

PROBLEM BASED LEARNING (PBL) LEARNING MODEL TO IMPROVE CRITICAL THINKING: BIBLIOMETRIC ANALYSIS

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Abstract: This research aims to identify trends in research publications on Problem-based learning models that improve critical thinking. When a search was carried out using Scopus data search regarding "Problem-Based Learning" plus "critical thinking from data from the last 10 years between 2014 and 2024, it was found that research on Problem-Based Learning and critical thinking learning models is increasingly developing and becoming more widespread and applied. To be able to see what research is relevant regarding the Problem-Based learning model and critical thinking, bibliometric analysis is carried out. This research uses bibliometric analysis assisted by R software. The results of the analysis show that data from 2014 to 2024 has been published in 569 Scopus journals. Research on Problem-Based Learning learning models and Critical Thinking is increasing every year; in 2014, there were only 31 Scopus articles. Until 2023, research in this field will continue to increase to 68 Scopus articles. This could mean that this research is increasingly in demand and applied in educational applications.

Keywords: *Problem Based Learning, critical thinking, bibliometric*

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INTRODUCTION

A teacher should be able to make learning interesting for students. Interesting learning provokes students to think deeply and analyze a problem and information. This kind of thinking process is a critical thinking skill. according to Utaminingsih et al. (2024) Ineffective and tedious learning processes can reduce students' learning experience. This situation has the potential to reduce students' ability to think critically to overcome various problems in everyday life.

In the classroom, students are explicitly taught to improve their thinking skills through the use of thinking maps (teaching about thinking), and then they are encouraged to utilize these thinking maps to think critically about the material learned (Siew, 2016). If students are accustomed to applying critical thinking when dealing with real everyday problems, they will get used to forming an independent way of thinking. When these skills are integrated into classroom learning, their critical thinking skills will be greatly beneficial. One strategy to support this is to implement a problem-based

learning model. This model uses an authentic problem-focused learning approach, allowing students to develop their own knowledge and improve their skills to a higher level (Married and Married, 2019).

PBL is a learning model that focuses on the context of real situations. This means that each student's life experiences play a role in the problem-solving process. In addition, the concept of critical thinking is not only limited to logical and consistent reasoning but also includes rational or practical behavior. Critical thinking also involves a moral attitude that includes respect for the opinions of others and a tendency to introspect (Leasa et al., 2023).

a student-focused learning approach, facilitating the development of diverse perspectives on students, promoting deep, active, and significant learning processes, and helping hone their problem-solving, research-solving, creative, and critical thinking skills (Junianto & Wijaya, 2019). Further advantages of problem-based learning for teachers include increasing attractiveness and motivation, developing inquiry skills, strengthening participation in courses, improving academic achievement, helping students define themselves, and improving critical thinking skills. This method also allows students to relate knowledge to applications in everyday life and supports group work. Before starting, this method can increase teacher confidence and, after implementation, increase student responsibility in their learning process (Balim et al., 2014).

Problem-based Learning is a learning model that prioritizes students' active participation in finding solutions to the problems or cases they face, which helps them solve those problems. Application of learning models *Problem-based Learning* can also improve students' critical thinking skills (Susanto et al., 2022). Research Analysis Results (Qondias et al., 2022) found that multicultural problem-based learning models proved effective in improving students' critical thinking skills. Therefore, this learning model is suggested as an innovative learning model. Further research results (Saputro et al., 2020), (Zuryanty et al., 2019) and (Ahdhianto et al., 2020) recommend that PBL be implemented more routinely in learning to improve students' critical thinking skills.

Research results (Puspita et al., 2023) Bibliometric analysis revealed that from 2017 to 2021, there were 98 articles on problem-based learning published in national and international journals. The year with the highest number of publications was 2020, with a total of 23 articles related to this topic. The analysis also noted that the number of publications using the keyword "application of problem-based learning" is still a research trend today.

RESEARCH QUESTIONS

1. What are the research trends related to *the Problem-based Learning* and critical thinking learning models that develop from year to year, and what is their potential for future research?
2. What is the relevance of the theory that develops from the concept of the learning model of *Problem-Based Learning and Critical Thinking* and its sustainability in the future?

