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Bibliometric Analysis of Development of Physics Learning Media Based on Educational Games: A Systematic Literature Review

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Abstract. *Physics is an abstract subject that requires visualization, so learning media is needed so that students are able to understand the concepts being studied. One of the learning media that displays visualization using technology is educational games. This research aims to analyze the development of educational game learning media in physics learning with a bibliometric approach using VOSViewer software. The method used in this research is bibliometric analysis. There are 6 classification clusters via VOSViewer software. The research results showed that articles were used with the titles "educational games" and "learning media", and the keyword "physics learning" began to increase rapidly in 2018, 2019, 2020 and 2021. These articles were produced from various universities in Indonesia and use Indonesian. In this research, 4 clusters were obtained which discussed topics regarding the development of educational game learning media in physics learning. On the topic of developing learning media for educational games, quite a lot has been done, but on the topic of the effectiveness of using educational games in physics learning, research has rarely been carried out.*

Keywords: Game Education, Learning Media, Physics Learning, Bibliometric

Introduction

Global demands require the world of education to always adapt to technological developments in an effort to improve the quality of education. Education is an endless process in the formation of fundamental basic abilities both regarding thinking power, intellectual and emotional power towards human nature and towards each other. The role of education in development which is increasingly developing at this time, especially in Indonesia is very important because it has relevance in producing thinkers and skilled workers to participate in making development a success. The increasingly rapid development of science and technology influences all aspects of human life, including the field of physics education. Physics is one of the sciences that has a big influence on the rapid development of technology. Therefore, it can be concluded that physics is one of the foundations of natural science and technology that can solve problems of natural phenomena as a whole.

Learning physics is one of the lessons most avoided by students. This is supported by research conducted by Apri, students have difficulty understanding physics concepts and consider physics to be a difficult subject because there are too many formulas, it is difficult to work on the questions, and it is not interesting. One of the factors influencing physics learning outcomes besides the perception of students who consider physics to be a difficult subject is the lack of variety in learning media applied by teachers. Based on the results of observations made by Nur Annisa, student learning outcomes at SMAN 3 DENPASAR are still classified as very low due to several factors, including the presentation of learning material which is still fairly monotonous. Physics is an abstract subject that requires visualization, so learning media is needed so that students are able to understand the concepts being studied. Therefore, teachers must be clever in choosing the right learning media so that the physics learning process becomes more fun and interesting.

The role of learning media in the learning and teaching process is an integral part of the world of education. Media is a tool or means used to convey messages or learning information that the source of the message wants to distribute to the target, targets or recipients of the message. Learning media is a tool that functions to explain several overall learning programs that are difficult to explain verbally. In general, media is a tool that conveys teaching messages. Meanwhile, learning media is all the tools and media used in the learning process. In teaching and learning activities, learning media is one of the factors that can help and support the achievement of predetermined learning goals. According to Dela, visuals can have a positive influence, which is proven by students' learning outcomes increasing after being treated using visual learning media. Therefore, the existence of learning media also determines the success of learning.

There are various kinds of visual learning media, one of which is game learning media. This game-based learning media can, among other things, help students understand concepts and stimulate students' curiosity so that it can increase motivation and improve student learning outcomes. The development of games in Indonesia is increasing every year. Games are a means of entertainment that is much sought after by adults and children. Games have an addictive charm that makes players addicted. So children often forget about studying because they become addicted and too engrossed in playing games. Usually children spend hours completing a

mission in the game. Apart from that, there are many traditional games that can be used as learning media, such as puzzles, snakes and ladders, uno stacko, monopoly, quizzes, bekel ball, and many more. Having games makes students feel comfortable, enjoyable and challenged to complete missions, and avoids boredom in learning.

