

Mapping the Evolution of Constructivist Pedagogy: VOSviewer Visualization of Interdisciplinary Applications, E-Learning Shifts, and Geographic Research Dominance

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Abstract

10 year research trend of constructivism in modern education is the main goal of this research. Scientific publication data taken from the Scopus database is analyzed using VOSviewer software to visualize networks, overlays, and density visualizations. The results of the study show that constructivism remains an important cornerstone in the development of modern education, shown by a significant increase in the number of publications. The United States dominated research production, followed by China showing increased attention to constructivism. Social Sciences is the field that applies constructivism the most, but other fields such as Arts and Humanities, Engineering, and Computer Science also show significant contributions. The analysis of keyword co-occurrence revealed several important trends, including an increased focus on technology integration (e-learning, modern technologies), the development of a learning environment that supports constructivism, and attention to student learning strategies. Overlay visualization shows the shift in research focus over time, while density view shows the intensity of research on specific topics. The conclusion of this study is that constructivism remains a relevant and dynamic approach in modern education. This research provides a comprehensive overview of the development of constructivism research and can be the foundation for further research that is more in-depth and specific.

Keywords: collaborative learning, constructivist learning, engineering education, innovation in learning, inquiry-based learning, learning paradigm shift, modern education, problem-based learning, project-based learning

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1. Introduction

Education is an important foundation in the development of a nation (Abubakar et al., 2022). Through education, individuals are prepared to become productive, innovative, and character members of society (Asmarani et al. 2021; Utomo & Alawiyah, 2022). Along with the times, the educational paradigm continues to shift. One of the approaches that is getting more and more attention in the world of modern education is constructivism.

Constructivism is a philosophy of science that emphasizes the active role of individuals in building their own knowledge and understanding (Suhendi, 2018; Saleem et al., 2021). In contrast to the traditional approach that considers students as passive recipients of information, constructivism views students as active learners who construct knowledge through interaction with the environment, experiences, and information they receive (O'Connor, 2022; Hailikari et al., 2022; Dziubaniuk & Nyholm, 2021). In the

framework of constructivism, knowledge is not something that is transferred directly from teachers to students, but something that is built personally by each individual through the process of assimilation and accommodation (Saleem et al., 2021).

The principles of constructivism have significant implications for educational practice (Harrison & Laco, 2022). Teachers no longer play the role of the only source of knowledge, but as facilitators who guide students in the process of knowledge construction (Sailer et al., 2021; Carless, 2022). Learning is designed to encourage students to think critically, be able to solve problems, and collaborate with others (Kim et al., 2022). An interactive, challenging, and real-life relevant learning environment is key to the application of constructivism.

Constructivism is not a new idea in the world of education. Its roots can be traced back to the thoughts of philosophers and educational figures such as Socrates, Plato, Jean Piaget, Lev Vygotsky, and John Dewey. However, the application of constructivism in modern education has gained significant momentum in recent decades (Sharma & Sharma, 2021; Yu et al., 2022). Orak (2021) in his writing stated that there are several factors that encourage this, including 1) the development of cognitive science, advances in research on how the human brain works have provided a deeper understanding of the learning process. These findings support the constructivist view that knowledge is actively constructed by individuals; 2) Shift in educational paradigm, a shift from a teacher-centered educational paradigm to a student-centered paradigm. Constructivism is in line with this paradigm because it emphasizes the active role of students in the learning process; 3) The demands of the 21st century where in the era of globalization and rapid technological development, individuals are

required to have the ability to think critically, solve problems, collaborate, and adapt to change. Constructivism is believed to help students develop these skills.

The application of constructivism in modern education can be seen in various forms, including: 1) Problem-Based Learning, in which students are faced with real challenging problems and they are required to find solutions through the process of investigation, collaboration, and critical thinking; 2) Project-Based Learning, in this learning students are involved in projects that are complex and relevant to real life. Through this project, students can apply their knowledge and skills in an authentic context; 3) Inquiry-Based Learning, in which students are encouraged to ask questions, conduct investigations, and build their own understanding of a topic; and 4) Collaborative Learning, where students learn together in small groups, share ideas, and collaborate to achieve common goals (Sukackè et al., 2022).

To comprehensively understand the development of constructivism in modern education, a systematic and data-based analysis is needed. This is where bibliometric analysis comes into play. Bibliometric analysis is a quantitative technique used to analyze data from scientific publications, such as journal articles, books, and conference proceedings (Donthu et al., 2021; Kumar et al., 2023). Through bibliometric analysis, data can be mapped by looking at trends and patterns in constructivism research, such as: publication trends, main research themes, research networks and collaborations, as well as influential researchers and journals. Bibliometric analysis provides a number of benefits in the context of constructivism research in modern education, including 1) helping researchers, educators, and policymakers to understand the direction of development of

constructivism research; 2) provide information on research areas that are still underdeveloped or that require further attention; 3) measuring the impact of constructivist research on the development of educational theory and practice; 4) help researchers to find potential collaborations with other researchers who have similar research interests.

