

## A bibliometric analysis of inquiry learning in primary education

Aulia Wulandari, Sukarno, Matsuri

Department of Primary School Teacher Education, Faculty of Teacher Training and Education, Universitas Sebelas Maret, Surakarta, Indonesia

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### ABSTRACT

The selection of a learning model is very crucial before the teacher carries out learning activities. Inquiry is a learning model that has existed for a long time and is recommended for use in learning activities. This study aims to map the results of studies related to inquiry learning in elementary schools. Bibliometrics is used as a method to map previous research. Data was obtained through the Scopus website from 2018–2022, and 143 datasets were obtained. Data analysis uses VosViewer software, which maps the data. The results revealed that the two authors have the highest total strength among the other documents. Meanwhile, based on sources, the International Journal of Science Education is the source with the highest link strength, and the Journal of Instruction is the source that is most widely cited. The Netherlands is the country with the highest number of connections, with 19 documents. Based on the author's curriculum keywords, reading dialogue, science education, and primary education are the most used keywords in 2021. Meanwhile, "narrative inquiry," "science teaching," and "professional teaching" are the least used keywords. The conclusion of this research is that inquiry is still one of the choices used in learning activities.

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### Corresponding Author:

Aulia Wulandari  
Department of Primary School Teacher Education, Faculty of Teacher Training and Education  
Universitas Sebelas Maret  
Kentingan, Ir. Sutami Street No 36, Jebres, Surakarta, Indonesia  
Email: aulia\_s032108001@student.uns.ac.id

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## 1. INTRODUCTION

The world of education is experiencing changes due to the rapid spread of information and technology. This requires each individual to have the ability to investigate, analyze critically, and conclude knowledge well. In modern education, learning activities not only provide answers but also foster curiosity to encourage asking questions, seeking answers, and building understanding during learning. This is different from traditional learning, which mostly just memorizes [1], [2].

The use of inquiry-based learning models is considered suitable if implemented in learning activities. The use of inquiry learning models has an impact in the form of training students to work in a group, discussing hypotheses, designing planning and evaluation, and building explanations based on the phenomena they encounter. Students are thus emotionally, behaviorally, and cognitively involved in learning activities. In addition, a sense of knowing and creativity arises in students. In line with this, the inquiry learning model was able to prepare students to face the 21st century [3], [4], [5]. The inquiry learning paradigm focuses more on students during the learning process. Students actively participate in learning activities by developing questions, creating problem-solving strategies, cooperating with peers, and sharing the outcomes of their studies. The notion of scaffolding is central to the inquiry learning approach, which means that educators merely serve as guides and instructors, providing assistance to encourage freedom of investigation [6], [7].

The inquiry-based learning model can be applied to various subjects according to learning objectives. By connecting the learning material with the experiences that students have had. This will bridge the gap between theory and practice, thereby creating a meaningful learning experience. Meaningful learning is obtained by students when they can receive new information independently during the learning process. The construction of existing knowledge with new things is a sign that meaningful learning has occurred [8], [9], [10], [11]. Furthermore, the starting point for meaningful learning can be reached by focusing on the needs of students, designing learning by looking at the competencies that will be obtained by providing learning that is contextual and related to the life experiences of students, and animating learning activities with the activeness of students [12], [13], [14], [15].

One of the keys to success in producing meaningful learning is for students to be active while learning, thus teachers must seek out and implement models, methods, or approaches that stimulate pupils [16], [17]. The learning model is a framework that uses stages to facilitate learning activities. The importance of choosing a learning model that will be used by the teacher in learning activities is crucial. The inquiry learning model has been recommended for several decades for use in learning activities. Students who are active in participating in learning activities and can build knowledge can be said to have an understanding of the inquiry learning model [18], [19], [20]. There are several important aspects in the inquiry learning model, such as defining problems, making hypotheses, and carrying out further proof. The results of the proof, which can be done through tests or practice, need to be combined with old knowledge and with new knowledge. And in the end, students communicate by expressing their findings [21], [22], [23], [24].