Developing students' abilities in the field of physics is one of the keys to success in adapting to the world of technology. Technological developments make it easier to access learning media and create learning media. In this era, it is difficult to avoid using smartphones anymore. Applications that are often used on smartphones include social media and games to relieve fatigue from daily routines. Based on the results of interviews conducted by Wafiq, he said that students often pay little attention to the explanations given by teachers and play with their own smartphones during learning. Therefore, learning media using technology using smartphones is needed, namely educational games. Educational games are a type of game that is used to provide learning to users through game media that is easy to understand. Utilizing technology in educational games in the teaching and learning process is one of the right ways, because educational games as a visual media have advantages compared to other visual media. The advantage of educational games is that they can develop students' thinking, logic, interest and motivation to learn because the games contain elements of obstacles, challenges, decisions, speed and reasoning as well as problem solving in the form of questions and puzzles.

There are still many topics related to educational game learning media in learning that have developed over time. This research aims to analyze the development of educational game learning media in physics learning with a bibliometric approach using VOSViewer software. Bibliometric visualization techniques are used to map groups of relationships between journals, co-authorship, researchers, and the occurrence of selected keywords to determine developments related to educational game learning media in physics learning. Therefore, researchers conducted research with the title "Development of Physics Learning Media Based on Educational Games: Bibliometric Analysis Using VOSViewer Software (2017-2022)".

Methods

The method used in this research is bibliometric analysis. Bibliometrics is a measurement method used to look for systematic patterns from various types of literature for a particular theme. The bibliometric analysis method can help researchers study bibliographic content and analyze citations for each article taken from the Harzing's Publish or Perish database. This bibliometric approach is important for determining the latest in conducting further research by identifying important themes in every research that has been carried out so far. Therefore, the researcher determined the research theme that will be analyzed for bibliometric mapping, namely the development of educational game learning media.

Bibliometric analysis was carried out using the Publish or Perish database sourced from Google Scholar with 1000 articles. Searches for research articles were carried out using Publish or Perish on July 2 2022 by searching for the keyword "physics learning" as well as searching for the titles "educational games" and "learning media". All articles were collected from the Google Scholar database, where Google Scholar is one of the most complete peer-reviewed journal databases globally and data was taken within the scope of research in Indonesia. To maintain the latest articles, researchers determined the search year range for the last 5 years starting from 2017 -2022. Metadata from Publish or Perish that has been saved in RIS format is then processed using

VOSViewer software to display visualizations in a bibliometric map. Bibliometric visualization techniques specifically to map groups of relationships between journals, co-authorship with authors, and the appearance of keywords to find out developments related to the development of educational game learning media in physics learning. Keywords that appear as research themes are extracted from the title and abstract of a publication or can be taken from key words provided by the author in the article. The VOSViewer software will display 3 types of visualization, namely network visualization, overlay visualization, and density visualization.

Results and Discussion

Determine the title of the educational game and learning media, as well as physics learning keywords in the Publish or Perish software. In Publish or Perish, determine the maximum number of results of 1000 articles and determine the search year, namely the last 5 years (2017-2022). The source that the researchers determined was the Google Scholar database. After the researcher obtained 1000 articles, the researcher saved them in CSV format for Microsoft Excel and RIS format for VOSViewer software.

