this research comprises 890 journal articles, which refer to the results of international publications sourced from the Scopus-indexed database, covering the period from 2013 to 2022 and related to epistemic

students in the learning process. The scope of this bibliometric research will capture the number of publication outputs, most relevant journals, productive researchers, contributing institutions and countries, cluster analysis, keyword analysis, and distribution maps of variable or dominant themes that are interconnected with the student's epistemic field of study (Dilekçi, Ü., 2022; Gunes, U., 2023; İnci, G., 2024). With bibliometric research methods, it is possible to obtain information on students' epistemic research trends through retrospective reviews, which are beneficial to education experts and school curriculum evaluators (Pham, P., 2022; Kutlu Abu, N., 2023).

Research Design

This research design consisted of several stages, including exploration, visualization, identification, and verification, as shown in Figure 1. The exploration stage is the search for article metadata in the Scopus database; the visualization stage is carried out using VOSviewer Software; the identification stage by mapping network variables or topics; and the verification stage is the evidence found through mapping research themes and trends related to students' epistemic research (Pradana, K. C., 2022; Semirhan Gökçe, P. G., 2021; Şeker, F., 2022). These stages provide a path for searching articles to characterize clusters based on emerging terms related to student epistemic studies in school learning.

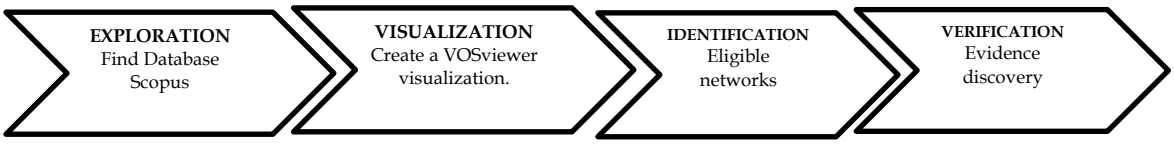

Figure 1. Stages of Research with Bibliometric Approach

Identification of source

This research aims to map research trends and publications related to student epistemic in the learning process, which is considered very important for teachers to know in order to maximize student learning potential in the school environment. The research process utilizes bibliometric methods to map research trends related to student epistemic development during the learning process in schools. The database for this research comprises 890 journal articles, referring to the results of international publications sourced from the Scopus-indexed database, covering the period from 2013 to 2022, related to epistemic students in the learning process. Data collection using the search keywords "epistemic students" and "learning, with search categories of article titles, abstracts, and keywords as follows; (TITLE-ABS-KEY (student AND epistemic) AND TITLE-ABS-KEY (learning)) AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013)) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "final")).

Furthermore, research data in the form of the number of publications per year, journals that contain student epistemic including author information, origin, and research topics from 2013 to 2022, which are processed and analyzed bibliometrically using VOSviewer software including the development of student epistemic research, core journal publications, the most productive authors, university affiliations, and mapping of student epistemic research topics based on keywords that often appear in research. The bibliometric analysis process also emphasizes the mapping of frequently occurring topics, as well as the collaboration of authors and institutions in relevant research. The final results of this bibliometric analysis are expected to identify further research opportunities and trends in scientific publications related to student epistemic development in the learning process within the school environment.

