

Research Trend of Subject Specific Pedagogy (SSP) in Physics Learning Through Bibliometric Analysis in 2012-2021 using Scopus Database and the Contribution of Indonesia

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ABSTRACT

Subject specific pedagogy (SSP) is the packaging of material into a comprehensive and educational learning set. The SSP consists of five main components, namely syllabus, lesson plans, modules, student worksheets and assessment sheets. This study aims to analyze the trends of SSP in physics learning research publication from 2012-2021, visualize SSP research trends and how Indonesian researchers contribute to SSP research. This study was conducted on June 8, 2022, using bibliometric analysis. Data obtained is 986 document results and taken by using Scopus database with "Subject Specific Pedagogy in Physics Learning" as the keyword from 2012 until 2021. The data mapping was carried out using VOS Viewer software. Based on the research results, it can be concluded that research on the SSP in physics learning is still limited. Therefore, this research has the potential to find novelty. SSP was first introduced as Pedagogical Content Knowledge (PCK) that mostly related to science teacher, competency, and lesson. From 86 countries, Indonesia became the third largest contribution research documents in SSP by placing two representative institutions: Universitas Negeri Yogyakarta and Universitas Pendidikan Indonesia. Indonesia also contributed the most prolific SSP in physics learning writer, Jumadi became the fourth most prolific writer.

Keywords: subject specific pedagogy, bibliometric, VOS Viewer, Scopus

1. INTRODUCTION

Teachers are not only presenters of teaching materials but also planners of appropriate learning designs for students. Even though the mastery of the material is very good, if it is not supported by knowledge of didactic factors, it will have the impact of an obstacle in mastering the material for students to what is conveyed by the teacher (Sopian, 2016). Teachers should be able to place students as partners in learning. Thus, students can be invited to be more active and contribute during the learning process.

Learning Physics is known to be difficult and scary for most students (Samudra et al., 2014). There are many formulas and equations that are difficult for students to understand. Therefore, the teacher's role in designing specific physics learning tools for teaching materials greatly influences students' perceptions of learning physics.

Subject specific pedagogy (SSP) research provides new insights for the development of learning tools, especially in physics subjects. Prasetyo, in his research, developed an integrated SSP which is integrated with Merapi disaster awareness education (Prastyo et al., 2021). The developed SSP is feasible to use and contribute to disaster awareness education for students.

Subject specific pedagogy in physics learning makes meaningful learning and suitable for student needs. This is not only affected the learning situation but also makes curriculum in physics learning more structured. Subject specific pedagogy is needed in physics learning to succeed the learning objectives of teacher.

Subject specific pedagogy is a set of learning consisting of syllabus, lesson plans, modules, worksheets, and assessment sheets (Guntara & Nona, 2019; Purwanti, 2016). The use of SSP in learning physics can increase students' learning motivation (Noor & Wilujeng, 2015). The development of SSP based on value clarification is also effective in cultivating the values of tolerance, discipline, responsibility, work ethic,

openness, positive thinking, self-development, cooperation, mutual respect, and fostering honesty for students. (Wijayanti & Widowati, 2019).

Subject specific pedagogy as pedagogy enacted in specific disciplinary/regional and social contexts. Pedagogy as informed decision-making drawing on a regional amalgam of content knowledge & pedagogical knowledge. PCK and recontextualization form part of a language and conceptual framework to improve vocational SET pedagogy (Thompson & Hanley, 2017).

Research from Deta, et al stated that bibliometric analysis on Socio Scientific Issues (SSI) research trends in physics learning at Scopus using VOS Viewer software shows that SSI research trends are related to scientific literacy, argumentation, and global warming. From 35 countries, Indonesia became the largest contribution research documents in SSI. Widodo becomes the most influential researcher from Indonesia (Deta et al., 2021)

Suprpto's research aims to analyze photographic physics studies and see trends in order to find opportunities in the next similar research. This research uses the Scopus database and is visualized using the VOS Viewer. Based on the display presented, there is an opportunity for the next researcher to conduct research on this topic (Suprpto, Kholiq, et al., 2021).

