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Research Article

The Shifting Tendency of Inquiry Learning Research in the Last Five Years: Real Contribution in Physics Education

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Abstract.
The research objective is to explore the trends research of inquiry learning in physics education in the last five years (2017-2021). This research is a bibliometric analysis. The findings show that research related to physics education is dominated by the most developed during the COVID-19 pandemic (2020 – 2021) country Indonesia. Meanwhile, the Journal of Physics Conference Series is the journal that publishes the most publications (Scopus) related to physics education, followed by the AIP Conference Proceeding. For research implications tolibrarians, and policy makers, (1) Research and development need to be carried out in-depth related to the growing trend of physics education so that it can be published in Scopus. (2) Cooperation and collaboration between other universities to increase publications at the international level. (3) The need for continuous research to follow current trends.

Keywords: shifting tendency, inquiry learning research, real contribution, physics education

1. INTRODUCTION

Inquiry-based learning is getting much attention as an effective learning approach. Therefore, it has been researched and implemented in various countries. Inquiry-based learning has been used in various subjects such as biology, mathematics, and social studies [1] and has been considered an effective learning approach in science education

[2, 3]. Inquiry learning is a constructivist approach in which students actively build their knowledge, with investigative and experimental activities as the activity center [4, 5].

Many countries have introduced Inquiry-Based Learning into science teaching [6]. However, in Southeast Asia, there are very few studies on the impact of authentic inquiry-based learning, or teaching on science education [7]. In addition, research on high school students is the most numerous, while studies on university physics education are relatively few [8].

Based on the issues and urgency mentioned above, it was necessary to analyze inquiry learning in physics education to determine trends in research throughout the previous five years (2017–2021). The findings of this study are believed to be useful to other researchers in the future. This research has a special goal: to explore trends while revealing details about the future of inquiry learning in physics education research. There are several research questions were asked to help achieve the specific research problem:

1) How many publications on inquiry learning in physics education from 2017-2021?

2) How has inquiry learning developed in physics education from 2017-2021?

3) How is the trend of visualization maps in inquiry learning developed in physics education from 2017-2021?

4) What is the finding and recommendation from the top-cited article?

2. RESEARCH METHOD

In this study, the research used was bibliometric literature analysis [9]. Literature and metadata searches were carried out using the Scopus database with the keywords 'inquiry learning' AND 'physics education' OR 'physics learning' obtained 599 documents. The data collection will be carried out on January 2022. The obtained documents are then reduced based on: Open access, 2017-2021, Document type: article and conference paper, Publication stage: final, Source type: journal and conference proceeding, and Language: English. Based on the criteria obtained, 218 from 599 documents. The results of the documents were then analyzed using VOSviewer software to analyze co-occurrence.

3. RESULT AND DISCUSSION

3.1. Publication by Year

Two hundred eighteen documents in the Scopus database are relevant to inquiry learning in physics education (2017-2021). The following are presented data by year in Figure 1.

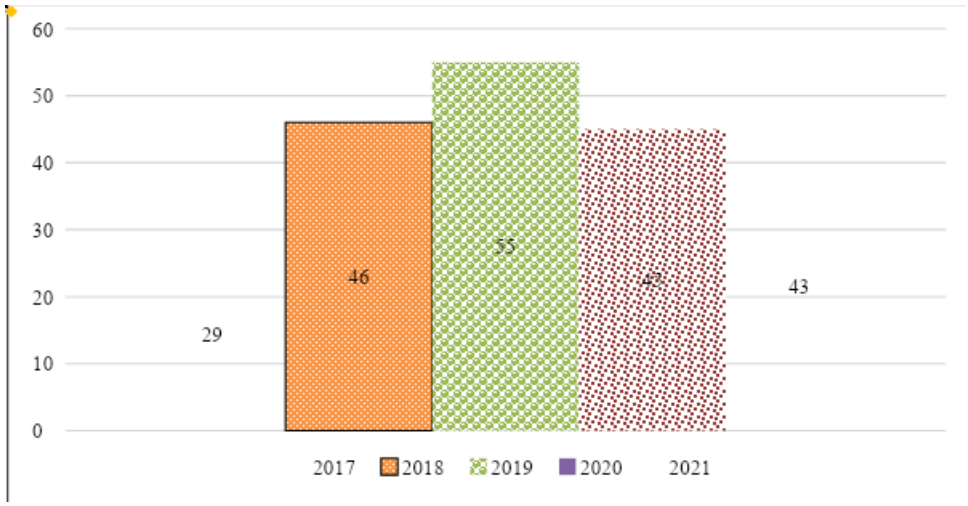

Figure 1: The document by year research on inquiry learning in physics education.