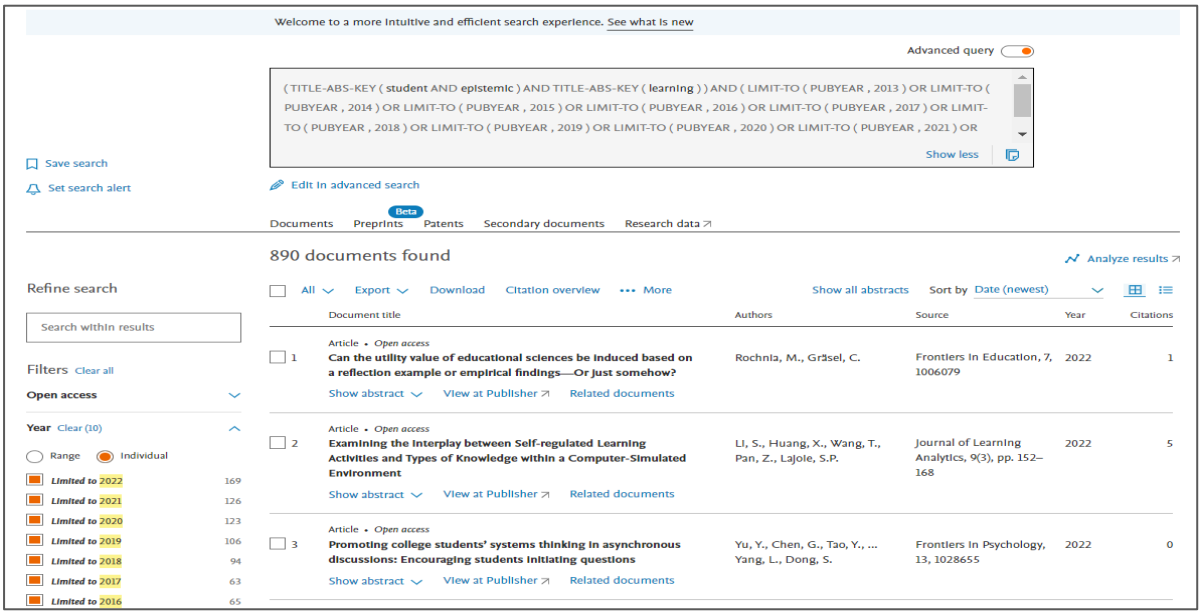

Figure 2. Keyword Search Results with Scopus Database Related Students Epistemic

Data Analysis

Data analysis in the study employed descriptive analysis, conducted through a meta-data review of articles sourced from the Scopus database (Zupic, I., 2015; Akyüz, H., 2021). Based on the identification of Scopus articles, the metadata of 890 relevant article documents that meet the criteria was successfully collected related to the themes and trends of student epidemic research in the learning process at school. In the next stage, the metadata of the articles was analyzed using VOSviewer software to identify and describe the trends of students' epistemic research in schools. Procedurally, bibliometric analysis encompasses various aspects, including the frequency of research based on the year of publication, the most productive author, college affiliation, and keywords that often appear in student epistemic research issues (Talan, T., 2021; Ninkov, A., & Frank, J. R., 2022). The bibliometric analysis process also emphasizes topic mapping based on the distribution of themes that often appear in articles, as well as the collaboration of authors and institutions in relevant research related to student epistemic studies in the learning process at school (Gunes, U. et al., 2023; İnci, G., & Köse, H., 2024). The bibliometric analysis process can provide an objective perspective on research trends in the field of student epistemic studies from 2013 to 2022, with a focus on the learning process in schools. The use of bibliometric methods aims to demonstrate a scientific approach to understanding issues and research directions. This research analysis is also expected to make a significant contribution to academics, researchers, and practitioners in understanding and further developing research, especially in the field of student epistemic studies within the school environment.

FINDINGS

There are several important sections described in the results and discussion to describe research trends related to student epistemic in the learning process, among others: 1) Development of student epistemic research publications; 2) Journal of relevant publications in student epistemic research; 3) Productivity of relevant researchers in student epistemic; 4) Publication of student epistemic research based on institutional affiliation and contributor country; 5) Mapping the development trend of student epistemic research topics based on keywords (Co-Word), as follows:

Development of Student Epistemic Research Publications

The development of research publications on epistemic students in the learning process, based on international publication data from 2013 to 2022, experienced a significant increase compared to the previous few years. According to the Scopus-indexed research database, the growth of research publications on student

epistemic development is highest in 2022, reaching 184 publication articles (20.44%). Further information on publication data on student epistemic can be seen in Table 1

Table 1. Year of Publication of Student Epistemic Research

Year published	Document	Percentage (%)
2022	184	20,44%
2021	130	14,44%
2020	118	13,11%
2019	105	11,67%
2018	92	10,22%
2017	63	7,00%
2016	65	7,22%
2015	53	5,89%
2014	40	5,00%
2013	40	5,00%
Total	890	100

The development of research publication growth regarding epistemic students in the learning process is evident in Table 1. Figure 2 reveals that from 2013 to 2022, there was a significant increase in publications, with 184 articles (20.44%) in 2022. In contrast, the increase in the previous two years, 2021 (130 articles, 14.44%) and 2020 (118 articles, 13.11%), was lower compared to the publication data in 2021. Based on these data, it has been illustrated that the trends in the development of research publications related to students' epistemic beliefs in learning can have a significant impact on researchers.

The increase in the number of publications related to students' epistemic beliefs in learning in 2022, which reached 184 articles or 20.44% of the total publications over the past decade, reflects important dynamics in the global education domain. One of the primary factors driving this surge is the ongoing impact of the COVID-19 pandemic on global education systems. During the pandemic, the learning system has undergone a drastic shift from face-to-face to online le, which requires students to develop the ability to learn independently, think critically, and evaluate information independently. In this context, epistemic beliefs become an important variable to investigate because they influence how students process digital information, distinguish credible sources, and actively shape their knowledge, often without direct guidance from teachers. Researchers are encouraged to explore how these epistemic beliefs develop and change in a new learning environment full of uncertainty. In addition to the pandemic factor, the growing attention to 21st-century education is also a significant backdrop. Modern education today emphasizes not only mastery of content but also higher-order thinking skills such as critical thinking, problem-solving, and lifelong learning, which are closely related to epistemic beliefs. Educational institutions, governments, and international organizations such as the OECD encourage curricula and policies that support the development of students' reflective capacity for knowledge. This has prompted researchers to deepen their understanding of how students construct beliefs about knowledge and how these beliefs affect their learning.