Hidayatullaah's research aims to analyze the results of bibliometric mapping visualization on ethnosience-based learning research trends and their contribution to physics learning. Data obtained from Scopus and Google Scholar in 2011-2020. The results showed that ethnosience-based learning had the majority contribution in science learning from elementary to junior high school level and physics at the high school to university level (Hidaayatullaah et al., 2021).

Research from Suprpto which aims to analyze research trends in the field of Technological Pedagogical Content Knowledge (TPACK) along with the contributions of Indonesian researchers from 2015 to 2019. This research was conducted through bibliometric analysis using the Scopus database and visualized using the VOS Viewer. The findings in this study can help researchers to recognize TPACK research trends and recommend directions for further research (Suprpto, Sukarmin, et al., 2021).

Bibliometric analysis is a popular and rigorous method for exploring and analyzing large volumes of scientific data (Donthu et al., 2021). This allows us to see the research characteristics of a particular field and can observe emerging areas within that research area. However, the application of bibliometrics in certain research areas is still underdeveloped.

The difference with the previous article lies in the focus of research. In this research focus on subject specific pedagogy in physics learning topic. The trend of research on subject specific pedagogy in physics learning is not very popular yet. However, there are many interesting things on this topic that have not been revealed by researchers.

Scopus is an abstract source and citation database curated by independent experts in their field (Elsevier, 2020). Scopus includes information from more than 16,000 peer-reviewed journals (life science > 4,100 titles; health science > 6,700 titles; physical sciences > 7,100 titles, and social science > 4,300 titles including 1,200 Open Access journals). It also includes 520 conference proceedings, 650 trade publications, and 315 book series (Salisbury, 2009). Together with the Web of Sciences, Scopus is the current behemoth of bibliographic information in academia (Pranckutė, 2021).

This study aims to analyze research trends in subject specific pedagogy in physics learning using the Scopus database and visualized using the VOS Viewer. Through the visualization, it will be used to analyze the opportunities for researchers to conduct similar research. In addition, it analyzes the novelty of research with subject specific pedagogy topics in physics learning. This is important so that researchers are able to compile material and data to conduct research on subject specific pedagogy topics. Thus, they can also play a role and contribute to research, especially researchers from Indonesia.

2. METHODS

The type's research of this study is descriptive research which was analyzed by using the bibliometric analysis method. The data obtained in the form of the publication numbers each year, authors, and journals that contain SSP articles in physics learning. Furthermore, the search results in the form of data samples are

downloaded in .ris and .csv formats. This research are analyzed using VOSviewer software from three types of mapping produced, namely network visualization, overlay visualization and density visualization.

This study was conducted on June 8, 2022. Data obtained is 986 document results and taken by using Scopus database with "Subject Specific Pedagogy in Physics Learning" as the keyword from 2012 until 2021. While the search strategy was little:

subject AND specific AND pedagogy AND in AND physics AND learning AND (LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012))

Research subjects were analyzed by using Microsoft Excel 2013. Like the publication trends in SSP field and document's types number was processed by using Microsoft Excel, which was formed into a graph. After the statistical results are obtained, the mapping data analysis is carried out using VOSViewer.

3. RESULTS AND DISCUSSION

The number of documents on Subject Specific Pedagogy in Physics Learning during 2012-2021

As of June 8, 2022, 986 metadata documents related to SSP research on physics learning have been obtained on the Scopus website. The document is the research data of SSP physics learning for the last 10 years from 2012-2021. The graph of the development trend of physics learning SSP research is shown in Figure 1 and the visualization using VOS viewer software is shown in Figure 2. The graph generally shows that there is an increase in the number of physics learning SSP research from 2012 to 2021, although in 2013 there was a not too significant decrease. In 2021, the number of SSP research on physics learning is the most compared to previous years, it can even be believed that in 2022 and beyond, it will still increase.