In the context of constructivism research in modern education, bibliometric analysis has become increasingly urgent. This is driven by several crucial factors. First, we are faced with an incredible explosion of scientific information. Research publications continue to grow exponentially, making it difficult for researchers to keep up with every latest development. Bibliometric analysis comes as a solution by helping researchers filter relevant information and identify key trends in constructivist research (Pessin et al., 2022; Yeung et al., 2022; Bortoluzzi et al., 2021). Second, there is an urgent need to evaluate the effectiveness of the implementation of constructivism in modern education. Bibliometric analysis allows us to obtain a comprehensive picture of the extent to which constructivism has been implemented and analyze its impact on

student learning outcomes. Finally, the development of information and communication technology has facilitated the process of bibliometric analysis. Today, there are a variety of software and online databases available that allow researchers to analyze scientific publication data efficiently and effectively.

2. Method

The method used in this study is a descriptive method with a bibliometric approach, where this bibliometric approach is an approach that uses quantitative techniques according to the bibliometric analysis guidelines proposed by Donthu et. Al (2021). The focus of this research analysis is: (1) bibliometric mapping to test the research trend of Problem Based Learning in Higher Education, and (2) analysis of keywords indexed in the article to identify research clusters and understand research themes related to Constructivism in modern education. In analyzing data from the Scopus database, researchers used the VOSviewer application to visualize networks, overlays and density visualizations. Figure 1 is the 5 steps for the bibliometric analysis that the authors used in the study.

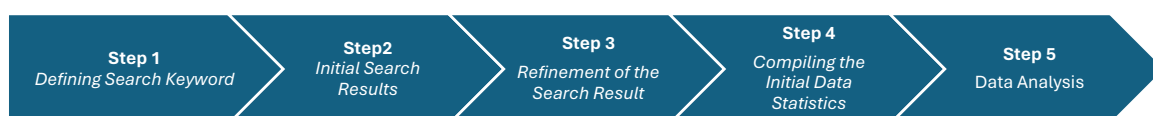


Figure 1. Steps of Bibliometry Analysis

a. Step 1: Defining Search Keyword

In the first step, the author uses a keyword search in the Scopus database with a choice of search formats 'title', 'article', 'abstract', and 'keyword'. The search is to conduct a literature search. The keywords used are "constructivism" AND "education" AND "modern".

b. Step 2: Initial Search Result

In the second step, the results of the initial search results with the keywords 'constructivism' AND 'education' AND 'modern' in the Scopus database produced several documents. From this initial search, 170 documents were obtained spread across various years of publication, field of science, and type of document. This stage also serves

as an overview of the scope of literature available before entering step 3.

c. Step 3: Refinement of the Search Result

The author made restrictions to refine the search to be even more specific. First, restrictions on the time frame for publication of documents, starting from 2014-2024. Second, the restriction on the subject area

chosen, namely only social science. Third, restrictions on the type of documents, namely those from journals and articles. Fourth, is the restriction on documents published using English. Figure 2 below shows the selection of documents that are adjusted to the inclusion criteria system carried out through 4 stages, namely: 1) identification, 2) screening, 3) eligibility, and 4) inclusion (Donthu et al., 2021; Todeschini & Baccini, 2016)

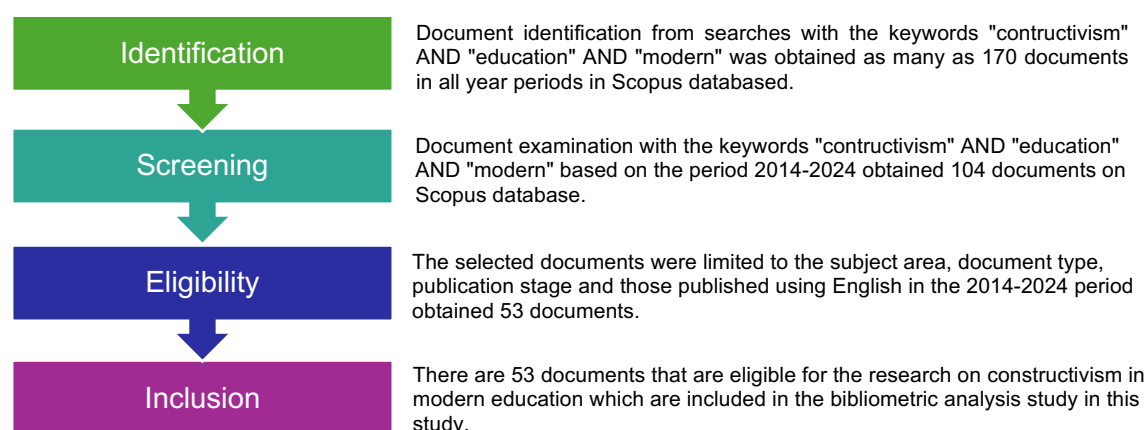


Figure 2 Steps to Improve the Results of Bibliometric Analysis Related to Constructivism in Modern Education

d. Step 4: Compiling the Initial Data Statistics

Documents that meet the requirements are used as a source of research data. The data obtained (downloaded) from the Scopus database is Comma Separated Values (CSV) and Research Information System (RIS). These two types of files contain important article information, such as bibliometric and bibliographic information that will later be used in the VOSviewer application.

e. Step 5: Data Analysis

Data analysis in this study was carried out in 2 stages, namely science data mapping and performance analysis. The analysis of co-occurrence data, keyword occurrence, and citations was carried out on bibliometric meta-data using VOSViewer software. Data

visualization from VOSviewer to create visual maps that illustrate the relationships between various entities in the data, such as network maps that show relationships between authors, institutions, or keywords, density maps that display the frequency density of keywords in a research field, and temporal graphs that illustrate research developments over time. Interpretation of the results of bibliometric analysis will involve identifying clusters to find interrelated research topic groups or sub-fields, analyzing research trends to see patterns and trends in research, and evaluating having an impact to assess the impact of research based on citations and contributions in a particular field. The results of the analysis will later be presented in the form of a table or network visualization map.