As such, epistemic beliefs are no longer considered a secondary issue but rather a key component in the development of student competencies in the information age. Other factors are also influenced by advances in access to scientific data, international academic collaboration, and the ease of digital publication, which have developed rapidly after 2020. International academic conferences, seminars, and research projects focusing on topics such as digital literacy, metacognition, and the epistemology of education have created opportunities for cross-disciplinary discussions. In addition, the growing awareness of the importance of an interdisciplinary approach to understanding student learning has encouraged researchers from the fields of educational psychology, educational philosophy, and learning technology to collaborate in exploring epistemic beliefs across various contexts. Support from research funding agencies and the emergence of new journals focused on educational innovation is also expanding the space for publication, allowing for a significant surge in the number of articles published by 2022.

Journal of Relevant Publications in Student Epistemic Research

Based on a search for keywords' epistemic students 'and 'learning articles' in the Scopus database, ten publications with the highest number of articles and citations were identified. Of these, it is known that publications related to epistemic students are primarily published in the Science Education journal (25 article publications, with a citation index of 606). The top ten core journals that publish research results related to student epistemic can be seen in Table 2.

Table 2. The Main Journal of Student Epistemic Publications

Name of Journal	Document	Citation
Science Education	25	606
Journal of Research in Science Teaching	21	497
International Journal of Science Education	28	395
Learning and Instruction	7	363
Computers and Education	13	282
International Journal of Computer-Supported Collaborative Learning	9	249
Journal of The Learning Sciences	7	232
Contemporary Educational Psychology	5	220
Research in Science Education	15	183

Referring to the explanation of Table 2 and Figure 2, it can also be seen that there are five scientific publication journals with the highest number of research documents related to the theme of epistemic students in the learning process: International Journal of Science Education (28 publications), Science Education (25 publications), Journal of Research in Science Teaching (21 publications), Research in Science Education (15 publications), and Computers and Education (13 publications). The results of this mapping also show the ten publication journals that are highly productive in conducting research related to students' epidemic research topics during the learning process. Thus, these journals can serve as a reference and primary publication source for researchers in the epistemological field of students.

The mapping results also reveal the International Journal of Science Education (IJSE) to be the most prominent source of research related to students' epistemic beliefs in the learning process for several strategic and substantial reasons that make it the primary channel for disseminating studies on this theme. First, the journal's primary focus is on science education, which is conceptually closely related to the development of students' epistemic beliefs. Science education not only teaches scientific content but also emphasizes scientific thinking, the validity of knowledge, and the process of forming evidence-based understanding—all of which are at the core of epistemic beliefs. Thus, many researchers have made this journal an ideal platform for publishing their research due to its suitability in terms of theme and approach.

Second, the International Journal of Science Education has a high reputation in the field of education and a strong indexation in various international scientific databases, including Scopus and Web of Science. This reputation makes the journal a prime destination for researchers seeking to reach the global scientific community and gain broader academic recognition. As the topic of epistemic beliefs is closely linked to cutting-edge educational issues such as science literacy, critical thinking, and inquiry-based learning, the journal is a strategic platform to discuss how students construct scientific understanding and how teachers and curricula can support this process. On the other hand, IJSE is open to this kind of multidisciplinary approach, which allows researchers to examine epistemic beliefs from various theoretical and methodological perspectives, whether quantitative, qualitative, or mixed. With its broad scope and targeted audience, the journal provides an ideal platform for researchers to explore the relationship between students' epistemic beliefs and learning outcomes, as well as the impact of teaching practices and educational policies. This is what makes IJSE the most productive and most in-demand for publications on these themes.

Productivity of Relevant Researchers in Student Epistemic

The productivity of the top 10 researchers who published their research results on epistemic students in the learning process from 2013 to 2022, indexed by Scopus, is evident in their varying productivity, as indicated by the number of published articles, which ranges from 5 to 12 articles, as shown in Table 3.