METHOD

Research methodology is carried out in various stages; the first is the identification stage. At this stage, data is collected from the Scopus database using keywords such as "Problem-Based Learning" and "PBL" and then combined with "Critical Thinking." This process resulted in a total of 569 documents; then, the screening stage was carried out. The Publication stage is final; the source is *Journal* and *Conference Proceedings*, and the notability stage uses "English." The document is then fed into the software, namely the *R application*, to perform bibliometric analysis of keywords in PBL and Critical Thinking. After that, data analysis was carried out to determine the main themes discussed in the latest research on PBL to improve critical thinking.

RESULT AND DISCUSSION

Table 1. Data Information

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2014:2024
Sources (Journals, Books, etc)	285
Documents	569
Annual Growth Rate %	-1,01
Document Average Age	4,61
Average citations per doc	10,57
References	17400
DOCUMENT CONTENTS	
Keywords Plus (ID)	1946
Author's Keywords (DE)	1234
AUTHORS	
Authors	1949
Authors of single-authored docs	68
AUTHORS COLLABORATION	
Single-authored docs	69
Co-Authors per Doc	3,64
International co-authorships %	8,787
DOCUMENT TYPES	
Article	435
conference paper	134

(Source: Bibliometric Results)

This information presents research data covering the time span from 2014 to 2024. This data comes from 285 sources, including journals, books, and others, with a total of 569 documents. The annual growth rate of these documents shows a decrease of -1.01%. The average age of documents was 4.61 years, and each document had an average of 10.57 citations. The total number of references used reached 17,400.

The document content consists of 1,946 Keywords Plus (ID) and 1,234 keywords from the author (DE). There were 1,949 authors who contributed to the study, with 68

authors writing individual documents. The number of documents written by a single author is 69. In terms of author collaboration, there are an average of 3.64 authors per document and 8.787% of documents have international collaboration.

The types of documents included in this data consist of 435 articles and 134 conference papers. This data provides a comprehensive overview of various aspects of research, including growth, collaboration, and keyword distribution, which can form the basis for further analysis in related subject areas.

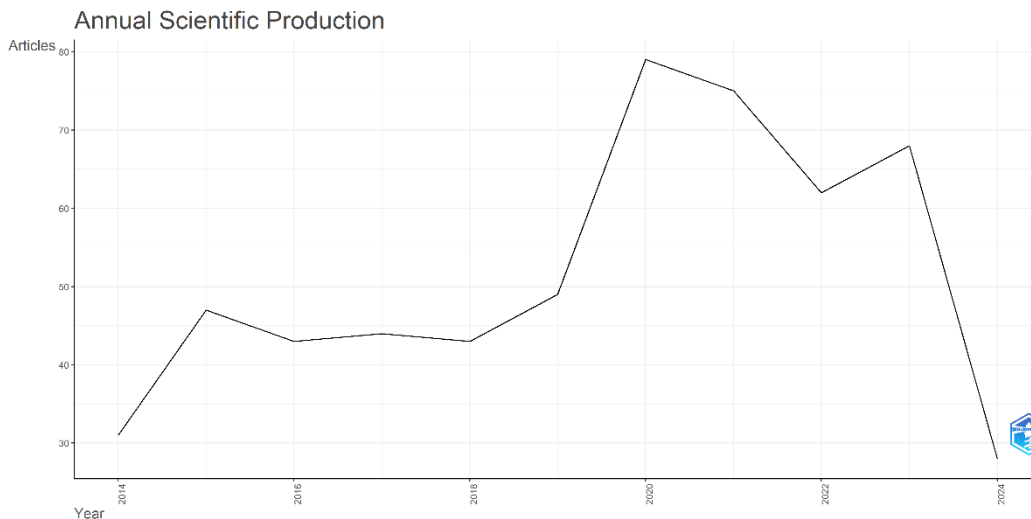


Figure 1. Annual Scientific Production (Source: Bibliometric Results)

Graph of annual scientific publications from 2014 to 2024, measured in the number of articles published each year. Understanding the image can be explained that the vertical part represents the number of articles, while the horizontal part represents the year published.