3. Result and Discussion

Research that discusses constructivism in the modern education era has been discussed for a long time and has become one of the topics that are quite in demand. Through bibliometric analysis, the author tries to describe how the development and spread of this research in the period from 2014 to 2024. The Scopus database shows a significant increase in the number of publications related to constructivism in modern education from year to year, this reflects the interest of academics in learning methods that prioritize

problem-solving as the core of learning activities. The analysis further highlights some of the leading institutions and researchers who contributed greatly to the development and dissemination of this constructivism research as well as the identification of the main topics and recent trends present in this research. In the metadata analysis taken from the Scopus database in figure 3, the author highlights the development of publications in the last 10 years.

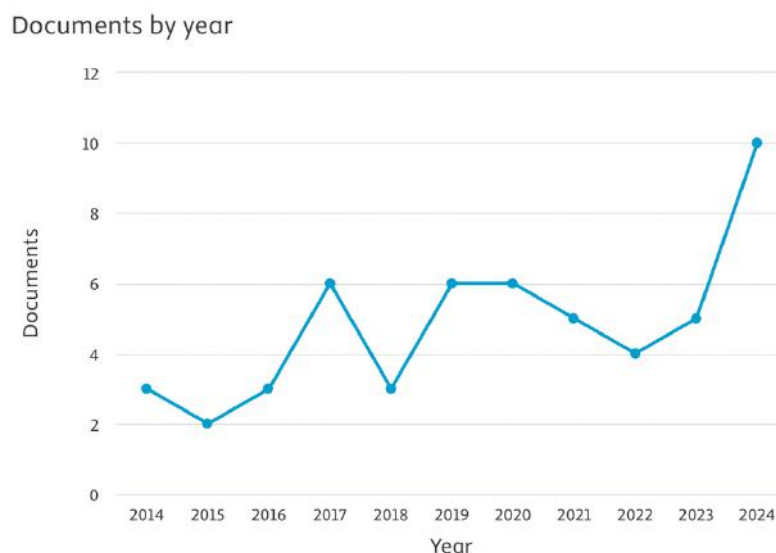


Figure 3. Development of the Number of Publications Per Year
(Source: Scopus Database 2024)

Figure 3 shows the distribution of the number of documents per year from 2014 to 2024, which illustrates the trend of research on constructivism in modern education. At the beginning of the 2014 period, there were 3 documents published. The number of publications decreased the following year to 2 documents, then increased to 3 more documents in 2016. A drastic surge occurred in 2017 with the number of documents reaching 6 documents, indicating a sharp increase in research interest in constructivism in modern education. Although it decreased in

2018 to 3 documents, the number of publications increased again and stabilized at 6 documents in 2019 and 2020. The research trend then showed a slight decrease in 2021 and 2022 with the number of documents being 5 and 4 respectively. However, there was a significant increase in 2023 to 5 documents, and reached a peak in 2024 with 10 documents. The increase in the number of documents in 2024 indicates that constructivism is still a relevant and interesting topic to be researched in the context of modern education. Fluctuations in

the number of documents in several years can be influenced by various factors, such as trends in educational issues, technological developments, and shifts in research focus.

Furthermore, the author conducts an analysis based on the subject of the research

area. The distribution of publications when viewed from Figure 4 is quite diverse, some subject areas still raise the topic of Constructivism in modern education.

Documents by subject area

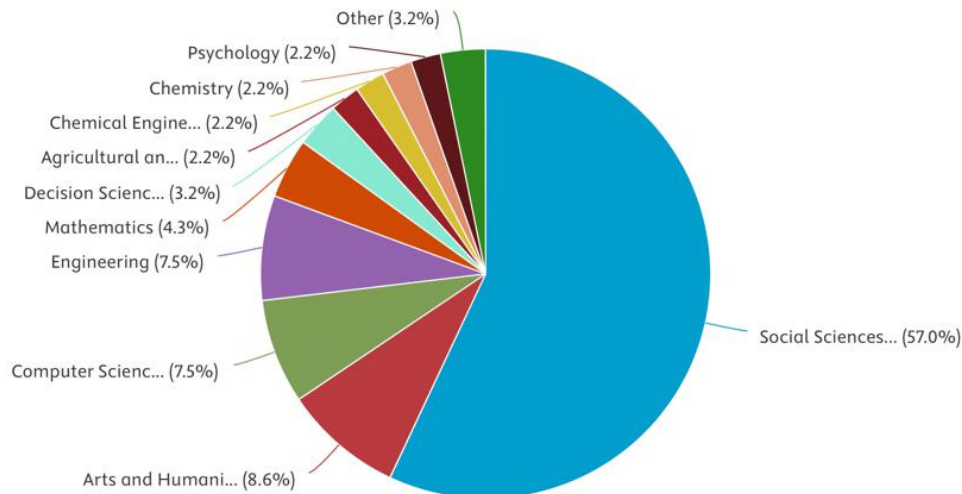


Figure 4 Distribution of Publications Hybrid Learning in Higher Education by Subject Area
(Source: Scopus Database 2024)