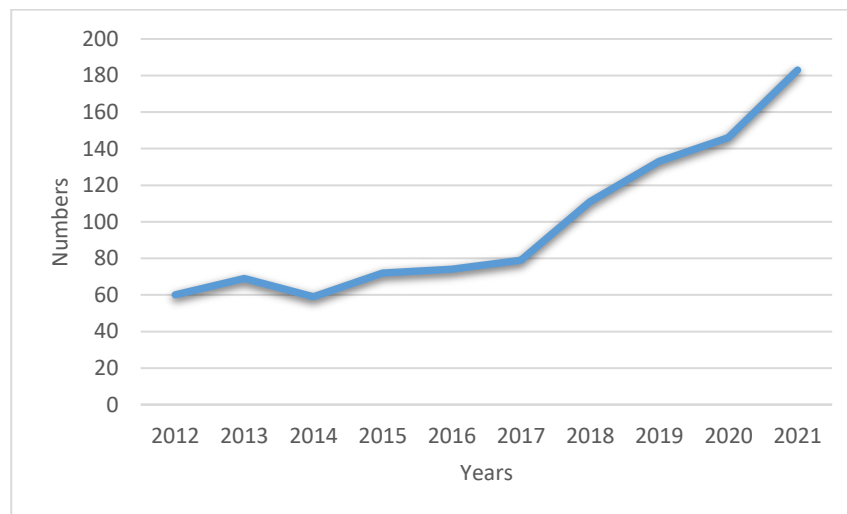


Figure 1. Graph of Research Development Trends in SSP physics learning

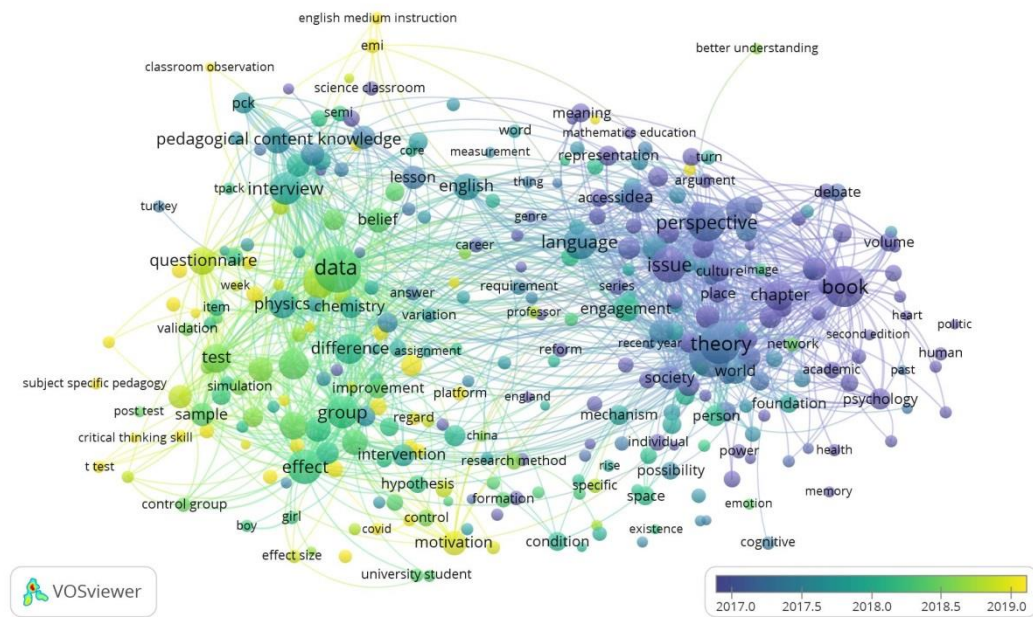


Figure 2. Visualization of the Position of the SSP Physics Learning

This shows that SSP research is an interesting research to study. When compared to the development of STEM research, TPACK, and other top research, SSPs are very few in number. However, the SSP for learning physics still has great potential to be developed in the future. This is evidenced by several SSP studies in 2021 which have interesting themes. In addition, SSP is closely related to the pedagogical knowledge of a teacher. With changing times, pedagogical knowledge will certainly follow these changes.