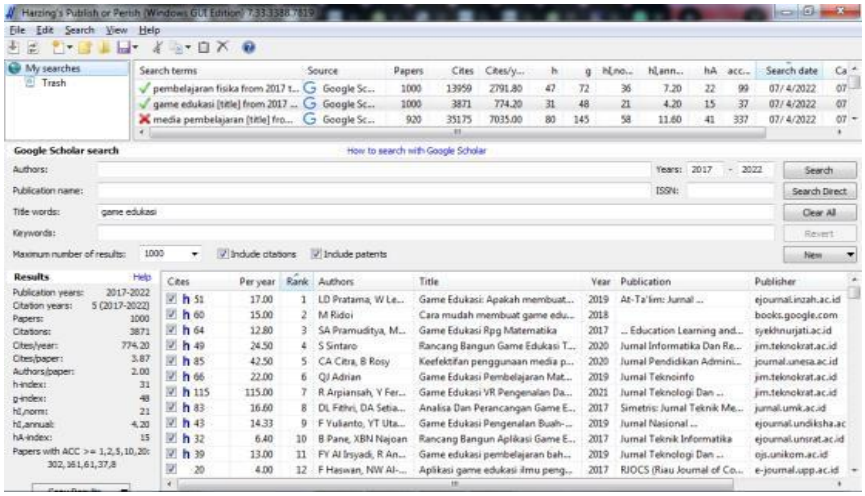

Figure 1. Keyword Determination in Publish or Perish

The CSV file obtained from the search results will be filtered and data processed by researchers by opening the file in Microsoft Excel, namely arranging the lowest year to the highest year. The lowest year of research is 2017 and the highest year of research is 2022. This was done by researchers to determine bibliometric research on educational game learning media with a range of 2017 to 2022.

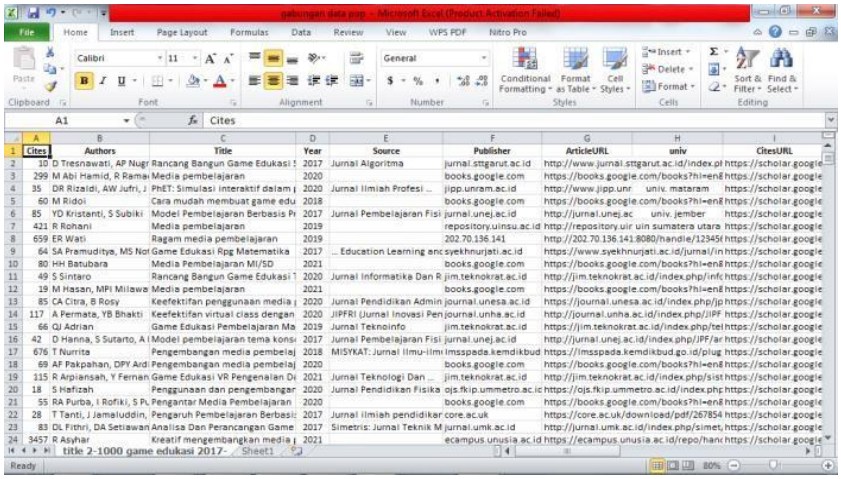

Figure 2. Filter and Process Research Data

After the researchers filtered and processed the search results data in the Publish or Perish (PoP) application. Researchers created a publication table based on the 2017-2022 period to be presented so that readers can see the number of publications from that year.

Table 1. Search Results by Title and Keywords

Year	Physics Learning	Game Education	Learning Media
2017	245	84	124
2018	226	111	174
2019	198	154	166
2020	178	185	256
2021	123	315	182
2022	28	141	18
	998	990	920

Based on the data in Table 1, it can be seen that the number of articles published with the title educational games in 2017 was in the lowest category, namely 84 articles, and in 2018 it was included in the highest category, namely 315 articles. Apart from that, the number of articles published with the title learning media in 2022 is in the lowest category, namely 18 articles, and in 2020 it is in the highest category, namely 256 articles. Another thing shown by the number of articles published with the keyword physics learning in 2022 is in the lowest category, namely 28 articles, and in 2017 it is in the highest category, namely 245 articles. However, there are 2 search result articles with the keyword physics learning, 10 search result articles with the title educational games whose year of publication is unknown, so the total number of articles whose year of publication is unknown is 12 articles.