It is clear from the data that the field of Social Sciences dominates research on constructivism with a proportion of 57%. This high percentage strongly indicates that constructivist approaches are most widely carried out in social and societal contexts. Social Sciences naturally align with constructivist principles because they emphasize interaction, collaboration, and the construction of knowledge through experience and dialogue. Within disciplines such as education, sociology, psychology, and communication studies, constructivism serves as a powerful theoretical lens to analyze how individuals and groups form meaning, negotiate understanding, and solve problems collectively. The dominance of this field also reflects the importance of constructivist learning models in addressing contemporary social issues such as inclusivity, diversity,

equity, and the cultivation of critical thinking skills among learners (Ismail et al., 2019).

In addition to Social Sciences, the field of Arts and Humanities occupies the second position with a proportion of 8.6%. Although smaller in scale, this percentage demonstrates the continuing relevance of constructivism in contexts such as art, literature, language learning, philosophy, and cultural studies. In these areas, knowledge is often subjective, interpretative, and deeply connected to human creativity and expression. Constructivist perspectives in Arts and Humanities allow learners to engage actively with texts, artworks, and cultural practices, thereby constructing personal and shared meanings. For instance, in language learning, constructivism supports interactive methods where learners build communicative competence through real-world practice

rather than rote memorization (Baskara et al., 2023). Similarly, in arts education, students learn by creating, reflecting, and interpreting works, which is directly in line with constructivist principles of active and experiential learning.

Interestingly, the fields of Engineering and Computer Science each hold the same proportion of 7.5%. This finding highlights that constructivist approaches are not confined to the social domain but also extend into technical and applied sciences. In engineering education, constructivism is applied through project-based learning, design thinking, and collaborative problem-solving activities. These methods encourage students to engage with real-world challenges and to construct knowledge by doing, testing, and reflecting on practical experiences. In computer science, constructivism has become increasingly relevant in teaching programming, artificial intelligence, and software development. Learners often engage in collaborative coding projects, simulations, and iterative design processes where knowledge is constructed through trial, error, and peer learning. The presence of constructivism in these technical domains reflects a broader shift toward more interactive and student-centered approaches in STEM education.

The field of Mathematics holds a proportion of 4.3%, which, while smaller compared to Social Sciences, is still noteworthy. Mathematics education has traditionally been associated with abstract reasoning and rigid problem-solving methods. However, the application of constructivist approaches in mathematics shows that learning is more effective when students are encouraged to explore concepts, identify patterns, and construct meaning rather than simply memorizing formulas. Constructivist strategies, such as inquiry-

based learning and the use of real-life problems, help learners develop a deeper conceptual understanding and greater confidence in applying mathematical principles.

Meanwhile, fields such as Agricultural Sciences, Biology, Chemical Engineering, and Chemistry each account for 2.2% of the proportion. Although these numbers are relatively small, they demonstrate that constructivism also finds relevance in natural sciences and applied scientific research. In biology and chemistry education, for example, constructivist methods can be seen in laboratory-based learning, where students actively participate in experiments, analyze data, and construct their own scientific understanding. Similarly, in agricultural sciences, constructivism may be applied through experiential learning in fieldwork, where students connect theory with practice in real agricultural environments.

Other fields not specifically mentioned account for 3.2%. This category likely includes emerging disciplines and interdisciplinary studies where constructivism is being adapted to unique contexts. The presence of these “other fields” underscores the adaptability and flexibility of constructivist principles in addressing the learning needs of diverse domains.

The dominance of Social Sciences in constructivist research can be explained by the theory’s inherent focus on social interaction, active knowledge construction, and meaningful learning all of which are central themes in social research and practice (Laksmiwati et al., 2024). However, the presence of other disciplines such as Arts and Humanities, Engineering, Computer Science, Mathematics, and the natural sciences highlights the wide applicability of constructivism. It is not confined to one particular domain but serves as a framework

that supports student-centered, experiential, and reflective learning across a variety of contexts.

Overall, the picture illustrates the diversity of fields that research and apply constructivism in modern education. The broad distribution across disciplines demonstrates the theory's capacity to respond to different educational challenges, whether in understanding human behavior, fostering

creativity, developing technical expertise, or enhancing scientific inquiry. Furthermore, the researcher also examined the geographical distribution of constructivism research across countries. This distribution is visualized in Figure 5, which presents the spread of publications and highlights how different nations contribute to the development and application of constructivist principles in education.