The number of documents on Subject Specific Pedagogy in Physics Learning Based on Source

SSP in physics learning in 2012-2021 varies widely, as shown in Figure 3. In the figure it appears that most publications of SSP research on physics learning are carried out using journals with a total of 594. However, there are at least 1 publication. in the form of a trade journal. It can be understood that the development of digital journals in the world is also growing faster. Digital journals (e-journals) through the Open Journal System (OJS) are an excellent means to publish research results in a wider scope. This can increase the good reputation for writers in the development of science. Citation of scientific papers, will increase if they can be indexed (at least on Google Scholar). Quality and indexed publications affect the reputation and visibility of the college.

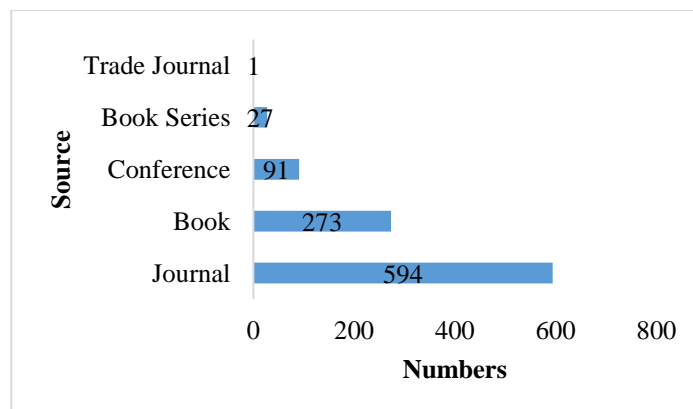


Figure 3. Number of SSP Research on Physics Learning based on Source

The percentage of documents on Subject Specific Pedagogy in Physics Learning based on language

Based on language, SSP research on physics learning varies as shown in Figure 4. The most dominant is SSP in physics learning using English with a percentage of 97%, while the rest uses the language of the country concerned. From these data, no articles were found in Indonesian. This is because journal publications in Indonesia indexed by Scopus use English. These journals include: Indonesian Journal of Science and Technology, Journal on Mathematics Education, Indonesian Science Education Journal, and Cakrawala Pendidikan. In addition, most of the journals in Indonesia use English.

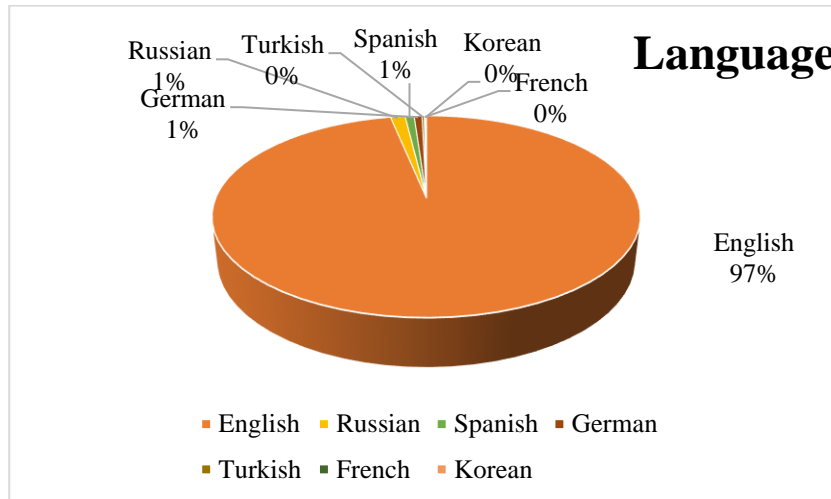


Figure 4. Percentage of SSP Documents on Physics Learning based on Language

Countries Distribution of Subject Specific Pedagogy in Physics Learning study during 2012-2021

The ten countries that have the most contributed to SSP research on physics learning in 2012-2021 are shown in Figure 5. This shows that SSP in physics learning has become an interesting topic in several countries. The largest contributors were the United States with 228 and Indonesia in third place with 73. In addition, a map of countries that contribute to SSP in physics learning is shown in Figure 6.