Table 3. Student Epistemic Researcher

Author Name	Document	Citation
Muis K.R.	12	615
Sinatra G.M.	9	509
Pekrun R.	9	421
Greene J.A.	5	303
Tsai C.-C.	15	245
Liang J.-C.	10	176
Chen Y.-C.	7	116
Rosman T.	6	106
Chiu Y.-L.	5	96
Hand B.	7	52

Referring to the description of Table 3 and Figure 3, Tsai C.-C became the author with the highest level of productivity with 15 publication articles; Muis K.R with 12 publication articles; Liang J.-C, there are 10 publication articles; Sinarta G.M and Pekrun R each nine publication articles; Chen Y.-C and Hand B, each seven publications; Rosman T with six publications; Greene J.A., and Chiu Y.-L with a total of 5 publication articles each. The results of the researchers' publications are also interconnected. The description of the flow of connectivity between the authors of articles on epistemic students in the learning process, such as the existence of a network of research publications conducted; Tsai C.-C., Chen Y.-C., Hand B., Greene J.A., Muis K.R., Pekrun R., and Rosman T and others, has shown the existence of connectivity of research publications related to epistemic students in the learning process which can be observed in the results of the Vosviewer analysis with the analysis item Network Visualization as follows:

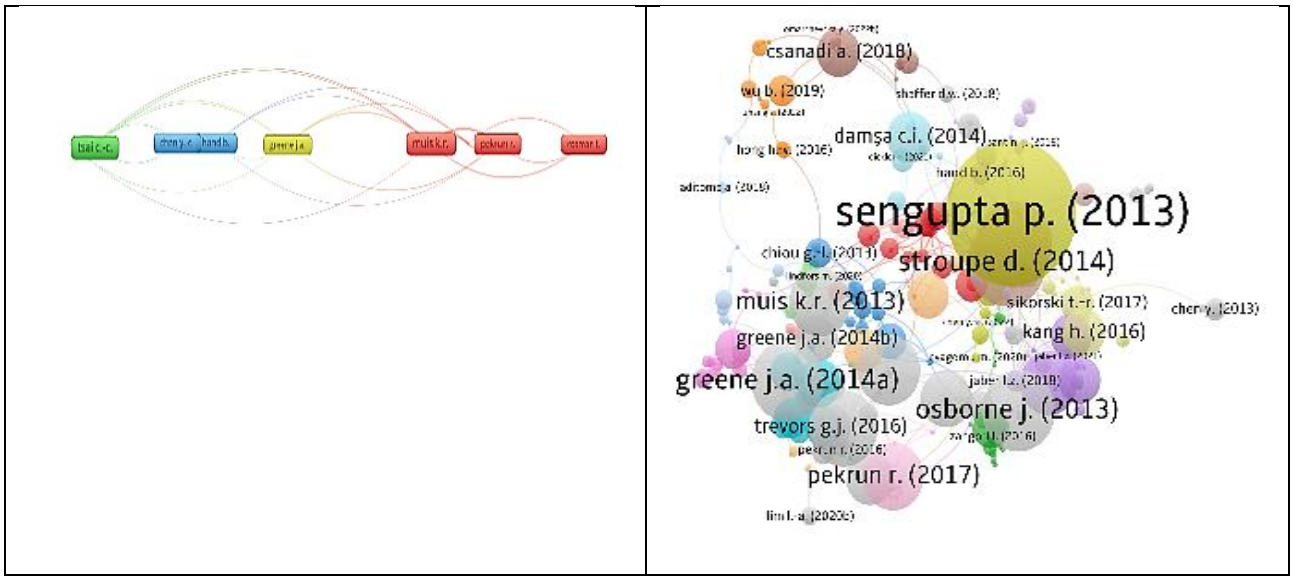

Figure 3. Group citation Publication Researcher Epistemic Student

Publication of Student Epistemic Research Based on Institutional Affiliation and Contributor Country

There are ten university affiliates as publication institutions at the formal education level that publish the most research about epistemic students in the learning process, including National Taiwan University of Science And Technology Taipei, University of Munich, Graduate Institute of Science Education National Taiwan

Normal University Taipei, University of Helsinki, Australian Catholic University, Institute For Research Excellence In Learning Sciences National Taiwan Normal University, Leibniz Institute For Psychology Information, University of Southern California, Universidad De Granada, and Vanderbilt University. Of all the higher education institutions that publish, the number of documents and citations related to epistemic students in the learning process can be seen in Table 4 as follows:

Table 4. Affiliation Student Epistemic Research Publications Citation

Publication Affiliation	Document	Citation
Graduate Institute of Digital Learning and Education, National Taiwan University of Science and Technology Taipei, Taiwan	6	96
University of Munich, Germany	5	265
Graduate Institute of Science Education, National Taiwan Normal University, Taiwan	5	17
University of Helsinki, Helsinki, Finland	4	8
Australian Catholic University, Sydney, Australia	4	249
Institute for Research Excellence in Learning Sciences National Taiwan Normal University, Taipei, Taiwan	3	6
Leibniz Institute for Psychology Information (Zpid), Trier, Germany	3	42
Rossier School of Education, University of Southern California, United States	3	147
Universidad De Granada, Granada, Spain	3	19
Vanderbilt University, United States	3	14