Teachers face several obstacles nowadays. One of them is identifying students' requirements and characteristics, as well as their lack of experience or flaws in developing appropriate learning plans that allow students to combine their knowledge [25], [26]. Another obstacle is the lack of training and understanding in applying the inquiry learning model in the classroom. So that the stages of the model to be applied will not be realized properly. Students who are passive during the activity will provide their own challenges to the teacher when learning.

Many studies have been conducted in primary schools that use inquiry-based learning paradigms. One of the papers examines the strategies used by primary school instructors to engage students in self-care while implementing critical literacy through inquiry-based pedagogy [27]. Other study investigates student-centered learning through inquiry, issues, projects, and cases. The research findings address issues such as problem design, teacher and student satisfaction levels, and the order in which information is acquired [28].

Based on the explanation, there has been a lot of research that discusses the implementation and exploration of learning activities that use the inquiry learning model. Meanwhile, this research discusses previous research using bibliometric analysis to obtain information on the extent of research discussing inquiry learning models in elementary schools in 2018-2022. By using bibliometric analysis, the hope is to find gaps in previous research to further explore learning activities that use the inquiry learning model. The research questions are as follows: i) distribution of publications by year, country, affiliation, and document type and ii) bibliographic coupling (co-occurrence, source, and document) and co-occurrence analysis.

## 2. METHOD

The use of bibliometrics as a methodology is useful for presenting research results from data related to inquiry learning models in elementary schools. This method can provide an overview of the vast body of existing literature. Bibliometric analysis has become popular in recent years because it can broadly map the characteristics and developments of research results in certain fields. In addition, the use of a bibliometric that can handle more research results can also produce a higher research impact [29], [30]. In other words, bibliometric analysis is useful for deciphering and mapping the cumulative scientific knowledge and nuances of the evolution of an established field by understanding large volumes of unstructured data rigorously. Therefore, a well-conducted bibliometric study can build a solid foundation for advancing a field in new and meaningful ways, it allows for gaining an overall view of a study, identifying knowledge gaps, deriving novel ideas for investigation, and positioning the intended contribution to the field [31], [32], [33].

### 2.1. Data collection

By using bibliometric analysis, this study aims to look at the characteristics of publications and research trends in the field of inquiry-based learning models, especially in elementary schools. The data collection process uses the keywords "inquiry learning" and "primary school." The scopus.com website was chosen to collect documents. The Scopus website was chosen because it contains reputable journals. The keywords used to collect data are as follows: (TITLE-ABS-KEY (inquiry AND learning) AND TITLE-ABS-KEY (primary AND school)) AND (LIMIT-TO (OA, "all")) 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)). On September 22, 2022, 143 documents matching the dates 2018-2022 were discovered in the search results.

## 2.2. Data analysis

The VOSviewer software was chosen to perform this bibliometric analysis VOSviewer (version 1.8.16), which can be downloaded for free. In the process of using the data that is already owned, it can be interpreted through data mapping. VOSviewer can display and visualize a network consisting of journal origins, keywords, most-cited citations, and links from the author's bibliography contained in the document [34], [35]. The results of the visualization of the data entered will display items representing the author's name, country, and keywords. The items that appear will consist of several networks and clusters. Each network and cluster are distinguished by a different color and thickness. The thickness between the lines and colors will show the strength of the items, and then the relationship between these items can be interpreted [36], [37], [38].

## 3. RESULTS AND DISCUSSION

### 3.1. Distribution of publications by year, country, affiliation, and document type

#### 3.1.1. Distribution of publications by year

The results of the analysis of data obtained through the Scopus website regarding the number of publications from 2018–2022. The distribution results can be seen in Figure 1. The Scopus database recorded a total of 24 publications in 2018. It can also be observed that there was a significant increase in 2019 with 27 publications and in 2020 with 37 publications. There was a decrease in the number of publications in 2021–2022. In 2021, there will be 32 publication documents, and in 2022, only 23 publication documents will be recorded.