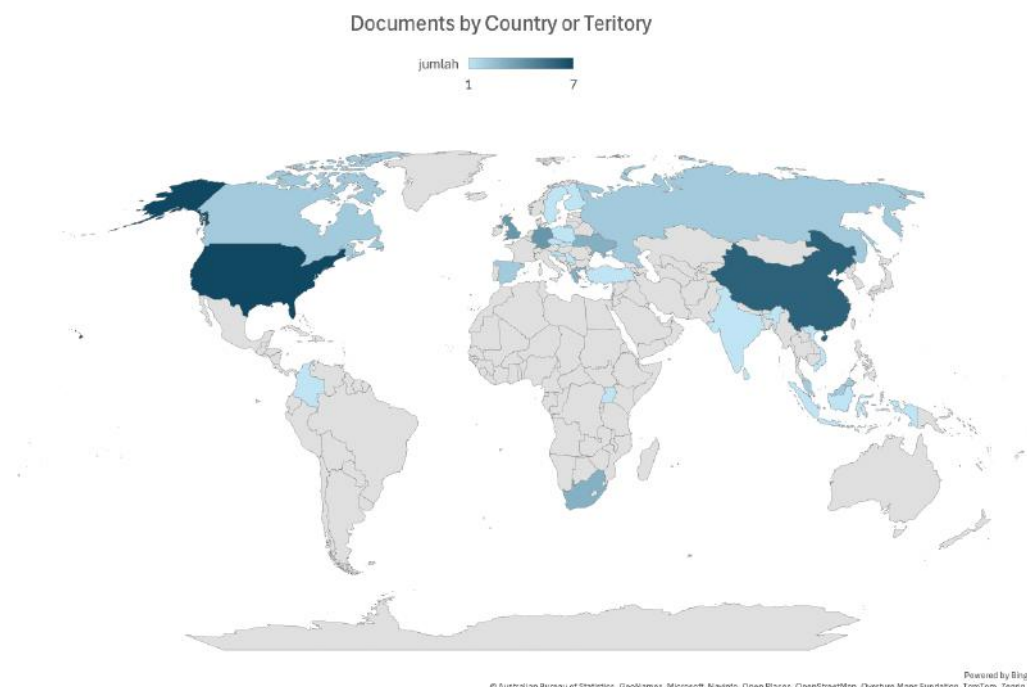


Figure 5 Distribution of Research Publications on Constructivism In Modern Education by Country

The distribution of publications of constructivism research in modern education shows a significant global pattern. The United States emerges as the leading country, contributing seven published documents. This high number of publications reflects not only the nation's strong academic tradition but also its consistent role in advancing educational theories and practices. As the birthplace of many pedagogical innovations, the United States continues to play a central role in developing and testing constructivist approaches within various levels of education, from primary schools to higher education institutions.

China follows closely with six publications, which illustrates the country's growing interest in applying constructivism to its rapidly developing education system. The emphasis on constructivist methods in China suggests that the nation is striving to move beyond traditional rote learning models toward more interactive and student-centered pedagogies. This trend also aligns with China's broader educational reforms that aim to foster creativity, critical thinking, and problem-solving skills in response to the demands of the 21st century.

Germany and the United Kingdom, each with four publications, also demonstrate

strong contributions. Both countries have a long history of educational research and theory development. Their engagement with constructivism reflects an ongoing effort to address contemporary challenges in education, such as digital learning environments, inclusive education, and competency-based learning (Dwiputra et al., 2023). By integrating constructivist principles, these nations aim to strengthen learner autonomy and engagement.

Meanwhile, Greece, South Africa, and Ukraine each produced three publications. Although the numbers are smaller compared to leading nations, these contributions highlight the relevance of constructivism across different cultural and socio-political contexts. In Greece, the focus on constructivism may be linked to reforms in curriculum design and the integration of technology in classrooms. South Africa's interest indicates an effort to address inequalities in education by adopting more participatory and learner-focused teaching methods. Ukraine's publications, on the other hand, may represent a growing academic discourse that seeks to modernize teaching practices in line with global standards.

Countries such as Canada, Malaysia, and Russia each contributed two publications. While their numbers are modest, they still signify that constructivism is spreading across diverse educational systems. Canada's involvement is consistent with its tradition of

progressive education, while Malaysia's contributions reflect its attempts to enhance educational quality and innovation. Russia's participation suggests a renewed interest in pedagogical reforms that encourage active learning.

Overall, this geographical distribution proves that constructivism research in modern education has become a global phenomenon. The dominance of the United States underscores its leadership in shaping the theory and practice of constructivism. At the same time, the variety of contributing countries demonstrates the wide relevance and applicability of this approach in addressing educational challenges worldwide.

To further illustrate this research, visualization was conducted using Vosviewer software. One of the techniques employed was keyword co-occurrence mapping, which helps analyze and visualize the relationships between frequently appearing terms (Utari et al., 2025). This method makes it possible to identify thematic clusters and patterns in constructivism research. Figure 6 displays the Vosviewer output, showing how keywords are interconnected, thereby providing insights into the main topics and trends within the field. Such visualization not only enhances understanding of the research landscape but also guides future studies in exploring gaps and opportunities within constructivist education research.