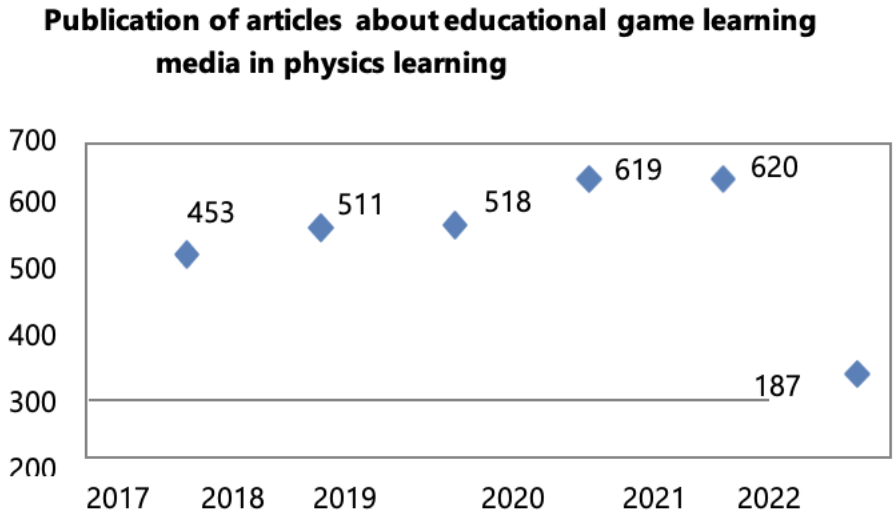

Figure 3. Article Search Graph for 2017-2022

The image above shows a graph of the number of articles that have been published regarding educational game learning media in physics learning in the last five years (2017-2022). In 2021, there was a lot of research development that discussed educational game learning media in physics learning, totaling 620 articles published in various journals. This proves that learning media in the form of educational games in physics learning continues to develop and provides results in the development of learning media that are innovative, creative, interactive and effective. Based on this, it is significant from the results of research into the development of "Development of an Android-Based Educational Game "Physics Words" for Elementary School Children on Style Concept Material" that the educational game "Physics Words" influences students' interest and motivation in learning. The high level of indication given by students regarding their interest and motivation in learning, especially the concept of style with educational games based on the Android operating system. Apart from that, the results of other research are entitled "Utilization of Learning Media. Based on the Educational Game Kahoot! in Physics Learning" shows that learning outcomes are high if the score for using game media is also high. This is shown by the percentage score from learning using game media which was 34.6% better than using power point media. The use of game media was applied to two different groups, namely the experimental group and the control group. The learning mastery shown in the experimental group obtained a score percentage of 87% and the control group obtained a score percentage of 79.8%. The difference in percentage results is because the experimental class students were more active than the control class in taking the quiz.

Based on the results of the Google Scholar Database search on the Publish or Perish (PoP) software, the three searches, namely 2 by title and 1 by keyword, will be combined to review the type of publication document shown in Figure 4 below.

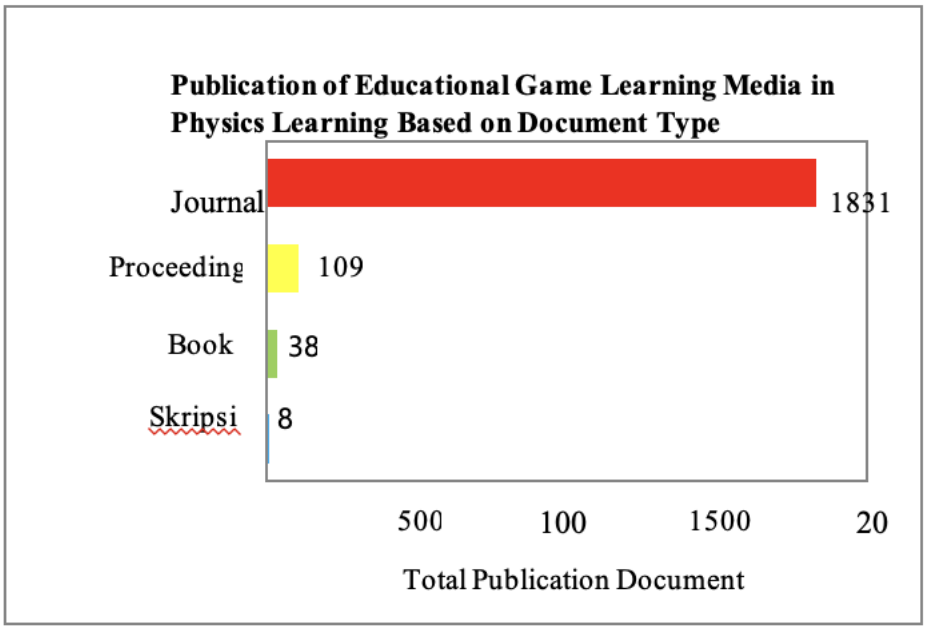

Figure 4. Publication of Educational Game Learning Media in Physics Learning in 2017-2022 Based on Publication Document Type on Google Scholar