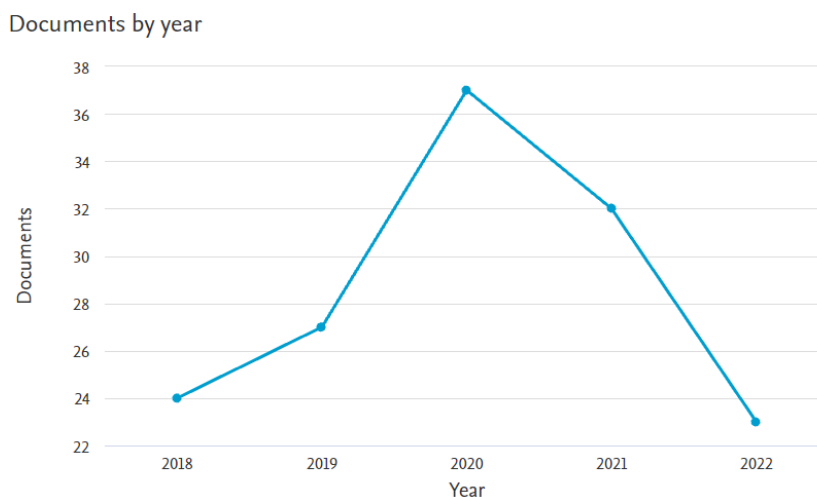


Figure 1. Distribution publication by year

#### 3.1.2. Distribution of publications by document type

The distribution of several types of documents related to inquiry learning is presented in Figure 2. The data distribution on the Scopus website notes that the article is the document with the highest percentage (87.8%) for the last 5 years. Conference paper is in second place by percentage (7.9%), followed by document reviews (2.2%), books (1.4%), and book chapters (0.7%).

#### 3.1.3. Distribution of publications by subject area

The distribution of the subject area is presented in Figure 3. The results of the distribution of published articles in 2018–2022 note several subject areas that appear according to the keywords used. Of the several subject areas that appear the most in social science inquiry learning, a total percentage (53.5%) is the most researched subject area from published documents. Furthermore, computer science (8.9%), psychology (8.5%), arts and humanism (7.0%), psychology and astronomy (4.2%), engineering (3.3%), medicine (2.8%), health professions (2.3%), environmental science (1.4%), mathematics (1.4%), and others (6.6%) are represented.

Documents by type

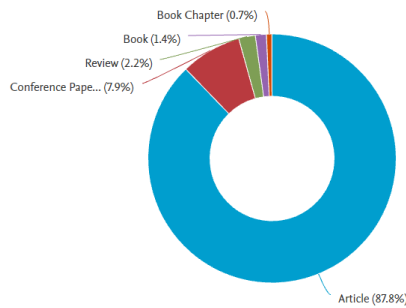


Figure 2. Distribution publication by document type

Documents by subject area

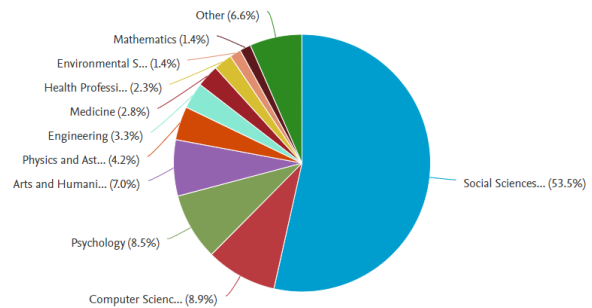


Figure 3. Distribution publication by subject area

### 3.2. Bibliographic coupling (document, sources, and countries) and co-occurrence analysis of the author keywords

#### 3.2.1. Bibliographic coupling by documents

The results of the bibliographic coupling by document findings will provide insight to the author regarding the highest number of documents with connections; this section will reveal how many documents have been combined bibliographically with other documents in Figure 4. Based on the findings, there are 35 documents after arrangement; namely, the minimum number of citations from a document is 5. So, out of 139 existing documents, 50 were discovered, but documents that lacked total link strength were excluded. Documents with the highest total link strength, with 15 and 18 citations [39], followed by documents with 13 and 22 citations [40]. At the same time, documents with the most citations (35 in total) are owned [41]. The names listed in the publication document can be interpreted as having the same reference.