Figure 1 shows that the publication of inquiry learning in physics education documents from 2017 to 2019 is also an increase, but from 2020 – 2021 it decreased. This is in line with research related to STEM education which has increased every year [10–12].

3.2. The Document Type and Source Type

The topic of inquiry learning in physics education research for 2017 – 2021 is based on Scopus data shown in Document Type and Source Type, and Source Title listed in Table 1.

TABLE 1: Document type and source type research on inquiry learning in physics education.

Document Type	Total	Source Type	Total
Conference Paper	116	Conference proceeding	115
Article	102	Journal	103

Table 1 describes the types of documents for 2017-2021 dominated by types of conference papers. Meanwhile, based on the type of sources used, the papers in the Conference Proceedings were dominated. Several studies published in proceedings, especially the Journal of Physics: Conference Series (JPCS), are inquiry research in the form of R&D [13–15] and experiments [16–19].

3.3. The Document Source Title (Top 10)

Furthermore, it continues to develop based on Title Source-based data, which can be seen in Table 2.

Table 2: Document source title research on inquiry learning in physics education (Top 10).

Source Title	Total	Source Type	SJR	Quartile
Journal of Physics Conference Series	66	Conference proceeding	0.183	Q4
AIP Conference Proceedings	13	Conference proceeding	0.164	Q4
International Journal of Science Education	6	Journal	1.003	Q1
Physical Review Physics Education Research	6	Journal	1.015	Q1
Eurasia Journal of Mathematics Science and Technology Education	5	Journal	0.506	Q1
European Journal of Physics	5	Journal	0.389	Q3
Journal of Baltic Science Education	5	Journal	0.388	Q2
Journal of Chemical Education	3	Journal	0.555	Q1
Journal of Science Education and Technology	3	Journal	1.280	Q1
Physics Education	3	Journal	0.402	Q3

Table 2 shows that the published documents are dominated by conference proceedings, especially from the Journal of Physics Conference Series. Some of the research published in the JPCS is applying the ADI learning model to improve students' scientific argumentation abilities [20]. Application of levels of inquiry to enhance mastery of junior high school [21]. Edmodo-assisted guided inquiry learning is appropriate for increasing the understanding of high school students' material and science process skills on static fluids [22].

3.4. Affiliation, Author, and Country

Based on documents obtained from Scopus that the Topics Research Inquiry Learning in Physics Education in 2017-2021 levels of the affiliate, author, and country are shown in Table 3.

Table 3 shows that most of the affiliates are from Indonesia. This is also supported by the most productive country in this research topic, Indonesia, and the most productive authors from Indonesia. Several researchers from Indonesia are inquiry-based learning research conducted at the high school level [16, 18, 23–31] and at universities [15, 17, 32–35]. Based on this, it was found that research on this topic is still rarely carried out, especially with the research subject being teacher candidates.

TABLE 3: Document affiliation, author, and country on inquiry learning in physics education (Top 10).

Documents by affiliation		Documents by Author			Documents by Country	
Affiliation	Total	Author	Total	Author's Country of Origin	Country	Total
Universitas Pendidikan Indonesia	11	Srisawasdi, N.	6	Thailand	Indonesia	63
Universitas Negeri Malang	11	Yuliati, L.	6	Indonesia	United States	39
Khon Kaen University	8	Yulkifli	6	Indonesia	Slovakia	12
Universitas Negeri Padang	8	Festiyed	4	Indonesia	Italy	10
Pavol Jozef Safarik University in Kosice	6	Ješková, Z.	4	Slovakia	Thailand	9
Università degli Studi di Palermo	5	Prayogi, S.	4	Indonesia	Spain	8
Matej Bel University	4	Utari, S.	4	Indonesia	China	7
Beijing Normal University	4	Verawati, N.N.S.P.	4	Indonesia	Finland	6
Universitas Negeri Surabaya	4	Balogová, B.	3	Slovakia	South Africa	5
Universitas Negeri Jakarta	4	García-Carmona, A.	3	Spain	Germany	4

3.5. Visualization of Inquiry Learning in Physics Education Research Trends at the Level Year 2017 -- 2021

There were 218 documents related to inquiry learning in physics education in Scopus data. Then the researcher visualizes the trend of the research topic with the help of VOSviewer. Research trends in this topic are shown in Figures 2 and 3.