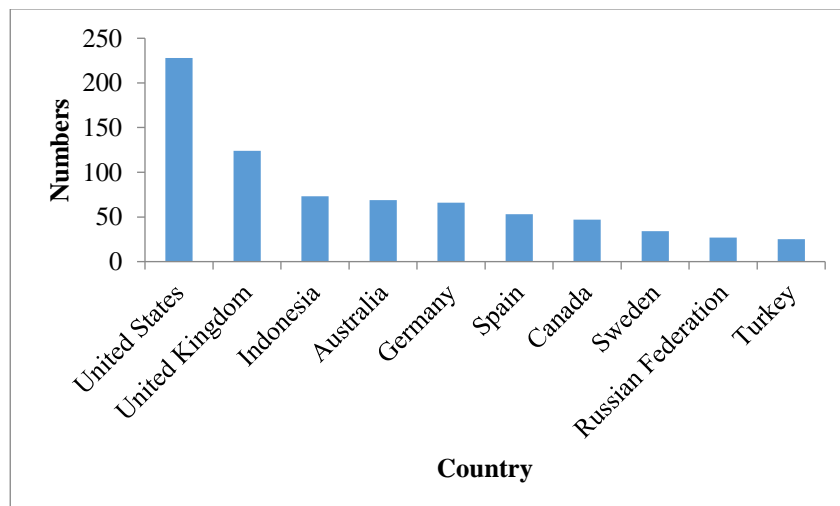


Figure 5. The Country's Contribution to SSP in Physics Learning in 2012-2021

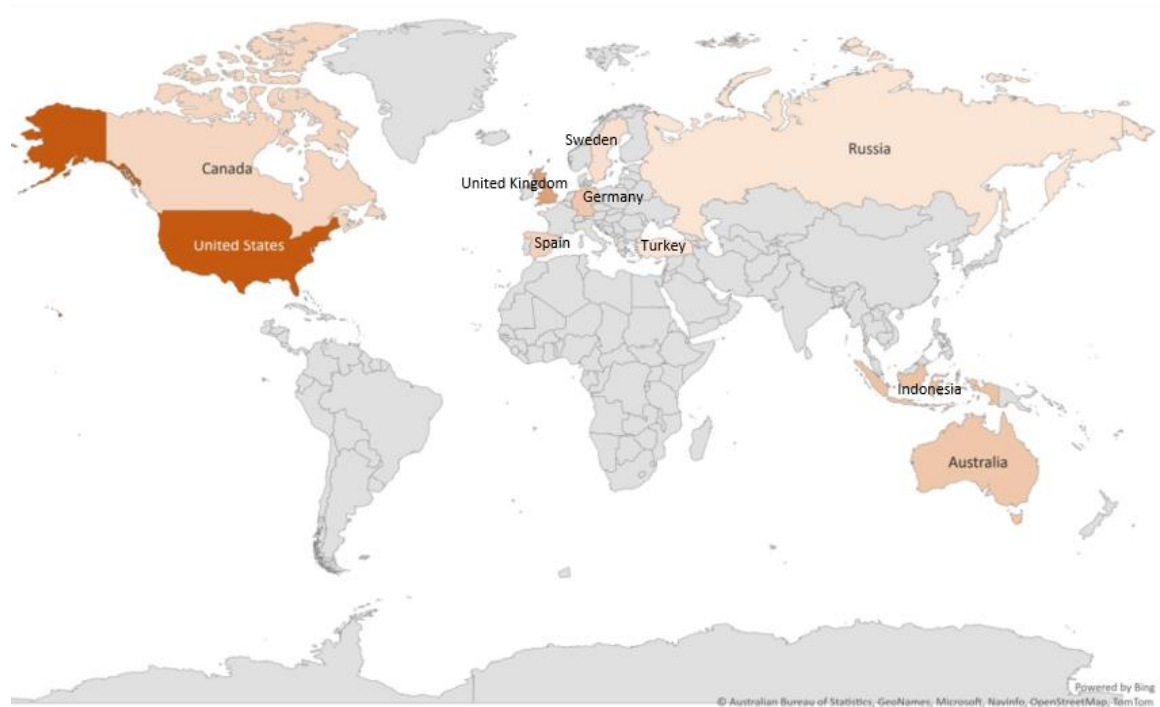


Figure 6. Visualization of Countries Contributing to SSP in Physics Learning in 2012-2021

In Figure 6 it can be seen that the sharper the color, the more contribution. From the figure, as many as 10 dominant countries. Meanwhile, there are still several other countries that have little contribution to the SSP in Physics Learning. This shows that there is still potential in these countries to improve SSP research on physics learning.