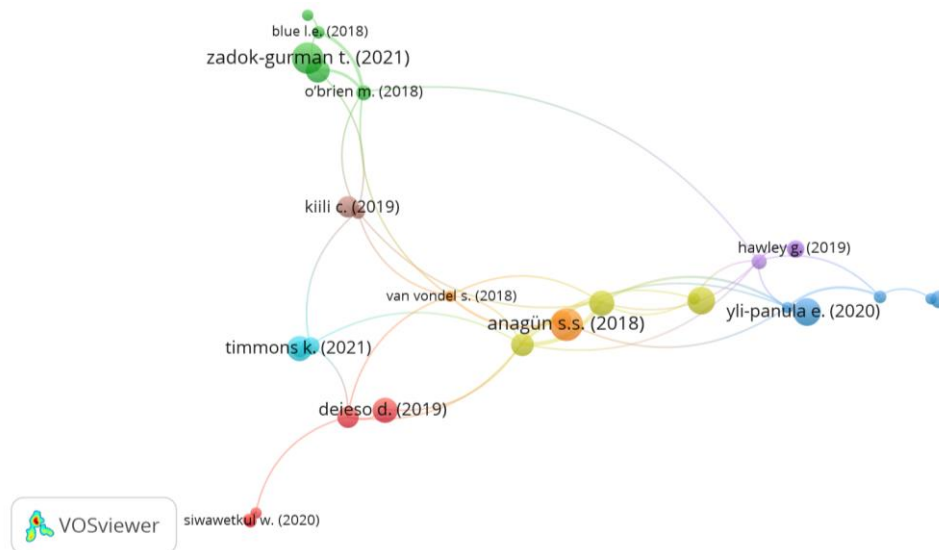


Figure 4. Bibliographic coupling by documents

#### 3.2.2. Bibliographic coupling by sources

In the data mapping process, several settings were made for selecting data. The criteria for selecting data are selecting at least two documents from each source, and the minimum number of citations for each document is one. So, 15 appropriate sources are obtained from 109 existing sources. The findings in the bibliometric coupling by source will guide researchers in identifying and finding sources of publication documentation. Based on the mapping results from the data obtained regarding inquiry learning in elementary schools, the findings reveal that the International Journal of Science Education is the source with the highest link strength of 53. Meanwhile, the International Journal of Instruction is the source with the most citations,

namely 58. the first number represents the document; citation; and total link strength: "International journal of science education; 3; 53; 53", "frontiers in education; 3; 3; 47", "research in science education; 2; 8; 41", "educational science; 5; 33; 41", "Journal of Baltic science education; 2; 5; 26", "crushed; 2; 1; 25", "international journal of stem education; 2; 17; 20", research in science and technological education; 2; 19; 20", Indonesian science education journal; 2; 6; 10", " revista eureka; 2; 10; 9", "international journal of instruction; 4; 58; 4", journal of physics: conference series; 7; 25; 3", "iop conference series: materials science; 2; 17; 1", Campbell system reviews; 2; 3; 0", and " linguistics and education; 2; 13; 0". The display of the mapping results can be seen in Figure 5.