According to the Google Scholar database, in 1986, out of a total of 2379 published documents searched with the titles learning media and educational games, as well as the keywords physics learning, there were 393 documents whose publication type was unknown. All published documents are in Indonesian.

In Indonesia, there are quite a lot of institutions that publish journals, proceedings, books and theses on research results regarding educational game learning media in physics learning. After screening 1986 documents, researchers obtained 54 documents discussing the topic of educational game learning media in physics learning. The number of published documents consists of the top 10 institutions conducting research on the development of educational game learning media in physics learning in 2017-2022 as shown in Figure 5 below.

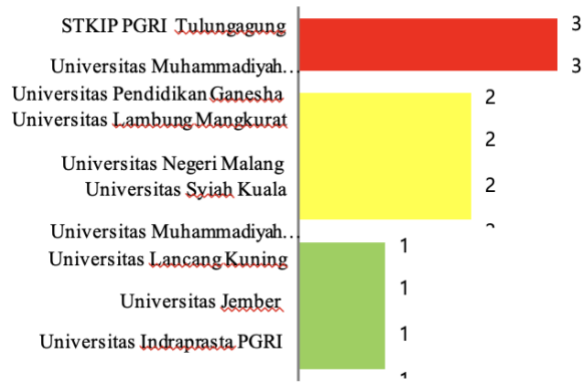

Figure 5. Publishing Institution for Educational Game Learning Media Publications in Physics Learning 2017-2022

The institutions with the highest number of publications are STKIP PGRI Tulungagung and Muhammadiyah University of Surakarta with 3 publications. Apart from that, there are 4 institutions that have a total of 2 publications, and 4 other institutions have a total of 1 publication.

The productivity of educational game learning media researchers in physics learning in the 2017-2022 period as indexed by Google Scholar is as shown in Figure 6 below.

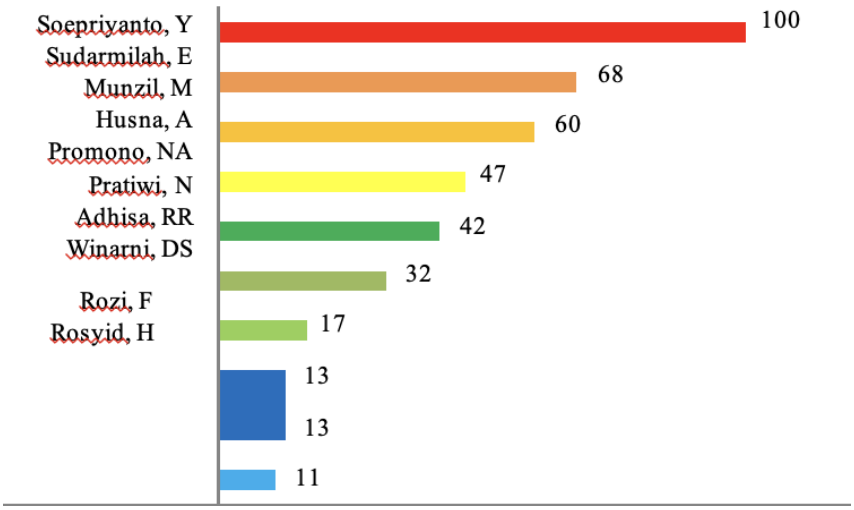

Figure 6. Physics Learning 2017-2022 Indexed by Google Scholar

Based on the results of the analysis, researchers searched for 2379 articles. Next, determine the visualization that researchers found using VOSViewer software. The use of VOSViewer software provides researchers with an alternative way to carry out the latest research by reviewing the resulting spider web mapping results.