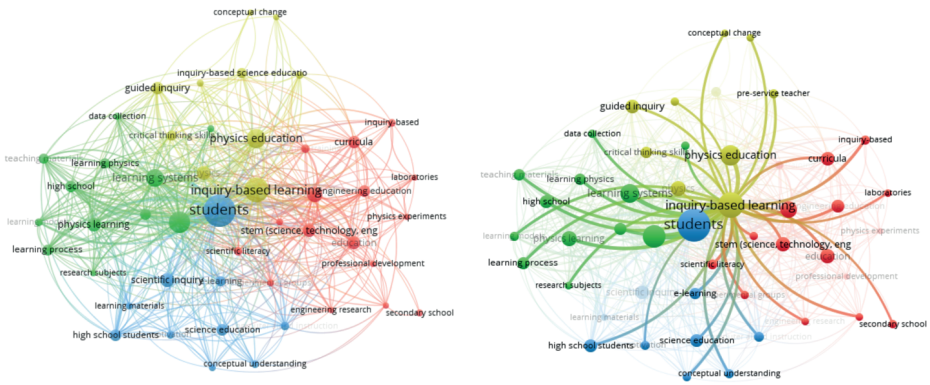

Figure 2: Network visualization research trend of inquiry learning in physics education (2017-2021).

Figure 2 is a visualization of the entire Scopus data-based research on inquiry learning in physics education for the year (2017 – 2021). The visualization results produce four-color clusters (red, blue, yellow, and green). The first cluster (red color) are curricula, education, engineering education, laboratories, physics experiments, scientific literacy, secondary school, stem, etc. The second cluster (green color) are education computing, learning physics, learning process, research and development, teaching materials, etc. The third cluster (blue color) are conceptual understanding, e-learning, high school students, learning environments, learning materials, motivation, science education, scientific inquiry, student, etc. The fourth cluster (yellow color) are conceptual change, critical thinking skills, guided inquiry, inquiry-based learning, inquiry-based science education, physics education, pre-service teacher, scientific knowledge, scientific reasoning, etc.

Inquiry-based physics learning improves the quality of physics learning and thinking skills, especially for prospective physics teachers [15]. Besides that, it can also increase students' conceptual understanding, inquiry process skills, and self-confidence in learning [36]. Applying the guided inquiry learning model can improve student learning outcomes [37], building a habit of mind for students [19]. The open-inquiry learning model effectively increases conceptual understanding, 21st-century skills, and student learning attitudes [7]. The science process skills of students who use the scientific inquiry learning model are better than conventional learning [18]. The Online-Based Inquiry learning model effectively improves the Physics Skills of 21st Century High School Students [25]. Edmodo-assisted guided inquiry learning is more effective in increasing cognitive aspects of scientific literacy [24].

The Reflective-Inquiry Learning model can encourage critical thinking skills, especially for prospective teachers [33, 35, 38]. Inquiry training based on web-student worksheets helps improve scientific literacy. It can be an innovation to enhance students' problem-solving abilities in physics learning at High School [13]. In addition, the acquisition of students' Physics concepts has changed positively during learning activities using the ADI learning model [30]. Applying inquiry-based laboratories and training their higher-order thinking skills [39] effectively support the construction of a comprehensive understanding of students' science concepts and processes [40]. The guided inquiry model physics learning combined with an effective advance organizer to increase students' understanding of physics concepts [15]. Students' scientific knowledge increased in the moderate category, and students' character developed well after applying inquiry learning through a neuroscience approach to physics learning [41].