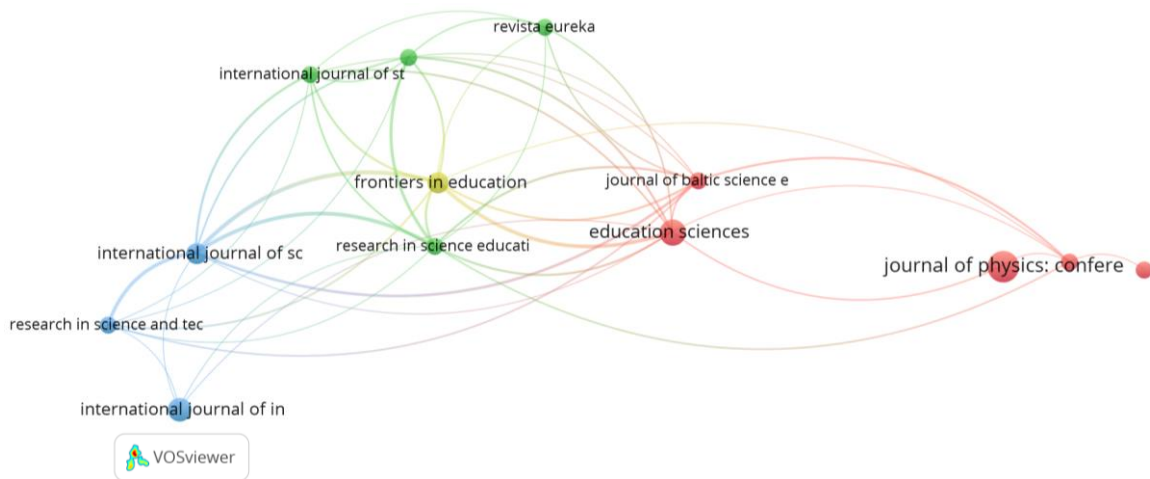


Figure 5. Bibliographic coupling by source

**3.2.3. Bibliographic coupling by countries**

Based on the findings of the analysis, the countries in the network can be identified as having the same references to inquiry learning in elementary schools in the Figure 6. The data selection process was carried out based on the minimum number of documents from each country, which was 5, and the least number of citations from each country, which was 1. Of the 50 countries identified, 10 were found to comply with the provisions. The figure shows the network results. The first country on the list with the highest number of connections is the Netherlands with a total of 19 documents, 135 citations, and a total link strength of 1107. The country's name is then displayed, along with the number of documents, citations, and total link strength. "South Africa; 8; 35; 882", "Australia; 18; 86; 462", "United Kingdom; 7; 58; 357", "United States; 18; 100; 222", "Spain; 10; 19; 166", "Finland; 6; 62; 153", "New Zealand; 5; 16; 31", "Malaysia; 5; 16; 28", and "Indonesia; 13; 78; 24".