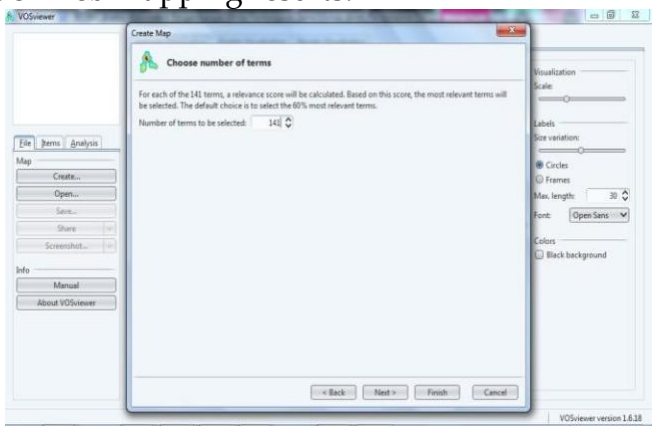

Figure 7. Determine the number of terms/words that appear

Then, in the analysis of educational game learning media in physics learning using the binary method, 14077 words were obtained with the minimum limit for the appearance of each word set to 10 times, so 141 words were obtained. Then, grouped into 6 clusters.

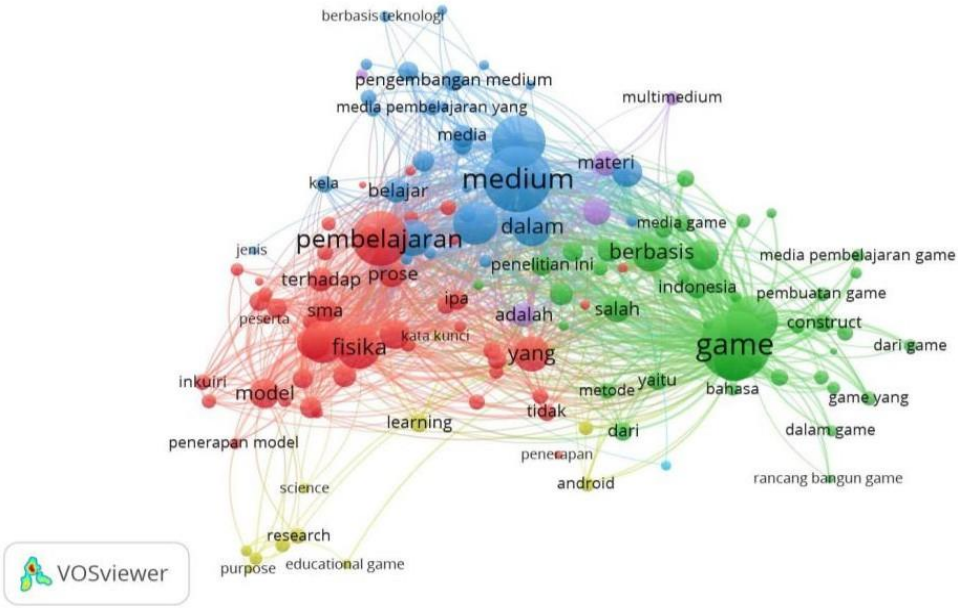

Figure 8. Network Visualization of 141 Items with 6 Cluster

The results of the binary method analysis show a more complex grouping. Cluster 1 is marked in red, and the words included in this cluster tend to be about "physics learning", "learning models", "inquiry", and so on. Cluster 2 is marked in green, and the words included in this cluster tend to be about "educational games", "game design", "game development", and so on. Cluster 3 is marked in blue, with the words included in this cluster tending to be about "learning media", "medium development", and so on. Cluster 4 is marked in yellow, with the words included in this cluster tending to be about "learning", "android", "educational games", and so on. Cluster 5 is marked in purple, and the words included in this cluster tend to be generally about "multimedium". Cluster 6 is marked in light blue, with words included in this cluster tending to be more common.