In 2014, a total of 30 scientific articles were published. Articles increased in 2015 to 45 articles but then decreased and stabilized at around 40 articles until 2018. In 2019, there was a significant increase, with the number of articles reaching more than 70. The peak of published articles occurred in 2020, with nearly 80 articles published. However, after reaching the peak, scientific production began to decline. In 2021, the number of articles published dropped slightly, still above 70 articles. A further decline occurred in 2022, dropping to around 60 articles. The year 2023 saw another increase, reaching around 70 articles. However, in 2024, there will be a drastic decline in scientific publications, with the number of articles dropping close to 30, but 2024 is still in May. So, this graph provides a visual picture of fluctuations in scientific production over the course of a decade, highlighting periods of significant increases and decreases in the number of articles published each year.

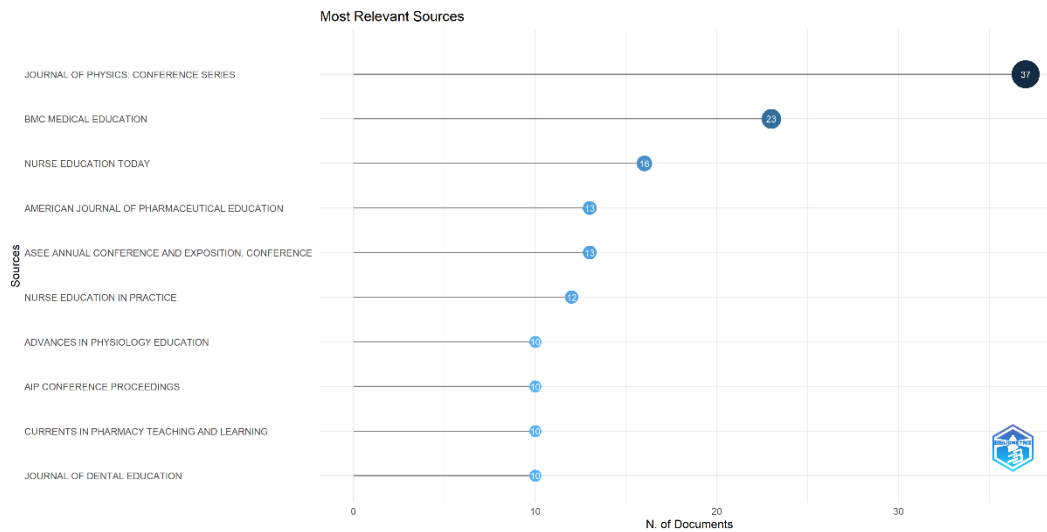


Figure 2. Most Relevant Sources (Source: Bibliometric Results)

This graph describes the sources most relevant to the number of documents published. The vertical axis displays the names of journals or conferences, while the horizontal axis describes the number of documents published.

The data above shows that the Journal of Physics: Conference Series has the highest number of publications, namely 37 documents. The follow-up by BMC Medical Education, with 23 documents, shows a significant contribution to the field of medical education. Nurse Education Today and the American Journal of Pharmaceutical Education have 18 documents showing a focus on nursing and pharmacy education. Furthermore, the ASEE Annual Conference and Exposition Conference has published 16 documents, and Nurse Education in Practice has published 12 documents. Furthermore, Advances in Physiology Education has 11 documents, and AIP Conference Proceedings and Currents in Pharmacy Teaching and Learning have 10 document publications each. The Journal of Dental Education has 9 documents showing its contribution to dental education.

Graphs can be used to identify the key sources that are most productive in producing scientific material in the period under review and provide insight into the distribution of academic and research focus in different educational and scientific fields.