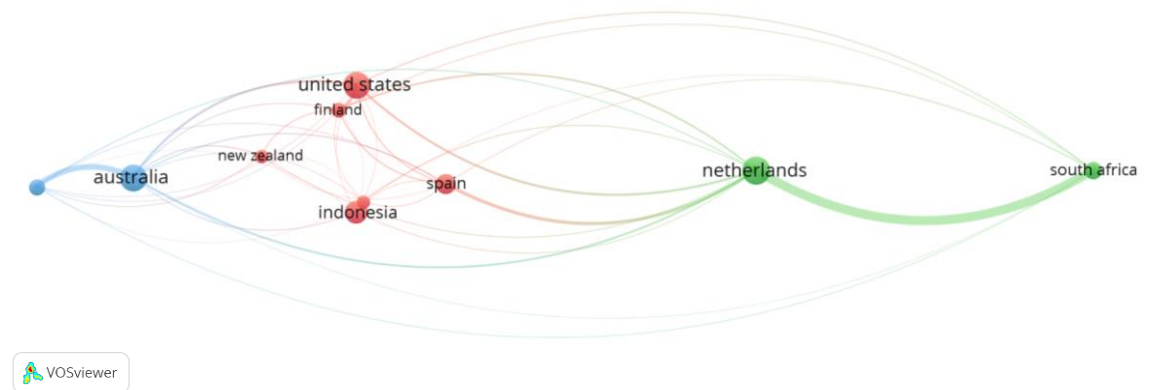


Figure 6. Bibliographic coupling by countries

### 3.2.4. Co-occurrence analysis of the author keywords

In this co-occurrence analysis, words that are frequently used in published documents will be presented. Through Figure 7, it will be known that each keyword used by the author is related to each other, or it can be said that the keywords that appear have been written simultaneously in a publication document. The criteria used in selecting data is the minimum number of keywords that appear together, which is 3. As a result, only 19 keywords appear out of 550. Primary Education is the most frequently occurring keyword, with 16 occurrences and a total link strength of 22. Keywords are then presented: occurrences and the total link strength of the network results that have been obtained. "primary education; 16; 22", "conversation analysis; 6; 12", "inquiry-based learning; 13; 12", "peer interactions; 4; 10", "dialogic reading; 3; 8", "science; 5; 8", "collaborative writing; 4; 6", "inquiry learning; 6; 5", "science education; 5; 5", "mathematics; 3; 4", "primary school; 7; 4", "covid-19; 4; 3", "curriculum; 3; 3", "inquiries; 6; 3", "inquiry-based science education; 3; 2", "mathematics education; 4; 2", "narrative inquiry; 3; 2", science teaching; 3;1", and "professional teaching; 3; 0". Based on the overlay visualization, it is known that from 2020 to 2021 a yellow line appears which indicates the most recently used keywords, namely science education, curriculum, and dialogue reading.

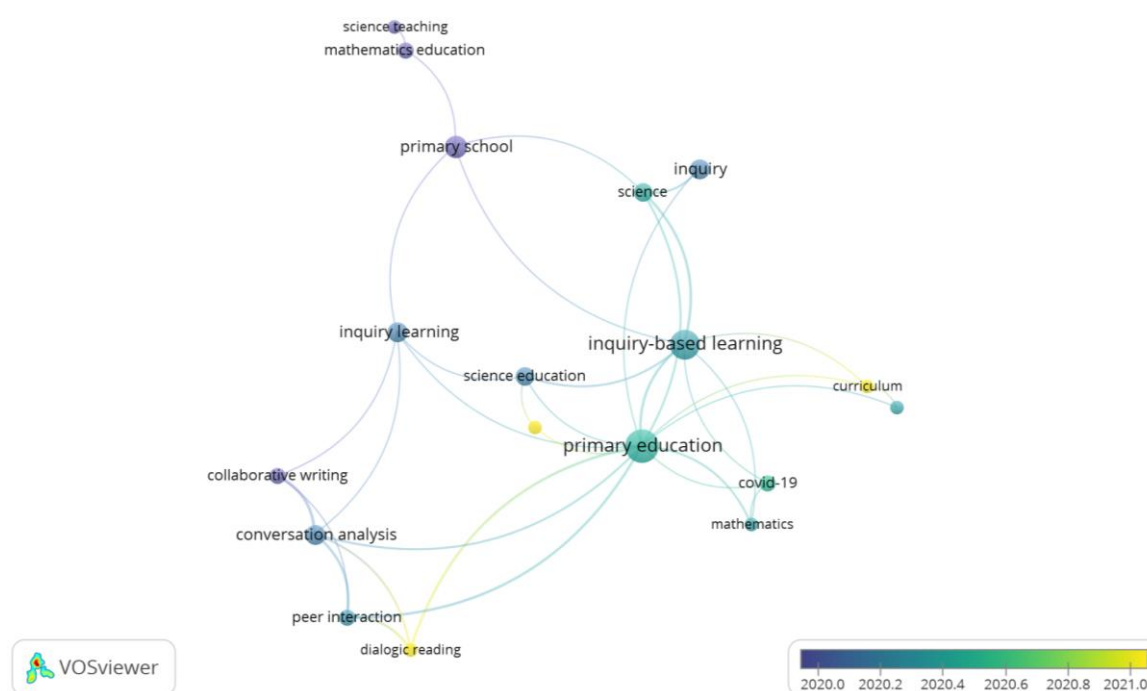


Figure 7. Co-occurrence analysis of the author keywords (overlay visualization)

### 3.3. Discussion

This study aims to reveal and map the results of studies that have been conducted related to inquiry learning in elementary schools based on year, country of origin, affiliation, document type, and bibliographic coupling, which includes co-occurrence, source, and document and co-occurrence analysis of the keywords used in the results of related studies. The Scopus website was chosen because it is the oldest platform and has a research database. Scopus claims to have 76 million publication-related records that are easy to access and cite [42], [43].