Top Author in Researching of Subject Specific Pedagogy in Physics Learning (2012-2021)

Based on SSP researchers on physics learning in the world, it is shown in Figure 7. In the figure it appears that researchers who dominate SSP in physics learning are Renkl, Kunter, and Kulgemeyer who have 5 studies, while Jumadi (Indonesian researcher) has 4 studies and is ranked 4 worlds during 2012-2021. This shows that Indonesia still shows its existence in the SSP in physics learning in the world, shown using the VOS viewer in Figure 8. Apart from Jumadi, there are several names of researchers in Indonesia who have contributed to SSP in physics learning as shown in Table 1.

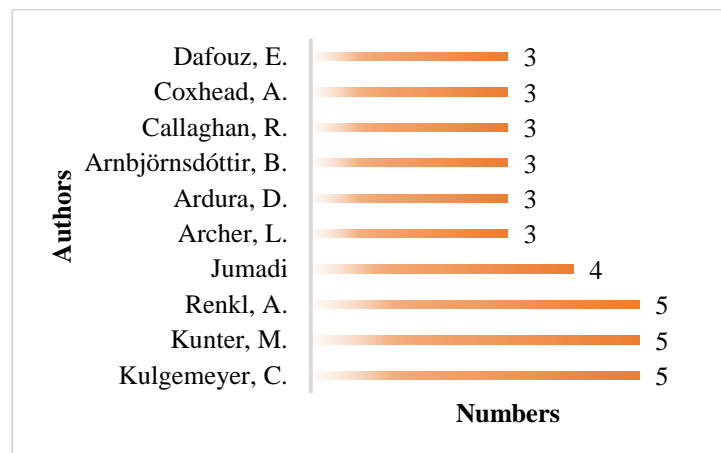


Figure 7. Top Author in Researching of Subject Specific Pedagogy in Physics Learning (2012-2021)