Based on some existing research, it is found that inquiry-based learning is researched on the following physics topics: Newton's Law [24, 26, 42], temperature and heat [43],

work & energy [28], Sound waves [21], Bernoulli Law [29], static fluid [22, 44], Rigid body equilibrium [31], electricity [17]. There is still little that discusses the application of inquiry-based learning on dynamic and static fluid topics.

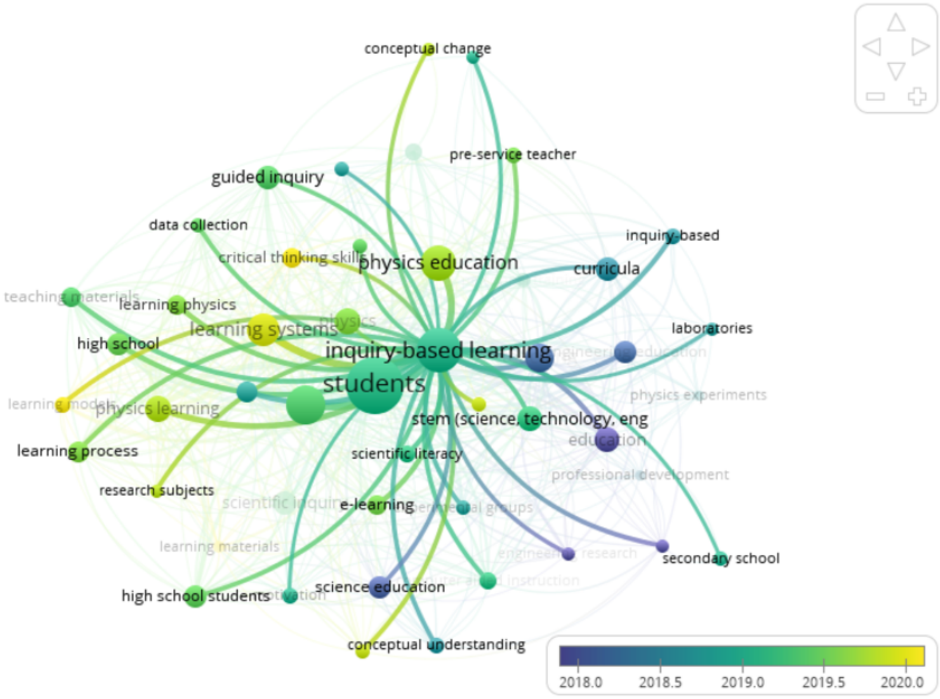

Figure 3: Overlay visualization research trend of inquiry learning in physics education (2017-2021).

In the overlay visualization of inquiry learning in physics education research trends, there are four colors: blue, purple, yellow, and green. Research on inquiry learning in physics education in the last 2 years related to learning environments, learning models, learning materials, learning systems, critical thinking skills, and experimental research.

The development of online learning tools with an inquiry learning model on material for rigid body equilibrium is effective and suitable for the physics learning process for class XI of senior high school [31]. Developing guided inquiry-based educational game worksheets is very practical for learning [14].

Inquiry-based learning for STEM Education shows that the ability to solve physics problems in the experimental group is different from the control group [16] and influences scientific literacy and achievement of physics concepts, especially in the subject of Newton's Laws [26]. Guided inquiry for STEM education has led students to analyze life problems based on physics principles. Students can solve life problems based on related physics principles through guided inquiry learning for STEM education [29]. Argument-based inquiry for STEM education is an innovative learning model that can encourage students' scientific reasoning [45].

Students' critical thinking skills can be improved through the application of inquiry-based learning, which has a significant effect on student's critical thinking skills [28]; the Inquiry Creative Process learning model is effective in improving the critical thinking skills of prospective physics teachers [32], the inquiry learning model is infused blended experiment [17], and integration of guided inquiry-based e-modules in ethnoscience [46]. As seen in Figure 3, the link between inquiry-based learning and further thinking skills still has a chance to be investigated further in the future.

4. CONCLUSION

The number of article publications (Scopus) increased from 2017 to 2019. Meanwhile, the Journal of Physics Conference Series has the most publications related to physics education, followed by AIP Conference Proceeding. In this case, the affiliation, author, and county in research on inquiry learning in Physics Education is dominated by universities from Indonesia. Through the results of the discussion that has been carried out, several keywords related to this topic were obtained, which can be used as a basis for further research.

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