Based on the results of data obtained through the Scopus website in 2018, it is known that the number of publications recorded was 24 documents, and from 2019 to 2020, there was an increase in published documents up to 37 documents related to inquiry learning. However, in 2021 there was a decrease in the number of publications, and in 2022 the number of publications was recorded at a total of 24 documents. The number of documents recorded in 2022 has not been fully recorded because the data collection process for 2022 is still in September, so it is still possible to add documents. In the Scopus data, the types of documents related to publication documents were dominated by articles, with a percentage of 87.8%. This relates to the main criteria for writing scientific articles that are easily published by taking into account the ethics of writing for large audiences who have substantive background knowledge [44]. The choice of articles as a place to publish

findings or reports from research that has been carried out is considered trustworthy because there are standards that must be adhered to for an article to be published [45].

Based on Scopus analysis, publication documents related to inquiry learning are classified into 11 categories. Social science is the most researched subject area; this can be seen in the use of inquiry learning in elementary schools, which requires relationships between the social environment and learning activities so that students can link new information with the information they already have to create meaningful learning [8], [16]. Inquiry is often related to social science because there is a change in the learning process from being teacher-centered and only in the classroom to being student-centered. Social sciences are the most researched subject due to inquiry that leads to more discussion activities, conducting observations and interviews, and exploring [46], [47], [48]. Furthermore, computer science, psychology, the arts, and humanism are categories that are related to almost the same percentage because inquiry learning is still related to social science. The most influential documents, with a total of 22 document citations and total link strength [40]. The most cited documents have the least number of citations [41]. Even though it has the highest number of citations, its total link strength is very weak. Inquiry, which is widely used in learning activities, has a complementary role in receiving and producing new knowledge. The use of inquiry can naturally improve educational processes and outcomes. So, it is necessary to do the design process for researchers and educators. To give good results during the learning process, the teacher needs to pay attention to and prepare learning activities so that inquiry learning can be carried out by the phases of inquiry theory. So that teachers have an important role in implementing inquiry learning in education [49], [50], [51].

Through the findings of bibliographic coupling by source, the International Journal of Science Education, Frontiers in Education, and Research in Science Education are the three most widely published document sources. This finding reveals that the three sources of literacy are interrelated when viewed from the clusters presented in the figure. Furthermore, it can also be seen from journal sources that have the same background as the field under study, and the publication documents are sent to journal sources that are relevant to the field under study. Of all the sources that are mapped, all lead to journals related to education, both for teachers and students. Findings on bibliographic coupling by countries reveal 10 countries that comply with the provisions. The Netherlands handles the most published documents and has the highest total link strength. Based on the results of the mapping, it can be interpreted that the publication documents related to inquiry and primary school from the Netherlands have a relationship with or connection with the ten countries on the map. It can also be seen that the Netherlands and South Africa are in the same cluster and have a thick network. Through this, publication documents from the Netherlands and South Africa have a strong relationship, and documents from the two countries may have the same references.

In the results of the co-occurrence analysis of the author's keywords, the keywords that appear the most are "primary education," "conversation analysis," and "inquiry-based learning" in the same cluster. While the least common keywords in inquiry in primary education are "narrative inquiry," "science teaching," and "professional teaching." Based on these results, in general, research areas for keywords used from 2018 to 2022 can be identified. The keywords contained in the Scopus database mapping results can provide researchers with information to determine trends for future research. As for another purpose of this study, to explore fields of study that focus on inquiry learning, especially in primary education, the mapping results in Figure 7 reveal that the most popular keywords in 2021 are "curriculum," "science education and primary education," and "collaborative writing." The curriculum that appears in the inquiry-based learning publication documents is one of the keywords that will appear in 2021. New challenges in the world of education have made many education practitioners choose and make inquiry a part of learning activities. Inquiry that provides experience to students in increasing understanding of content with systematic stages [52], [53], [54]. Collaboration and inquiry are new and have contributed to the recent development of the literature. Inquiry is one of the approaches used in collaborative writing to explore critical art-based inquiry in social science [55], [56].

