# Global Research Trends on 4D in Education Using Bibliometrics Analysis Techniques

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#### Abstract

The 4D development model is a development model that has systematic stages of activity consisting of define, design, development, and disseminate. However, in the range of 2000 to 2023, there is still little analysis that discusses global research trends on 4D in education. Therefore, the purpose of this research is to find out the global research trend about 4D in the field of education. This research method uses descriptive quantitative methods using bibliometric analysis. The data source used is publication data extracted from the dimensions database. The results of this study show that 4D topics in education will become a trend in the future. This can be seen from the results of VOSviewer visualization which shows that there are still many novelties that can be discussed in the topic. The limitation in this study is that it is only limited to using the Dimensions database. Therefore, further research is needed on 4D topics in education from other databases and is carried out regularly to see the development of 4D topic trends in education

Keywords: 4D, Education, Bibliomatrik Analysis, VOSviewer

#### Abstrak

Model pengembangan 4D adalah model pengembangan yang memiliki tahapan kegiatan yang sistematis yang terdiri dari define, design, development, dan disseminate. Namun dalam rentang tahun 2000 hingga 2023 masih sedikit analisis yang membahas mengenai trend penelitian global tentang 4D dalam bidang pendidikan. Maka dari itu, tujuan dari penelitian ini peneliti adalah untuk mengetahui trend penelitian global tentang 4D dalam bidang pendidikan. Maka dari itu, tujuan dari penelitian. Metode penelitian ini menggunakan metode kuantitatif deskriptif dengan menggunakan analisis bibliometrik. Sumber data yang digunakan merupakan data publikasi diekstrak dari database dimensions. Hasil dari penelitian ini menunjukkan bahwa topik 4D dalam bidang pendidikan akan menjadi trend di masa depan. Hal ini dapat dilihat dari hasil visualisasi VOSviewer yang menunjukkan masih banyak novelty yang dapat dibahas dalam topik. Keterbatasan dalam penelitian ini adalah hanya terbatas dengan menggunakan database Dimensions. Oleh karena itu, diperlukan penelitian lebih lanjut mengenai topik 4D dalam bidang pendidikan dari database lain dan dilakukan secara berkala untuk melihat perkembangan dari trend topik 4D dalam bidang pendidikan.

Kata Kunci: 4D, Pendidikan, Analisis Bibliometrik, VOSviewer

#### Introduction

In the current era of globalization, humans are faced with very rapid technological developments (Oviyenti, 2016; Mesiono et al., 2024). These developments make humans required to continue to develop in order to continue to be relevant to the times (Aspi & Syahrani, 2022; Mardhiyah et al., 2021). Therefore, education is an important factor in an era where technology is the main driver of social and economic transformation (Yuristia, 2017). Education must continue to adapt to these changes in order to prepare the nation's future young generations with relevant skills and knowledge (Puspa et al., 2023; Later & Fadriati, 2023). This is because education is a vital foundation in preparing individuals for their future lives (Halim, 2022; Nurhayati & Rosadi, 2022).

The importance of this education makes educators have to find ways for students to continue to be relevant to the times, namely getting used to technology (Alimuddin et al., 2023; Putri et al., 2023). One of the steps that can be used is to make innovations in learning (Ritonga et al., 2022; Ambarwati et al., 2021). Innovation in learning is very important because it can increase students' attention in learning (Samura, 2015). One of the innovations that can be done by educators is the development of learning media.



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Learning media is a tool or means used by educators in the learning process to help students understand the concepts taught better (Yuliono et al., 2018; Khotimah & Risan, 2019). The use of learning media in education aims to increase student involvement in learning (Nazmi, 2017; Rahmawati et al., 2024). In addition, the use of learning media can increase students' creativity and student learning outcomes (Annissa & Wikarya, 2022; Rijal, 2020; Hutabarat & Hasibuan, 2020). In some cases, learning media can improve students' problem-solving skills, students' numeracy literacy, and students' interest in learning (Rizky & Marhaeni, 2023; Marhaeni & Miralda, 2023; Mumpuni et al., 2022).