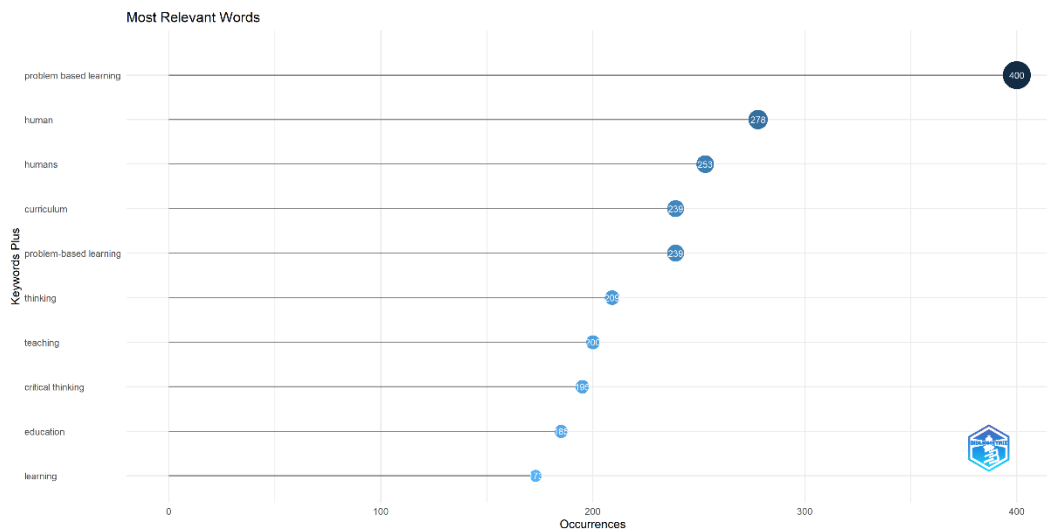


Figure 3. Most Relevant Word (Source: Bibliometric Results)

This horizontal bar graph shows the most relevant words based on the number of events in the analyzed data set. This graph uses a horizontal axis to describe the number of occurrences of each word and a vertical axis to name those words.

The word "learning" had the most occurrences, recorded 400 times, indicating the main focus on learning in the data studied. The word "education" appears 280 times, indicating the importance of the topic of education. "Critical thinking" was recorded 120 times, indicating the importance of critical thinking skills in the material being studied or taught. The word "teaching" appears 80 times, describing the focus on the teaching process. Other words, such as "thinking" and "problem-based learning," each appeared 50 times.

This graph illustrates the frequency distribution of keywords related to critical topics in the data set. It provides insight into essential focus areas such as learning, education, and critical thinking skills, which are crucial in academic and research contexts.

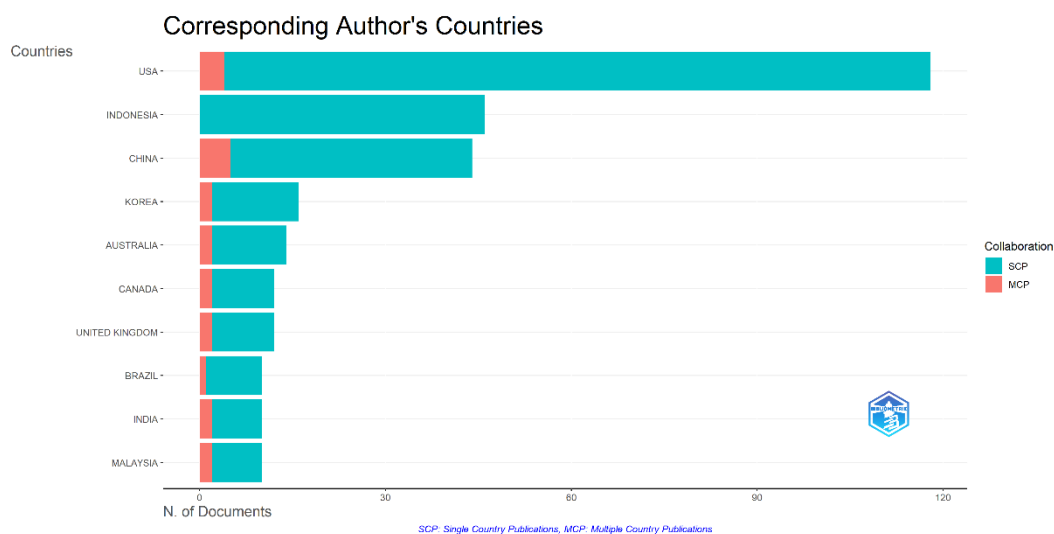


Figure 4. Corresponding Author's Countries (Source: Bibliometric Results)

This horizontal bar graph depicts the correspondence author's country of origin by a number of documents published, with a breakdown by type of collaboration: publications from one country (Single Country Publications (SCP) and publications from multiple countries (Multiple Country Publications (MCP)).

This graph shows that authors from the **USA** have the highest number of publications, with large contributions from publications from one country. It is followed by authors from **China**, which also shows a high number of publications from one country but has fewer publications from several countries compared to the USA. Writers from **Indonesia** are seen as active in both types of publications but are more dominant in publications from one country. Other countries such as **Korea, Australia, Canada, the United Kingdom, Brazil, India, and Malaysia** are also shown in the chart. Each of these countries shows different activity within SCP and MCP, with most having more publications from a single country than from cross-country collaboration.