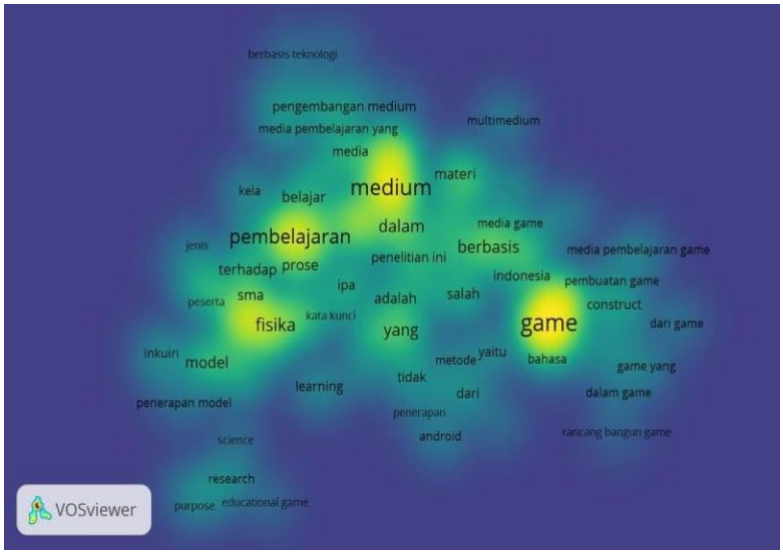

Figure 9. *Density Visualization of* 141 *Items with* 6 *Cluster*

Figure 9 shows that items included in the cluster will appear on the density visualization screen. Each item will display a color according to the density of the item at that time. Based on the light color that appears, it indicates that research can still be carried out in 2020 and above to look for updates, while the dark color that appears indicates that much research has been carried out in 2020 and below.

Based on the results of the VOS Viewer and Publish or Perish analysis, it can be stated that research with the development of education-based games in physics learning in the 2017-2022 period has been widely carried out with respective objectives, such as increasing interest, motivation, critical thinking, creative thinking and others. Research on the development of educational game-based learning media in physics had the most research in 2020 and experienced a decline in 2022. However, this research is still worth carrying out and developing so that novelty can be obtained from this research. One way is by integrating educational game-based physics learning into learning models that suit the characteristics of physics learning.

Conclusion

Articles on the topic of educational game learning media in physics learning were obtained via Publish or Perish software and analyzed via VOSViewer software. The top 18 articles were selected from 54 articles obtained from this software with the most citations and publications regarding educational games in physics learning. The most frequently cited topic regarding educational game learning media in physics learning is the Development of Science Adventure Educational Games to Improve Students' Problem Solving Skills, published in 2019, with a total of 47 citations. Based on the data obtained, articles used with the titles "educational games" and "learning media", as well as the keyword "physics learning" began to increase rapidly in 2018, 2019, 2020 and 2021. In addition, there are 6 classification clusters with 141 items using VOSViewer software. Looking at this cluster, research on the development of learning media using a variety of educational games in physics learning was found, but research on effectiveness is rarely carried out. Based on the development of publications regarding the development of educational game learning media in physics learning in 2017-2022 according to the highest

Google Scholar database in 2021-2022. The types of publication documents are proceedings, journals, books and theses with the language used being Indonesian. Because the search uses Indonesian, the resulting articles come from Indonesia, but are published by several universities.

Therefore, the use of educational game learning media in physics learning can help teachers to innovate in learning media both online and offline. There are several recommendations regarding educational game learning media as follows:

1. In physics learning, teachers should be able to develop online and offline learning using educational game media
2. Based on the VOSViewer results that have been shown for other research recommendations, namely conducting research on educational game learning media on the topic of effectiveness because it is rarely done.

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