Learning media innovation is required to be relevant to the times (Widyawati & Sukadari, 2023). Therefore, a model is needed that can help educators in developing the learning media they want to develop. One of the development models that can be used is 4D. The 4D development model is a development model that has systematic stages of activities consisting of define, design, development, and disseminate (Thiagarajan, 1974). This 4D development model was also developed specifically for the development of a learning tool (Tanjung & Nababan, 2019; Kristanti & Julia, 2017). Therefore, the 4D development model is very much needed by educators in developing learning media.

However, there are still few analyses that discuss global research trends on 4D in the field of education. This is shown by searching the Dimension database by typing the keyword "4D" from 2000 to 2023. Therefore, the purpose of this study is to find out the global research trend about 4D in the field of education. The analysis that will be used in this study is bibliometric analysis. Bibliometric analysis is one of the research methods that analyzes publications using statistics (Fu et al., 2023; Sweileh et al., 2017). Bibliometric analysis uses a quantitative approach to determine the trend of global publications precisely (Chen & Ho, 2015; Soares et al., 2020). The research questions in this study are: (1) How many publications about 4D in the field of education in the range of 2000 to 2023; (2) How many citations regarding 4D in the field of education in the range of 2000 to 2023; (3) How many publications regarding 4D in the field of education are seen from the field of research in the range of 2000 to 2023; (4) How many journals have published research on 4D in the field of education in the range of 2000 to 2023; (5) Who is the researcher who has conducted the most research on 4D in the field of education in the range of 2000 to 2023; (6) What are the novelties in research on 4D in the field of education in the range of 2000 to 2023; (7) What are the trends in research on 4D in the field of education in the range of 2000 to 2023; (8) What are the research topics regarding 4D in the field of education in the range of 2000 to 2023 that are rarely discussed; and (9) Whether the authors of research on 4D in the field of education in the range of 2000 to 2023 often collaborate or not. Method (Cambria Font, Size 14, Bold Text)

This research method uses a descriptive quantitative method using bibliometric analysis. The data source used is publication data extracted from the dimensions database on April 3, 2024. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses method according to Page et al (2021), abbreviated as PRISMA, is used to extract articles from database dimensions. The PRISMA flow chart is presented in Figure 1.



Figure 1. PRISMA Flowchart (Page et al., 2021)

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In Figure 1, the PRISMA method consists of 3 stages, namely: Identification, Screening, and Included. The first stage, namely the Identification stage, was carried out by searching the dimension database on the topic of 4D and found 48823 records from the dimension database published in the data range from 2000 to 2023. Then at the screening stage, 2 screenings are carried out, namely filtering those that are not in the field of education and those that are not articles or proceedings. From the results of the screening, there were 46836 records issued. Then, the Included stage produced a final sample of 1987 articles. Next, this final sample will be analyzed using VOSviewer. VOSviewer is a computer program for creating and viewing bibliometric maps (Van Eck & Waltman, 2010). VOSviewer is used to visualize the results of the publication database used in this study, and then the results of the visualization will be analyzed.

#### Results

This section outlines bibliometric analyses on 4D topics in education extracted from database dimensions in the year range from 2000 to 2023. In this section, the results and discussion of the analysis of 4D topic topics in the field of education which are focused on the number of publications, the number of citations, classification by aspect (research field, journal, researcher), network visualization from aspects (co-occurrence, co-authorship), publication clusters reviewed from aspects (co-occurrence, co-authorship), overlay visualization, and density visualization will be described *Numerous Publications* 

A search from 2000 to 2023 resulted in 1987 publications of scientific articles on the topic of 4D in the field of education. Furthermore, the number of 4D publications in the field of education per year is presented in Figure 2.