This graph effectively shows the tendencies and dynamics of international collaboration in scientific publications, emphasizing the important role of specific countries in global knowledge production and cross-border scientific collaboration.

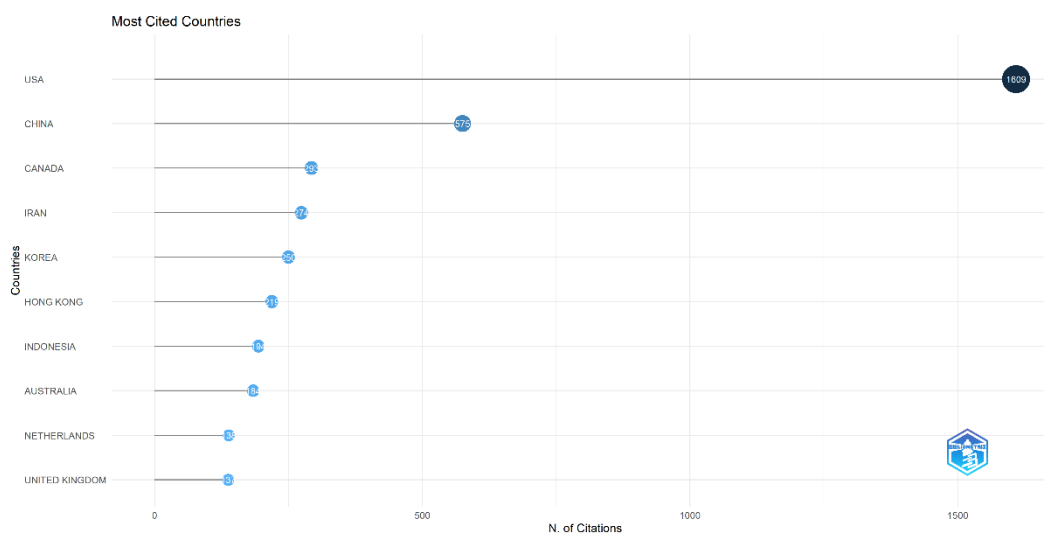


Figure 5. Most Cited Countries (Source: Bibliometric Results)

This graph shows the countries with the highest citations in the scientific data set. It uses a horizontal axis to illustrate the number of citations and a vertical axis to show the countries' names.

From the chart, it can be seen that **the USA** occupies the top position with a very high number of citations, close to 1600 citations. **China** came in second with about 750 citations. Furthermore, **Canada** and **Iran** each showed a significant number of citations, with Canada approaching 350 citations and Iran about 325 citations. Other countries such as **Korea**, **Hong Kong**, and **Indonesia** have a more moderate number of citations, with Korea and Hong Kong each having around 300 citations, while Indonesia has around 200 citations. **Australia**, **the Netherlands**, and **the United Kingdom** are also listed in the chart, each with fewer citations than the countries above it but still significant in their contributions to the scientific literature.

This graph provides a clear insight into the influence of publications from different countries in the global academic community, showing how research from certain countries is more widely cited by the scientific community, indicating the influence and quality of the research produced.

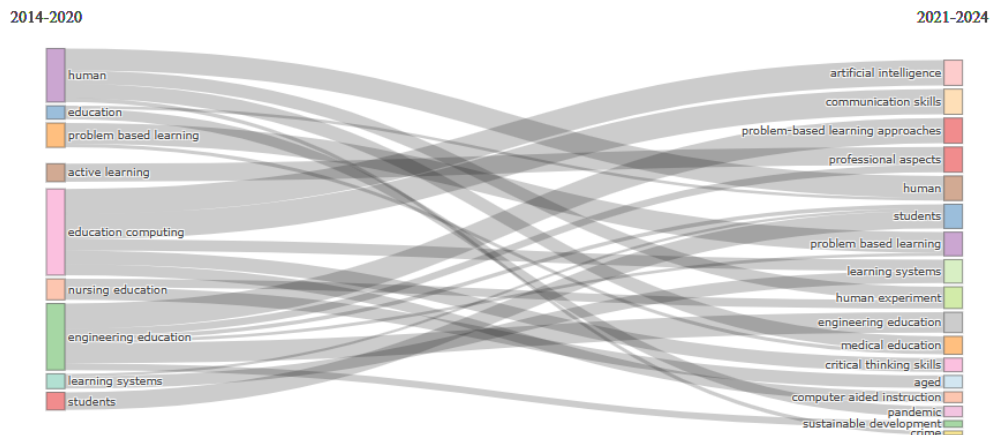


Figure 6. Trend Topics (Source: Bibliometric Results)

This Sankey diagram illustrates the shift in research topics from 2014 to 2020 to 2021 to 2024. This diagram uses vertical axes on both sides to show the topics covered, with gray connections connecting those topics from one period to the next, indicating a continuation or shift in the focus of the study.