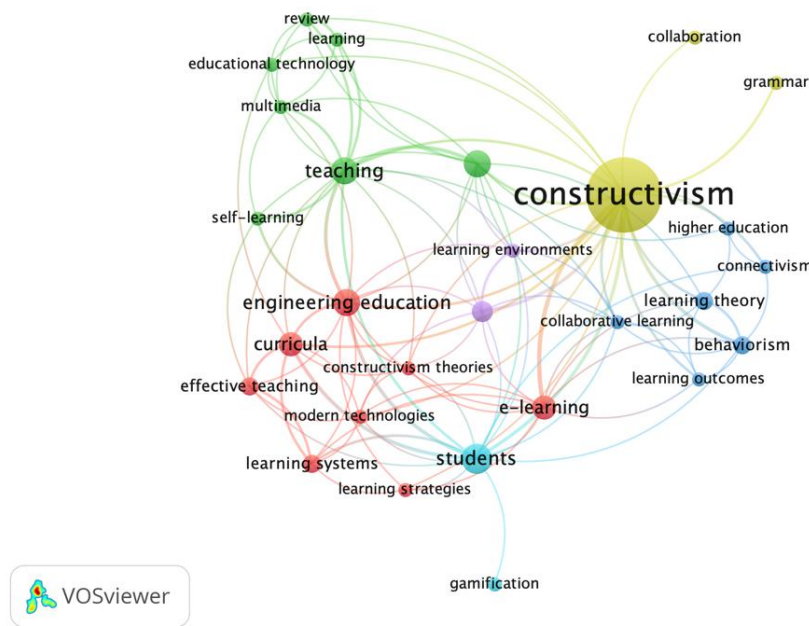


Figure 6. Network Visualization Map of Keywords' Co-Occurrence

The visualization of keyword co-occurrence provides a comprehensive overview of the landscape of constructivist research in modern education. Through this mapping, it becomes easier to identify not only the dominant themes but also the interconnections between various concepts that shape the field. At the center of the visualization, the cluster of “constructivism” emerges as the dominant node. This cluster is strongly linked with terms such as “learning,” “teaching,” “learning environment”, and “learning theory.” The close association of these keywords reaffirms that the primary focus of constructivist research lies in the study of how knowledge is actively constructed by learners, how teaching strategies can facilitate this process, and how the learning environment can be designed to support meaningful and student-centered learning experiences (Irvaniyah et al., 2025).

Another significant aspect revealed in the visualization is the appearance of the “educational technology” cluster. The presence of keywords such as “multimedia” and “e-learning” within this cluster

demonstrates a growing trend in integrating constructivist principles with technological innovations. In today’s digital era, the development of online platforms, virtual classrooms, and interactive media has provided new opportunities for applying constructivist learning theories. These technologies allow learners to interact with content dynamically, collaborate with peers remotely, and engage in personalized learning experiences. The connection between constructivism and educational technology highlights an important trajectory for future research, where the focus shifts toward maximizing the potential of digital tools to foster deeper learning and creativity.

The cluster of “collaborative learning” further emphasizes the importance of social interaction in the constructivist paradigm. Constructivism posits that knowledge is not built in isolation but emerges through dialogue, cooperation, and shared problem-solving (Maghfiroh et al., 2024). The presence of this cluster reinforces the idea that group activities, peer discussions, and cooperative projects play a critical role in

helping learners internalize concepts. This aspect of constructivism is particularly relevant in modern education, where teamwork and communication are essential skills for both academic and professional success.

In addition, the visualization draws attention to the “student” cluster, which directs focus toward learning strategies and learner-centered approaches. This cluster suggests that researchers are increasingly examining how different strategies such as inquiry-based learning, problem-based learning, or self-regulated learning—can be used to enhance student engagement and autonomy. By positioning students as active agents in their own learning processes, constructivism encourages exploration, reflection, and independent thinking.

A noteworthy finding is the relationship between constructivism and other learning theories such as “behaviorism” and “connectivism,” which appear in the “learning theory” cluster. This indicates that comparative studies are being conducted to examine how constructivism aligns with or

diverges from other theoretical frameworks. For example, behaviorism emphasizes reinforcement and observable behavior, while connectivism focuses on learning in the digital age through networks and connections. The visualization suggests that constructivism continues to be examined not in isolation, but in dialogue with other paradigms, thus enriching the theoretical discussion in educational research.

Overall, this keyword co-occurrence visualization plays a critical role in identifying research trends, mapping the position of different studies, and providing inspiration for future directions in constructivist research. By making visible the relationships between concepts, researchers gain valuable insights into which areas are well established and which areas still hold potential for exploration. This form of analysis not only strengthens the understanding of current academic discourse but also helps in setting new agendas for the continuous development of constructivist approaches in modern education.