#### 4. CONCLUSION

The conclusion drawn from the results of the analysis that presents the mapping results from the Scopus database can provide the potential for future research. The results of the research documents reveal that the research trend with the inquiry learning variable is still in great demand and that there has been an increase in 2018–2022. Articles are one of the most dominant choices based on document type. The results from the database show that social science is the most researched subject among all the published documents obtained. Based on the results of the bibliographic coupling by document is the document that has the most links with other documents. Bibliographic coupling by source, which maps publishers of publication documents, reveals that the International Journal of Science Education is the place of publication in most situations. Furthermore, from the coupling of bibliographies by country, the Netherlands became the country with the greatest number of publications that complied with the provisions, namely 19 documents. Finally, based on the co-occurrence



analysis of the author's keywords, it was found that the keywords that appear in each publication document are interconnected and appear simultaneously, namely primary education, conversation analysis, and at least three of the following: narrative inquiry, science teaching, and professional teaching. Meanwhile, the keywords that appear in 2021 are curriculum, science education, primary education, and dialogic reading.

Through the results of the study, we found that future research could further explore inquiry learning models in elementary schools on topics that are still rarely researched. This can be known based on keywords and subject areas that are still rarely used. The authors make the following limitations and recommendations based on the findings of this study: This study only uses data taken from the Scopus database, with a total of 143 documents obtained from 2018–2022. For future research, data sources from other databases can be added so that the results of the documents are more numerous and varied. This research only focuses on inquiry learning in primary education; it would be better if there was research that added other variables and subjects to future research. This research only uses VosViewer as a tool for analyzing data. It only reveals the mapping results of the number of documents in 2018–2022, document type, subject area, bibliographic coupling by document, sources, countries, and co-occurrence analysis of the author keywords. It would be better if future research conducted content analysis so that the results obtained would be a more in-depth analysis.




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**BIOGRAPHIES OF AUTHORS**

**Aulia Wulandari**    is a student at Sebelas Maret University. Aulia Wulandari received a bachelor's degree from Ahmad Dahlan University in Yogyakarta, Indonesia, in 2020. She joined Sebelas Maret University, majoring in Master in Elementary School Teacher Education at the Faculty of Teacher Training and Education, Surakarta, Indonesia. Several manuscript articles have been published in the field of education, especially in elementary schools, related to teacher self-efficacy. She can be contacted at email: aulia\_s032108001@student.uns.ac.id.



**Sukarno**    is received additional duties as Teacher Professional Education Manager (PPG) at FKIP UNS and Supervisor of the Teacher Professional Education Competency Test Center (UKMPPG). He completed his undergraduate education in counseling education at Sebelas Maret University, continued his master's education in counseling education at the State University of Malang, and completed a doctoral program in educational sciences at Sebelas Maret University. He has published journals related to improving the quality of lectures, teacher professional development, and learning models. He has also published a book entitled Learning Management Systems: To Support the Blended Learning System Model (Publisher: UNS Press). He can be contacted at email: sukarno57@gmail.com.



**Matsuri**    is a doctor at Sebelas Maret State University and serves as a lecturer. Matsuri received a doctorate in sports science from the Surabaya State University Postgraduate Program. He has researched the effects of total body resistance exercise (Trx) on strength and power increasing, gifted analysis, digital literacy, and the TPACK approach, which is related to the sports sector and the education sector, especially in elementary schools. The published studies consist of four articles published in reputable journals international seminars and conferences and three books. The achievements he has obtained are a Coach of the Asian Para Games 2018 in the sport of sitting volleyball; International Referee at the International Volleyball Federation (FIVB) from 2016–present; and Referee Level 2 International Sitting Volleyball (World Paravolley). He can be contacted at email: matsuri@staff.uns.ac.id.