This diagram illustrates how the focus of research in education and related sciences has evolved and adapted to changing trends and needs. For example, increased interest in "artificial intelligence" and "critical thinking skills" signifies a response to technological developments and an emphasis on critical thinking skills. Meanwhile, the emergence of "pandemic" and "sustainable development" as new topics reflects the influence of current global events and the urgent need to address sustainability issues.

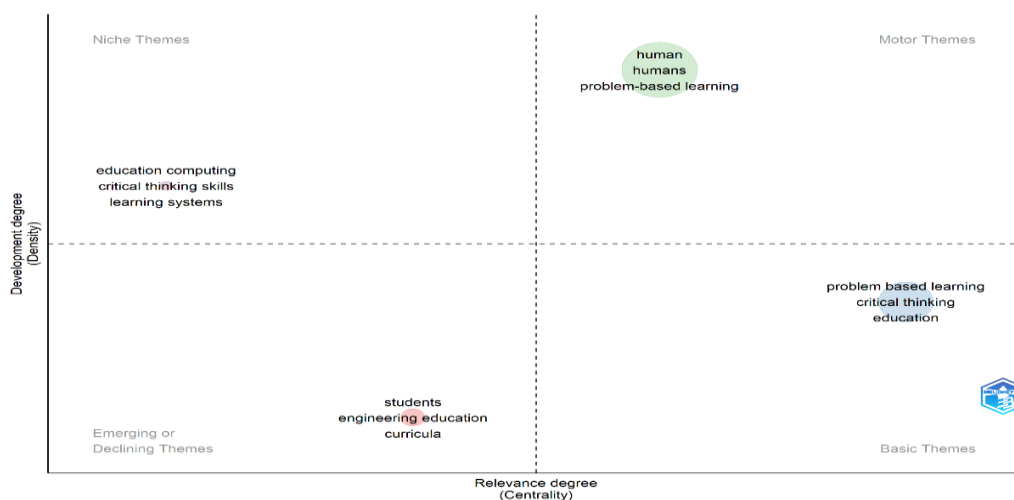


Figure 7. Thematic Map (Source: Bibliometric Results)

This figure explains the classification of research themes into four different categories based on the level of relevance (Centrality) and level of development (Developmental degree). **Motor Themes** (top right

quadrant): These are themes with a high level of relevance and development. These themes are "human," "humans," and "problem-based learning." These themes are central to the field of research, showing that they are highly central and constantly evolving. **Basic Themes:** Includes themes that have a high level of relevance but a lower level of development. These themes are "problem-based learning", "critical thinking", and "education". While these themes are important, they don't evolve as rapidly as motorcycle themes.

Niche Themes (top left quadrant): These themes have a high level of development but lower relevance. These themes include "education computing", "critical thinking skills", and "learning systems". These themes may be very specific and evolve within a particular niche. Next **Emerging or declining Themes (lower left quadrant):** Includes themes with a low level of relevance and development. These themes are "students," "engineering education," and "curricula." While not particularly central or rapidly growing today, they are nonetheless important in academic discussions. This matrix provides a valuable view of current research priorities and how certain themes are considered important or underdeveloped in a particular research field. This helps in identifying research foci that may require more resources or less attention in the future.

CONCLUSION

The analysis shows that between 2014 and 2024, there will be 569 publications on problem-based learning models to improve critical thinking with the keywords "Problem-Based Learning" and "Critical Thinking" in Scopus-indexed journals. The data obtained shows that this research continues to grow and has increased in 2014 publications totaling 30 documents, increasing until 2020, amounting to 80 documents, then decreasing slightly until this year. This means that research on learning models and critical thinking skills has a good trend and is in great demand.

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