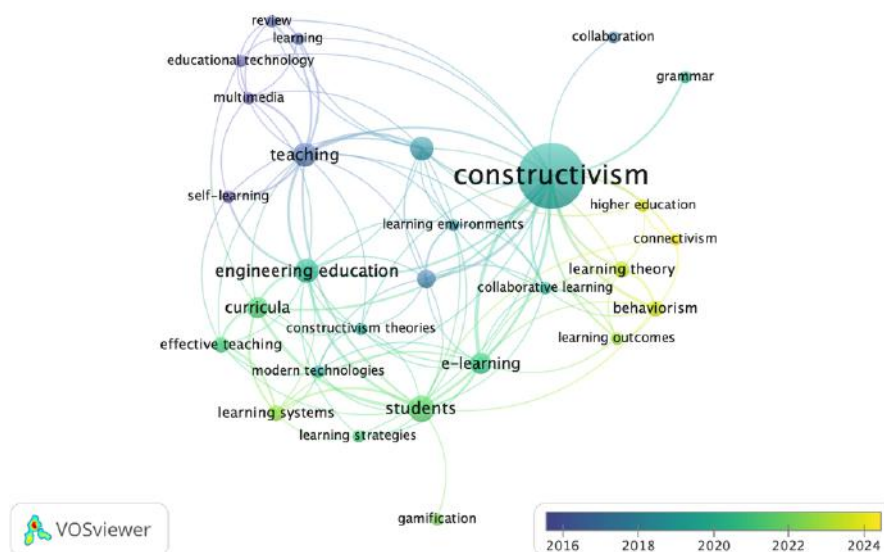


Figure 7. Overlay Visualization Map of Keywords' Co-Occurrence

Figure 7 illustrates the dynamics of constructivism research in modern education during the period from 2014 to 2024. This visualization offers valuable insights into how

the focus of scholarly work has evolved over the past decade, highlighting both the enduring centrality of constructivism and the ways in which related themes have emerged and gained prominence. The keyword “constructivism,” visualized in green, consistently appears as the foundation of research throughout the timeline. Its continuous presence underscores the fact that constructivism remains a core theoretical framework in educational research, providing a basis for analyzing teaching practices, learning processes, and the construction of knowledge in diverse educational contexts (Priandani et al., 2025).

Alongside this constant presence, the trend also reveals a noticeable increase in studies integrating technology into constructivist approaches. This is evidenced by the emergence of keywords such as “e-learning” and “modern technologies,” both of which are visualized in yellow, indicating that they became more prominent toward the later part of the period. The appearance of these terms reflects the rapid expansion of digital tools, online platforms, and virtual classrooms in education, particularly accelerated by global developments such as the COVID-19 pandemic, which reshaped traditional learning practices. Researchers are increasingly exploring how constructivist principles can be effectively applied in digital contexts, ensuring that students remain active participants in their learning despite the shift to technology-mediated environments.

Another significant keyword that appears in yellow is “learning environments.” Its increasing visibility signals a growing concern with the design and structuring of educational settings that align with constructivist ideals. Rather than viewing learning environments as neutral spaces, researchers emphasize the importance of creating interactive, flexible, and student-

centered environments. This includes both physical classrooms designed for collaboration and digital platforms tailored for inquiry-based and experiential learning. The focus on learning environments demonstrates a deeper understanding that effective constructivist learning requires intentional planning of spaces where students can actively engage, experiment, and reflect.

The dynamics of learning theory development are also evident in the visualization. Keywords such as “connectivism” (yellow) and “learning theory” (green) highlight ongoing discussions about the evolution of learning paradigms. Connectivism, in particular, reflects the growing recognition of networked learning in the digital age, where knowledge is distributed across connections and learners construct meaning through interactions with technology and communities. Its emergence alongside constructivism suggests that scholars are not only applying constructivist principles but also comparing and integrating them with other theories to address the challenges of modern education (Hernawan et al., 2025). The presence of “learning theory” as a stable keyword throughout the decade further reinforces that constructivism continues to be situated within broader theoretical debates, serving as a reference point for comparison and refinement.

Overall, the visualization provides a clear understanding of how the focus of constructivist research has shifted over the past ten years. From a strong theoretical foundation centered on “constructivism,” the research trajectory has expanded toward technology integration, innovative learning environments, and the exploration of complementary learning theories. These shifts indicate a responsive and adaptive scholarly community that continuously reinterprets constructivism in light of changing

educational needs and technological advancements. More importantly, the dynamics captured in Figure 7 suggest that constructivism remains highly relevant, not as

a static theory, but as a living framework that evolves to meet the demands of modern education.