Table 4 presents the position of the National Taiwan University of Science and Technology, Taipei, as a higher education institution that has published the most research topics related to epistemic students, specifically in six publications. Meanwhile, the University of Munich and the Graduate Institute of Science Education, National Taiwan Normal University, Taiwan. Both are in the second strip, with each featuring five articles on student epistemic aspects in the learning process. The third position is occupied by the University Of Helsinki and the Australian Catholic University, with a total of 4 publication articles each. Furthermore, the Institute for Research Excellence in Learning Sciences, National Taiwan Normal University, the Leibniz Institute for Psychology Information, the University of Southern California, the Universidad de Granada, and Vanderbilt University have each published three research publications related to student epistemic aspects in the learning process.

The dominance of higher education institutions from Taiwan, such as the National Taiwan University of Science and Technology and the National Taiwan Normal University, in research publications related to students' epistemic beliefs reflects the country's strong commitment to developing research-based educational quality and pedagogical innovation. There are several key reasons why Taiwan stands out in this area. First, the education system in Taiwan places great emphasis on science and technology-based education, as well as the development of higher-order thinking skills, including the ability to think critically, reflectively, and independently—all of which are directly related to the epistemic aspects of students. The Taiwanese government is also actively promoting curriculum reform based on 21st-century competencies and literacy, which emphasizes not only the content of lessons but also students' understanding of the process of knowledge formation. In this context, epistemic beliefs become a key concept that is important to research in order to support more effective learning policies and practices. Second, Taiwan has a strong and integrated education research ecosystem supported by collaboration between universities, research centers, and education policy agencies. Institutions such as National Taiwan Normal University have graduate programs and science education research centers that actively conduct empirical and theoretical studies related to science learning and educational epistemology. Many of these studies receive funding support from the government and international organiza-

tions and are published in reputable international journals. In addition, the academic culture in Taiwan encourages international collaboration and global publication, making their research results easily accessible and contributing significantly to the global research map.

Third, there is a strong tendency among Taiwanese academics to adopt a cross-disciplinary approach, combining the perspectives of cognitive psychology, science education, and learning technology. This creates a new space for exploring the topic of epistemic beliefs that may not have been previously addressed in other countries. The perseverance in developing instruments, evaluating classroom practices, and applying learning theories in complex local contexts has made Taiwan one of the leading research centers in student epistemic studies. Thus, the high number of publications from Taiwanese institutions is not only a reflection of quantity but also shows the depth and strategic focus on the importance of epistemic research in improving the quality of learning.

In addition to data on the top ten university affiliations with the number of research publications related to student epidemic, there are 5 (Three) universities with the most publication document citation index. In this case, the University of Munich, Germany, is the first affiliation with a total of 265 publication citations; second place is occupied by the Australian Catholic University, Sydney, Australia, with 249 publication citations; third position is the Rossier School of Education, University of Southern California, United States with 147 publication citations, fourth rank National Taiwan University of Science and Technology, Taipei, Taiwan with 96 publication citations. In fifth place is the Leibniz Institute for Psychology Information (Zpid), Trier, Germany, with 42 publication citations. The five institutions that publish research related to student epidemic in the learning process, which can be seen in Table 5 as follows:

Table 5. Affiliation With Top Citation Student Epistemic Research

Publication Affiliation	Document	Citation
University of Munich, Germany	5	265
Australian Catholic University, Sydney, Australia	4	249
Rossier School of Education, University of Southern California, United States	3	147
Graduate Institute of Digital Learning and Education, National Taiwan University of Science and Technology, Taipei, Taiwan	6	96
Leibniz Institute for Psychology Information (Zpid), Trier, Germany	3	42

Furthermore, Table 6 presents the position of ten countries that contribute to Scopus-indexed student epistemic-related research publication documents, with the United States, United Kingdom, Australia, Germany, Taiwan, Canada, China, Finland, the Netherlands, and Israel occupying the highest numbers. To illustrate this, it is explained in the following table:

Table 6. Top Contributing Countries to Students' Epistemic Field Research

Countries	Documents	Citation
United States	289	4665
United Kingdom	73	866
Australia	63	683
Germany	62	913
Taiwan	50	510
Canada	40	755
China	32	137
Finland	30	412
Netherlands	27	311
Israel	16	210