According to Figure 2, the number of publications on 4D topics in the field of education has increased exponentially from year to year (dotted line). It can also be seen in Figure 2 that the tendency of article publications with 4D topics in the field of education began to tend to increase starting from 2012 with the number of publications there were 5. This trend began to increase until in 2023 it reached a total of 606 publications related to 4D topics in the field of education. The average publication of articles with 4D topics in the field of education is 82.79. Thus, the topic of 4D in the field of education is a topic that is in demand to be researched.

## Lots of Citations

The number of citations for 4D topics in the field of education is 2753 citations from 2000 to 2023. Furthermore, the number of citations per year is presented in Figure 3.



Figure 3. Number of Citations for 4D Topics in Education from 2000 to 2023

According to Figure 3, the number of citations on 4D topics in the field of education from year to year has increased exponentially. Citations on 4D topics in the field of education began in 2009 with a total of 5 citations and began to increase in 2018 with a total of 28 citations. The number of citations is increasing until in 2023 it will reach a total of 1082 citations. The average citation regarding the topic of 4D in the field of education is 114.71 citations. The research data revealed that out of the total 2753 articles cited, the publication entitled "Mobile Augmented Reality Assisted Chemical Education: Insights from Elements 4D" Anderson et al (2014) was the most cited publication with 73 citations. This article was published in the Journal of Chemcical Education which is indexed by Scopus is in the second quartile (Q2) with a 2023 SJR of 0.54. Thus, articles published in journals that are indexed by reputable indexers will be widely cited by other authors. This bibliometric analysis provides information on the impact of research where studies are ranked based on citations received (Pahwa et al., 2022). Thus, this article has an impact so that it can be used as one of the references in research that reviews the topic of 4D.

## Bidang Sustainable Development Goals (STGs)

Based on the field of research, publications on 4D topics in the field of education can be grouped. Furthermore, the number of publications by research field (the 5 largest) is presented in Figure 4.





According to Figure 4, Quality Education ranks first by research field with 1079 articles. Thus, the topic of 4D is most widely applied to the quality of education. *Journal* 

Based on journals, publications on 4D topics in the field of education can be grouped. Furthermore, the number of publications based on journals (the 5 largest) is presented in Figure 5.



Figure 5. The Number of Publications on 4D Topics in the Field of Education Reviewed from Journals According to Figure 5, the Science Education Research Journal ranks first based on journal sources that contain 4D keywords with 98 articles, followed by AIP Conference Proceedings with 66 articles. Thus, the most relevant journal coverage for the 4D topic is the Science Education Research Journal.

Researchers

Based on the researcher, publications can be grouped. Furthermore, the number of publications based on researchers (the 5 largest) is presented in Figure 6.



Figure 6. The Number of Publications by Researchers on 4D Topics in the Field of Education Reviewed from Researchers

According to Figure 6, Aris Doyan from the University of Mataram, Indonesia ranks first based on authors with a total of 22 articles followed by Susilawati from the University of Mataram, Indonesia with a total of 19 articles. Thus, Aris Doyan is the most prolific researcher in the topic of 4D. *Network Visualization untuk Co-occurrence* 

VOSviewer provides network visualization maps. Furthermore, the network visualization for the co-occurrence of these 169 terms is presented in Figure 7.





Figure 7. Network Visualization on 4D Topics in Education

According to Figure 7, there are 168 terms, 6 clusters, 5970 links, and a link strength of 10695. In Figure 1.9, two terms connected by a line show that the two terms appear together in a title and abstract such as learning and increase. Conversely, two terms not connected by a line indicate that the two terms do not appear together in the title and abstract such as learning and innovation. Thus, this network visualization can be used by researchers to identify emerging areas from the research domain (Lam et al., 2022). For example, the term learning is connected to android, and student is connected to self-efficacy, but self-efficacy is not connected to LKDP. Thus, the novelty for research on 4D topics in the field of education can be obtained through research on 4D, namely the development of LKPD with self-efficacy variables. In the same way, another novelty is the development of android applications with interest variables.