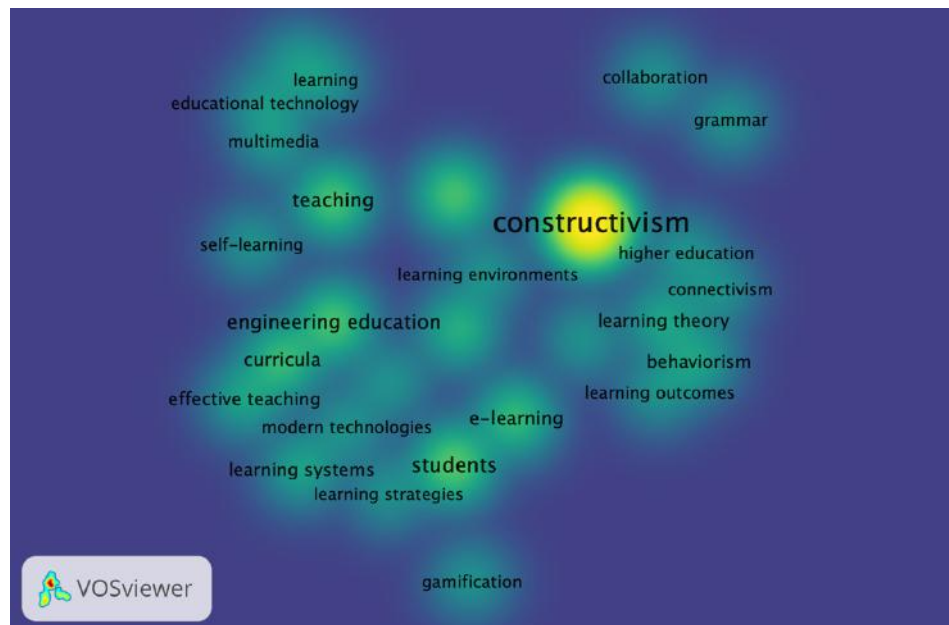


Figure 8. Density Visualization Map of Keywords' Co-Occurrence

The density visualization map illustrates the frequency of keyword occurrence in constructivism research in modern education. The lighter and more yellow an area is, the more often keywords in that area appear in the literature. "Constructivism" is central in bright yellow, indicating that this keyword is very frequently used, confirming its position as a central concept. The areas of "e-learning", "modern technologies", and "educational technology" also show an increasing frequency of occurrence, indicating a research trend that is increasingly integrating technology. The high frequency of "learning environments" indicates attention to the design of learning environments that support constructivism (Emilzoli et al., 2024). "Students" and "learning strategies" also appear frequently, indicating a focus on the student's learning process. This map provides a quantitative overview of keyword frequency, complementing the bibliometric

analysis with information on how often a topic is discussed in constructivism research.

The bibliometric trends observed in this study not only provide statistical evidence of research growth but also carry strong implications for both theory and practice. The steady increase in publications after 2017 indicates that constructivism has become a widely accepted framework across multiple educational contexts (Hedar et al., 2025). This trend demonstrates that constructivist pedagogy continues to be relevant in addressing contemporary educational challenges, particularly the need for critical thinking, collaboration, and adaptability among students.

When examined from an interdisciplinary lens, constructivism has extended beyond the traditional boundaries of education. For instance, its presence in engineering and computer science research, though smaller in percentage compared to social sciences, reveals an effort to embed

constructivist approaches into technical and vocational learning. In STEM fields, constructivism supports experiential and inquiry-driven methods, encouraging learners to design, test, and refine solutions to real-world problems. Similarly, its role in the arts and humanities reflects a strong emphasis on interpretation, meaning-making, and cultural awareness as well as dimensions that are central to constructivist philosophy.

The visualization results also show the growing intersection between constructivism and digital technologies, particularly e-learning platforms, virtual simulations, and AI-based adaptive learning systems (Priandani et al., 2025). This is a significant finding, as it illustrates how constructivism is being redefined in the digital age. Online learning environments now attempt to replicate the social and interactive conditions of face-to-face classrooms, but with the added flexibility of technology-mediated collaboration. For example, collaborative tools embedded in learning management systems can mirror Vygotsky's idea of social constructivism by providing virtual spaces for peer-to-peer dialogue, mentoring, and co-construction of knowledge.

Another important point is the global spread of research. The United States and China stand out not only because of the number of publications but also because of their educational policies and investments in digital learning innovation. China's surge in publications reflects its national agenda to integrate modern pedagogies with technology, while the United States demonstrates a long-standing commitment to constructivist research traditions. Interestingly, emerging contributions from countries such as South Africa, Ukraine, and Malaysia illustrate that constructivism resonates across diverse cultural and socio-political contexts. This signals the

universality of constructivist ideas, even though their applications may vary depending on local educational needs.

From a practical standpoint, the findings highlight the importance of professional development for teachers and educators. If constructivism is to remain impactful, teachers must be trained not only to design student-centered learning but also to integrate modern tools effectively. The bibliometric evidence of frequent keywords such as "learning environments" and "learning strategies" suggests that educators are continuously experimenting with classroom designs that can foster autonomy and engagement. However, it also reveals a gap: while digital tools are frequently mentioned, there is less discussion about the pedagogical frameworks needed to ensure that technology use aligns with constructivist values rather than mere content delivery.

4. Conclusion

Based on the bibliometric analysis of the research on constructivism in modern education over the last ten years (2014-2024), it can be concluded that constructivism remains an important foundation in the development of modern education. There has been a significant increase in the number of publications, demonstrating the relevance and dynamics of research in this area.

The United States dominated research production, followed by China showing increased attention to constructivism. Social Sciences is the field that applies constructivism the most, but other fields such as Arts and Humanities, Engineering, and Computer Science also show significant contributions.

The analysis of *keyword co-occurrence* revealed several important trends, including an increased focus on technology integration (e-learning, modern technologies), the

development of a learning environment that supports constructivism, and attention to student learning strategies. Overlay visualization shows the shift in research focus over time, while *density view* shows the intensity of research on specific topics.

The bibliometric findings in this study also confirm that constructivism is not just an academic phenomenon, but also has broad practical implications for the world of education. Teachers and educators are required to continue to develop competencies in designing learning that is adaptive to technology, but still based on constructivist values. From a policy perspective, the results of this research can be the basis for formulating educational strategies that emphasize collaborative learning, problem-solving, and digital integration.

This study provides a comprehensive overview of the development of constructivism research in modern education, and can be the foundation for further research that is more in-depth and specific. Further studies are needed to explore the implementation of constructivism in various educational contexts, develop innovative constructivist learning models, and analyze their impact on student learning outcomes.

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