Referring to the explanation in Table 6, it can be seen that the country that publishes the most research on epistemic students is the United States (289 publications)—then followed by the United Kingdom (73 publications), Australia (63 publications), Germany (62 publications), Taiwan (50 publications), Canada (40 publications), China (32 publications), Finland (30 publications), Nederlands (27 publications), and Israel 16 publications). Furthermore, Figure 4 shows that the thicker yellow color represents the dominant image of the country that publishes the most epistemic research fields related to students' learning processes in the school environment. In this case, the United States occupies the top position as the country with the most significant number of publications in the field of studying students' epistemic beliefs, namely 289 publications, due to several structural, academic, and historical factors that strongly support the development of research in the field of education, especially in cognitive and epistemological aspects of learning due to several important aspects including; First, the US has a long tradition in educational research and cognitive psychology. The concept of epistemic beliefs itself developed from theories originating from US academics, such as William Perry, Barbara Hofer, and Paul Pintrich, who formed the initial foundation of the study of students' beliefs about knowledge and the process of knowing. This is supported by leading research institutes, world-class universities, and educational associations, such as the American Educational Research Association (AERA), which actively encourages the publication, collaboration, and dissemination of educational research. This fosters a rich and productive research ecosystem that yields a large number of high-quality scientific publications.

Second, the high level of research funding and access to academic resources in the US makes it easy for researchers to explore in-depth topics such as epistemic cognition. Many universities and educational institutions in the US receive grants from the federal government (such as from the National Science Foundation) and private organizations to conduct experimental and longitudinal research on how students form, reflect, and revise their understanding of knowledge in various learning contexts. This topic is becoming increasingly relevant in 21st-century education, which demands information literacy, critical evaluation skills, and inquiry-based learning. Third, the diversity of educational contexts and openness to interdisciplinary approaches in the US is another important factor. The education system in the US encompasses various school models, learning cultures, and diverse ethnic and socio-economic backgrounds of students, which enable epistemic research to be conducted within multiple frameworks and contextual variables. In addition, collaboration between the fields of educational psychology, cognitive science, educational philosophy, and learning technology is strong in the US, encouraging holistic and innovative research. This makes the US a global center for the development of educational theory and practice rooted in a deep understanding of students' epistemic processes. As such, the US is the country with the most significant contribution of publications in this study.

DISCUSSION

Mapping The Development Trend of Student Epistemic Research Topics Based on Keywords (Co-Word)

The mapping of research topic trends is an important part of ensuring the development and opportunities for further research in the study of student epistemic in the learning process in the school environment. The research mapping process is carried out with the help of VosViewe software to provide a more valid visualization of research trends conducted over the last 10 years using the keyword 'student epistemic.' Based on the search results through article data on the Scopus website, 890 metadata documents of published articles on student epistemic in the learning process were obtained. Article metadata documents are processed in CSV format and then analyzed with the VosViewer application, resulting in the following analysis data.

The results of the VOSviewer visual network circle in the following Figure 5 shows the existence of 8 clusters consisting of 66 themes related to students' epistemic research development:

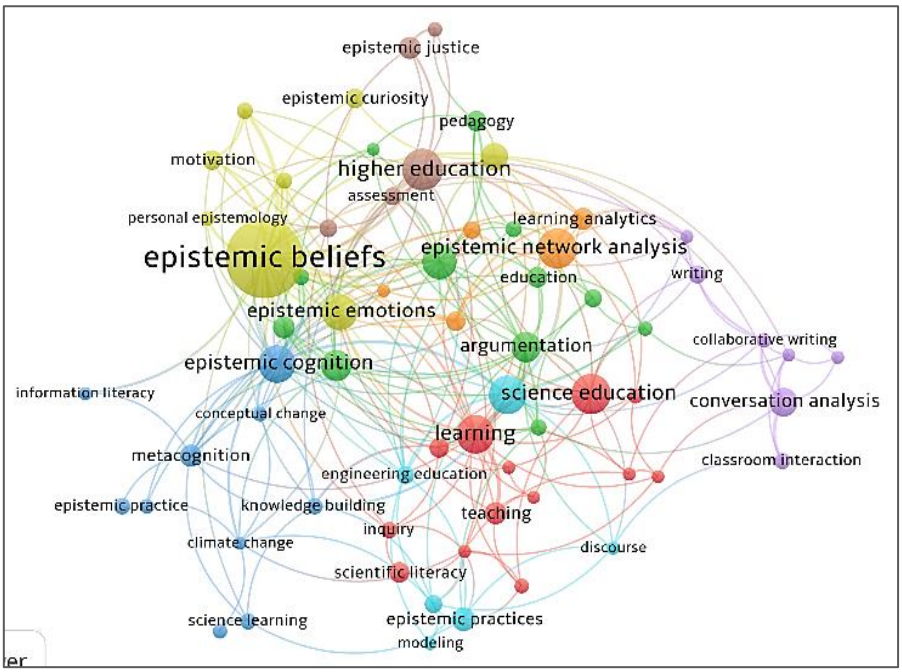

Figure 5. Visual Network of Student Epistemic Themes

The mapping results of the Network Visualization Software VOSviewer circle above include several main cluster domains, including Cluster 1 in red, which consists of 13 topic items: academic writing, case study, epistemic agency, inquiry, learning, professional development, science education, scientific literacy, scientific modeling, scientific practices, secondary education, teacher training, and teaching. Cluster 2 Green consists of 12 topic items: argumentation, collaboration, discourse analysis, education, epistemological beliefs, epistemology, game-based learning, pedagogy, problem-based learning, self-efficacy, student engagement, and teacher education. Cluster 3 Wraba Biru comprises 10 topic items: climate change, conceptual change, epistemic cognition, epistemic practice, information literacy, knowledge building, metacognition, the nature of science, science learning, and science teaching. Cluster 4 Yellow consists of 8 topic items: achievement, epistemic beliefs, epistemic curiosity, epistemic emotions, knowledge, learning strategies, motivation, and personal epistemology. The 5 Color Purple Cluster consists of 7 topic items: classroom interaction, collaborative writing, conversation analysis, epistemic access, epistemic stance, feedback, and writing. The 6 Light Blue Color Cluster consists of 6 topic items: collaborative learning, discourse, engineering education, epistemic practices, epistemic tools, and modeling. The 7-Orange Color Cluster consists of 5 topic items: emotions, epistemic network analysis, learning analytics, problem-solving, and self-regulated learning. The 8 Brown Color Cluster consists of 5 topic items: assessment of epistemic justice, higher education, science, and social justice. The research visualization network on student epistemics can serve as a reference for developing student epistemic research within the social learning process, particularly in the school environment.

Based on the results of the VOSviewer data distribution visualization frame (Figure 6), the themes of writing articles in Scopus-indexed journals over the past decade are presented. This is related to students' epistemic, which is depicted in purple, blue, turquoise, dark green, light green, and yellow. In this case, the theme items related to "epistemic beliefs" and "epistemic cognition" in purple are included in the cluster or category of student epistemic research themes that previous researchers have relatively widely explored. Meanwhile, the topic themes are "epistemic stance," "epistemic practices" in light green and "epistemic emotions," "epistemic curiosity," "epistemic access," "epistemic network analysis," "epistemic tools," "epistemic agency," and " epistemic justice" in yellow are the latest themes related to research developments related to student epistemic so that these topic items can be used as a reference for the latest research implementation related to students' epidemics in the learning process at school.