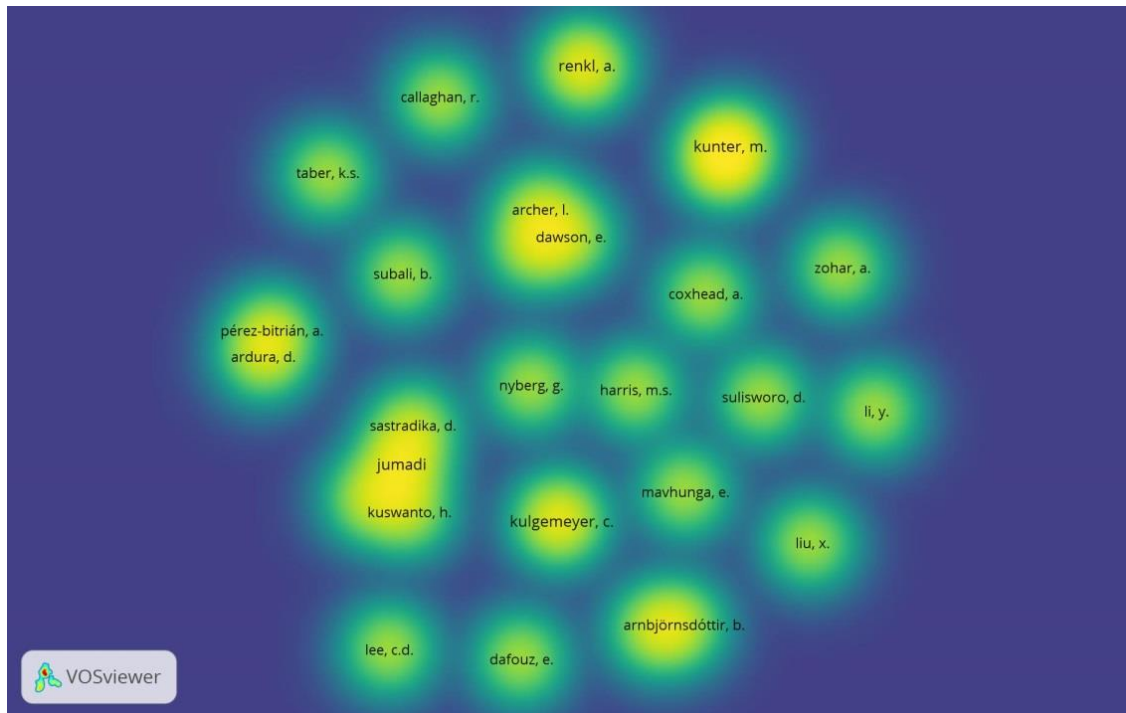


Figure 8. Top Author in Researching of Subject Specific Pedagogy in Physics Learning (2012-2021)

Figure 8 shows that the lighter the yellow color, the more SSP research on physics learning is in its last year. In addition, the wider the yellow area, the more researchers contribute. The widest area in the picture contains several Indonesian researchers, namely: Jumadi, Kuswanto, and Sastradika.

Tabel 1. Top Author in Researching of Subject Pedagogy in Physics Learning in Indonesia

No	Name	Number of Documents
1	Jumadi	4
2	Kuswanto, H.	3
3	Sastradika, D.	3
4	Subali, B.	3
5	Sulisworo, D.	3
6	Wilujeng, I.	3

Table 1 shows that apart from Jumadi, there are 5 other names that contribute to SSP research in physics learning and each has 3 studies that are indexed by Scopus. Ranking in the table, based on the last year of publication. Kuswanto is in 2nd position which means his research is in the last years, compared to other researchers. In addition, the visualization of the relationship between studies using the VOS viewer is shown in Figure 9.

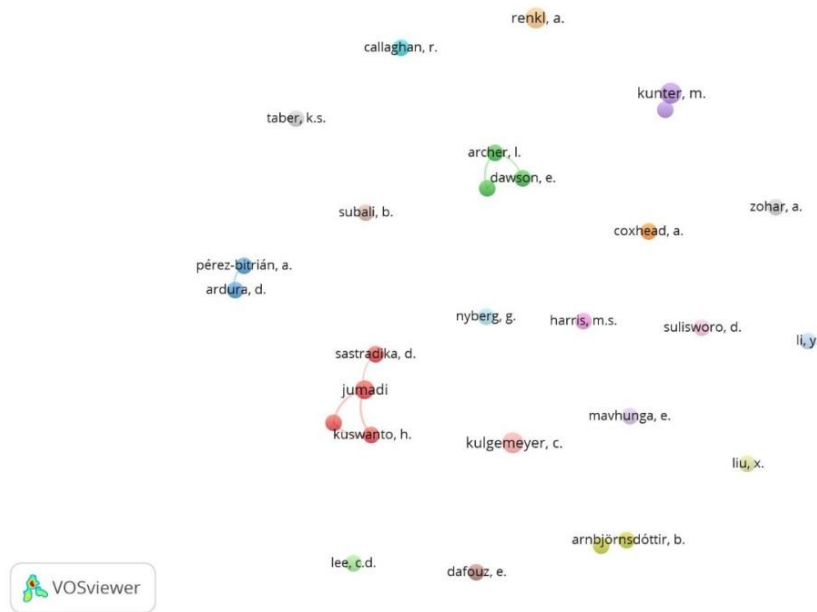


Figure 9. Connectedness of SSP researchers in Physics Learning in 2012-2021

Figure 9 shows that the most connectedness is 3 researchers (Indonesia), including Jumadi, Sastradika, Kuswanto. Meanwhile, the image is more dominantly connected by 2 researchers and there is no connection at all with other researchers. The research connection is in the form of mutual citations.