#### Overlay Visualization untuk Co-occurrence

Likewise, VOSviewer provides overlay map visualization. Furthermore, the overlay visualization for the co-occurrence of these 169 terms is presented in Figure 8.



Figure 8. Overlay Visualization on 4D Topics in Education

In Figure 8, the overlay visualization on 4D topics in the field of education provides an analysis based on 4D keywords from 2000 to 2023 to observe the trend of research titles related to 4D topics. According to Figure 1.10, the yellow term implies that the keyword is the current research interest (Lam et al., 2022). Thus, the current research trend on the topic of 4D is yellow terms. For example, 4D is associated with LKPD, E-books, androids, and development.

Density Visualization untuk Co-occurrence

In addition, VOSviewer displays a density visualization map. Furthermore, the density visualization for the co-occurrence of these 106 terms is presented in Figure 9.



Figure 9. Density Visualization on 4D Topics in Education

In Figure 9, the density visualization in the 4D topic shows a visualization of the density level of a term indicated by a particular color. Blue indicates high density while yellow indicates low density. High density means that the topic has been widely used in previous studies whereas low density means that the topic is still little used in previous studies. That way, the next research topic related to 4D that is suggested is a topic that has a low density visualization in the low category. For example, 4D is associated with LKPD, E-books, androids, and self-efficacy.

# Network Visualization untuk Co-authorship

In addition, VOSviewer shows network visualization for co-authorship. Furthermore, the network visualization for co-authorship of 82 authors is presented in Figure 10.



Figure 10. Network Visualization for Co-Authorship on 4D Topics in Education

In Figure 10, network visualization for co-authorship on the topic of 4D shows the connection between authors. Two authors are connected by a line indicating that the two authors appear together as authors in an article. In contrast, two authors not connected by a line indicates that the two authors do not appear together as authors in an article. So, the authors can be clustered based on their connection. According to Figure 1.12, there are 58 authors, 28 clusters, 38 links, and a link strength of 102. Some of the 61 authors in Figure 1.12 are not connected to each other. The largest pool of connected authors consists of 12 authors. In Figure 1.12, there are 28 clusters consisting of cluster 1 (6 authors), cluster 2 (5 authors), cluster 3-5 (4 authors), cluster 6-8 (3 authors), cluster 9-15 (2 authors), and cluster 16-28 (1 author). Thus, the cluster at most is a single writer

## Discussion

Based on the analysis of the Dimensions database, it was found that the trend of discussing 4D topics in the field of education began to increase in 2012. This can be seen from the number of publications that have increased from 2012 to now. In addition, the number of citations in the same year also showed an increase. The journal that publishes the most related to 4D topics in the field of education is the Journal of Science Education Research. The most prolific writer is Aris Doyan from the University of Mataram, Indonesia.

Meanwhile, based on the visualization results from VOSviewer, it can be found that novelty for research on 4D topics in the field of education can then be obtained through research on 4D, namely the development of LKPD with self-efficacy variables. In the same way, another novelty is the development of android applications with interest variables. In addition, the current research trend on 4D topics is yellow terms. For example, 4D is associated with LKPD, E-books, androids, and development. This is corroborated by the results of density visualization which shows that the next research topic related to 4D suggested is a topic that has a low density visualization category. For example, 4D is associated with LKPD, interest, android, and self-efficacy.

## Conclusion

The results of this study show that the topic of 4D in the field of education will become a trend in the future. This can be seen in the results of the analysis which shows an increase in the number of publications and citations every year. This is also reinforced by the results of VOSviewer visualization which shows that there are still many novelties that can be discussed in the topic. The limitation in this study is that it is only limited to using the Dimensions database. Therefore, further research is needed on 4D topics in the field of education from other databases and carried out periodically to see the development of trends in 4D topics in the field of education.

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