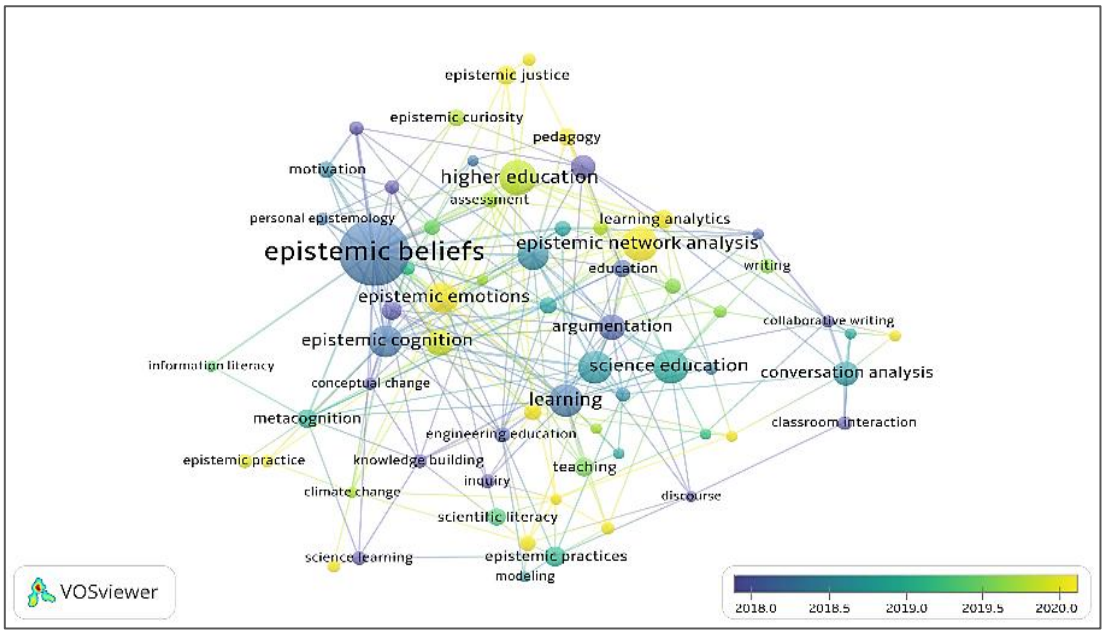

Figure 6. Overlay Visualization of Students' Epistemic Research Theme

Furthermore, based on the results of density visualization using VOSviewer software, Figure 7 shows the level of density. The density of research themes is displayed in bright yellow. The brighter the colors of a theme, the more research is done on that theme. On the other hand, the fainter the color, which means that the theme is still rarely researched. Themes with faint colors, such as "epistemic access," "epistemic access," "epistemic practices," "epistemological beliefs," and "epistemic tools," are topic items that can be used as references and become research opportunities, especially examining students' epistemic problems at school. In connection with this, it can be visualized as shown below:

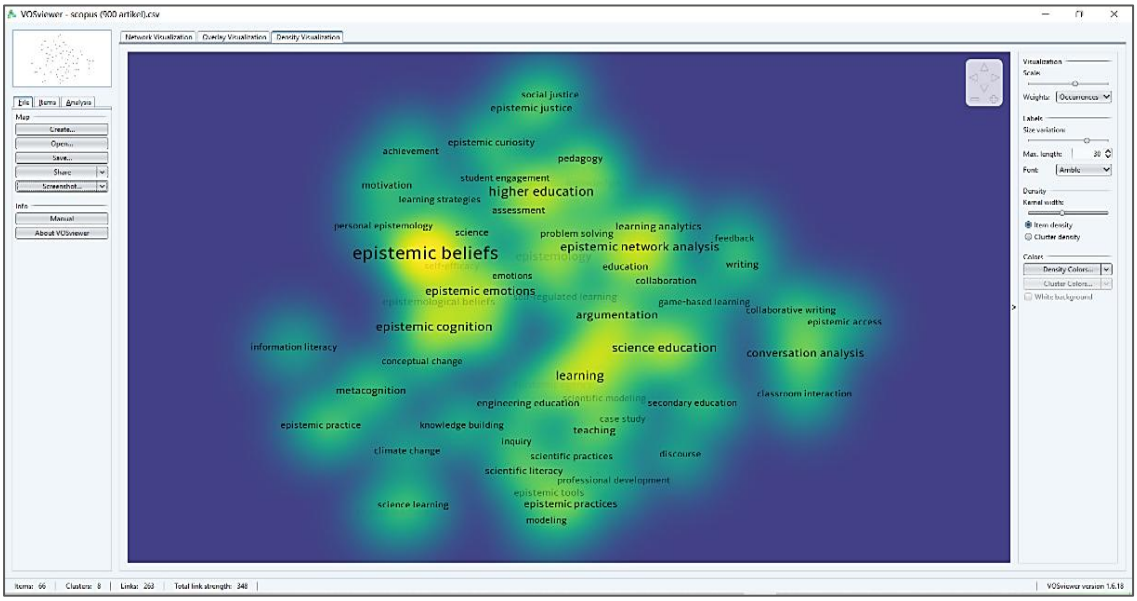

Figure 7. Density Visualization of Students' Epistemic Research Topic

Thus, it can be understood that the results of the analysis of research mapping on epistemic students in terms of overlay visualization and density visualization have related themes, namely the themes "epistemic access," "epistemic access," "epistemic practices," "epistemological beliefs," and "epistemic tools." In other words, the themes mentioned still have a level of research that is rarely related to them. Therefore, these themes can become new fields of research and serve as a reference for the development of further studies related to epistemic issues of students in the school learning process.

CONCLUSION

Epistemic research on students in the learning process can provide an academic picture of the role of conceptual beliefs in students' acceptance of the learning process, allowing teachers within the school to conduct early diagnostics and assemble effective learning strategies for students. Based on a bibliometric analysis of publications related to students' epistemic beliefs in the learning process indexed in Scopus from 2013 to 2022, a clear trend of increasing research activity is evident, with the highest number of publications recorded in 2022, totaling 184 articles (20.44%). The journal Science Education is identified as the most frequent publisher on this topic, with 25 articles and a citation index of 606. In terms of individual productivity, the most active researchers are Tsai C.C, Muis K.R, and Liang J.-C. At the institutional level, National Taiwan University ranks highest in research output, while the United States leads among countries, contributing 289 publications with a total citation index of 4665. The network visualization analysis revealed eight main thematic clusters in students' epistemic research, highlighting interconnected topics such as "epistemic access," "epistemic practices," and "epistemic tools." These themes, however, remain underexplored in relation to one another, indicating substantial potential for future research in expanding the academic understanding of students' epistemic beliefs in school learning contexts.

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