Number of documents on Subject Specific Pedagogy in Physics Learning across source title

Based on the number of SSP research on physics learning in various journal sources or proceedings, it is shown in Table 2. The publications in the Journal of Physics Conference Series are at most 36 studies among others, while the least in Sustainability Switzerland are 9 studies.

Tabel 2. Number of documents on Subject Specific Pedagogy in Physics Learning across source title

No	Name of Journal or Proceeding	Number of Documents
1	Journal Of Physics Conference Series	36
2	Journal Of Research In Science Teaching	16
3	Computers And Education	13
4	International Journal Of Science Education	13
5	Education Sciences	12
6	Chemistry Education Research And Practice	11
7	Research In Science Education	11
8	ASEE Annual Conference And Exposition Conference Proceedings	10
9	Frontiers In Psychology	10
10	Sustainability Switzerland	9

Top Universities/Institutions in the Subject Specific Pedagogy study in Physics Learning (2012-2021)

Based on universities/institutions that study SSP in physics learning, Table 3. The table shows that Yogyakarta State University (Indonesia) has the most SSP research on physics learning in the world.

Tabel 3. Top Universities/Institutions in the Subject Specific Pedagogy study in Physics Learning (2012-2021)

No	Name of Universities	Number of Documents
1	Universitas Negeri Yogyakarta	14
2	Helsingin Yliopisto	12
3	Monash University	12
4	Michigan State University	12
5	Universität Bremen	11
6	Universitas Pendidikan Indonesia	11
7	University of Oxford	10
8	Stockholms universitet	10
9	UCL Institute of Education	9
10	The University of Hong Kong	9

Top Universities/Institutions in the Subject Specific Pedagogy study in Physics Learning (2012-2021) in Indonesia

Table 4 shows universities/institutions in Indonesia that study SSP in physics learning. There are 8 universities/institutions in Indonesia that study SSP in physics learning. In Indonesia, the universities/institutions that contribute the most to the SSP are Yogyakarta State University and the Indonesian Education University. This is not surprising, because these two universities are the oldest campuses for producing professional teacher candidates. Until now, the campus has become a mecca for prospective teachers or teachers in developing pedagogical abilities.

Tabel 4. Top Universities/Institutions in the Subject Specific Pedagogy study in Physics Learning (2012-2021)

No	Name of Universities	Number of Documents
1	Universitas Negeri Yogyakarta	14
2	Universitas Pendidikan Indonesia	11
3	Universitas Ahmad Dahlan	7
4	Universitas Negeri Malang	7
5	Universitas Sebelas Maret	6
6	Universitas Negeri Semarang	3
7	UIN Sulthan Thaha Saifuddin Jambi	3
8	Institut Agama Islam Negeri Ternate	2

Although there are relatively few documents related to SSP at Scopus, SSP research still exists today. This is supported by the finding of several studies related to pedagogy abilities in 2022 at Google Scholar including: Kayaalp et al. (2022); Li et al., (2022); Oztay & Boz, (2022). In developing SSP, Indonesia is closely related to the curriculum applied. However, curriculum development is also inseparable from the potential in Indonesia including: 1) an archipelagic country, local wisdom, 2) becoming a crossing point for the world economy, 3) various tribes, 4) mining goods, 5) large population, 6) diverse flora, 7) fauna, 8) scattered fish producers, 9) maritime countries, and 10) historical figures. From this potential, of course, pedagogy skills can be developed in accordance with the development of technology and 21st century skills, namely: 1) Critical Thinking, 2) Collaboration, 3) Communication, 4) Creativity, 5) Computational Thinking, and 6) Compose.

4. CONCLUSION

Based on the research results, it can be concluded that research on the SSP in physics learning is still limited. Therefore, this research has the potential to find novelty. SSP was first introduced as Pedagogical Content Knowledge (PCK) that mostly related to science teacher, competency, and lesson. From 86 countries, Indonesia became the third largest contribution research documents in SSP by placing two representative institutions: Universitas Negeri Yogyakarta and Universitas Pendidikan Indonesia. Indonesia also contributed the most prolific SSP in physics learning writer, Jumadi became the fourth most prolific writer.

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