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Bibliometric Analysis of Mathematics Learning Video using VOSviewer. How the Trend and What Next?

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Abstract: Bibliometric Analysis of Mathematics Learning Video Using VOSviewer. How the Trend and What Next?. Mathematics learning video is one of the audio-visual media used to increase students' interests, motivations, and achievements in mathematics learning. **Methods:** This study is a bibliographic analysis of mathematics learning videos, which has not yet previously been conducted. **Objectives:** This study addresses research trends and future research opportunities on mathematics learning videos. **Findings:** 300 article metadata on mathematics learning videos were extracted by Publish or Perish (PoP) software from the Google Scholar database. Those articles have been published until 2022. From 1579 terms, 32 related terms were obtained, and only 25 were verified. Network, overlay, and density visualizations were generated using VOSviewer software. **Conclusion:** Finally, this study provides suggestions for possible future research on the mathematics learning videos.

Keywords: Bibliometric analysis, mathematics learning video, vosviewer.

Abstrak: Bibliometric Analysis of Mathematics Learning Video Using VOSviewer. How the Trend and What Next?. *Video pembelajaran matematika merupakan salah satu media audio-visual yang dapat digunakan dalam pembelajaran matematika karena dapat meningkatkan minat, motivasi dan prestasi belajar matematika siswa.* ***Metode:*** *Penelitian ini adalah analisis bibliografi tentang video pembelajaran matematika yang belum pernah dilakukan sebelumnya.* ***Tujuan:*** *Kajian dalam penelitian ini mencakup trend riset dan peluang riset kedepan tentang mathematics learning video.* ***Temuan:*** *300 metadata artikel yang berkaitan dengan video pembelajaran matematika diekstrak oleh software Publish or Perish (PoP) dari database google scholar. Artikel tersebut telah dipublikasi hingga tahun 2022. Diperoleh 32 terms yang bersesuaian dari total sebanyak 1579 terms, namun hanya 25 terms yang lolos verivikasi. Selanjutnya dilakukan visualisasi network, overlay dan density dengan menggunakan software VOSviewer.* ***Kesimpulan:*** *Studi ini memberikan salah satu masukan untuk kemungkinan penelitian yang bisa dilakukan kedepan berkaitan dengan video pembelajaran matematika.*

Kata kunci: *Analisis bibliometrik, video pembelajaran matematika, vosviewer.*

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INTRODUCTION

The COVID-19 pandemic has led to the closure of schools, colleges, universities, and other educational facilities (d'Orville, 2020; Muhammad, 2020; Schleicher, 2020; UNICEF, 2021). It is estimated that around 1.7 billion students have been affected globally. In response to this issue, UNESCO recommends implementing distance learning programs and open educational applications and platforms; therefore, teachers can reach students and limit disruptions in education systems around the globe. In Indonesia, through a circular letter issued in March 2020, the Minister of Education and Culture has regulated the educational activities during the pandemic by enacting the agenda of 'learning from home' through online or distance learning.

Online learning is a system that takes place unexpectedly without any prior training. It is a system that both teachers and students need to accept and apply. At this stance, students need to rely more on their own resources to continue distance learning through the internet, television, radio, or other digital resources they possibly have. On the other hand, teachers also need to adapt to the new pedagogical concepts, especially dealing with interactive teaching deliveries that might be completely different from the previous ones. In this case, both students and teachers, have to accept and adapt as soon as possible to the new era in the world of education.

Such conditions cause fundamental changes in education and the learning process. It is undeniable that we currently experience a disruption era in education. This condition raises some challenges that require an immediate approach to solve. Several studies on online mathematics learning have been carried out, such as Muntazhimah et al. (2020) and Mok et al. (2021), which mentioned that students were dissatisfied and encountered problems with online learning during the pandemic. In a similar vein, Fadilla et al. (2021) revealed that 69% of students perceived online learning did not help them perform better in mathematics. Thus, 67% of students required videos as the learning media. This notion is aligned with Basa & Hudaidah (2021), stating that the major drawback of online learning for students is the difficulty of understanding mathematics; thus, a direct visualization becomes necessary. Kusumaningrum & Wijayanto (2020) also highlight that college students could not thoroughly understand the lesson during online lectures. For that reason, they need learning videos and online discussions delivered via the applications, either WhatsApp or Google Classroom.

Based on the previous explanation, it is evident that many students require a direct visualization for mathematics learning. Online learning amid the pandemic becomes doubly difficult for students to understand mathematics without any explanation from teachers. One of the media that can be used as an alternative for mathematics learning is a mathematics learning video. It is typical of audio-visual media in which the usage relies on senses, such as eyes and ears. Therefore, its role in learning is significant (Bromberek-Dyzman, Jankowiak, and Che³miniak 2021; Xu and Wu 2021), especially to make it easier and clearer to understand when those videos are used to transmit the information related to the learning materials (Michelsanti et al. 2019; Ningratih, Astawan, and Margunayasa 2021; Wang, Wang, and Huang 2020). Students' control of the instructional videos can increase their engagement with the learning contents (Asrori, 2021), thereby increasing their interest in learning (Larue and Watling 2021; Pattemore and Muñoz 2020). Audio-visual media also help students acquire certain knowledge, skills, or attitudes and make learning experiences more meaningful (Michelsanti et al. 2019; Pattemore

and Muñoz 2020) and more active (Olagbaju and Popoola 2020). The use of audio-visual media, such as mathematics learning videos, is worth to be developed as it improves students' learning outcomes and motivations (Hanif, 2020; Sun & Gao, 2016).

Research on mathematics learning videos has been numerously conducted. Nurhayati et al., (2020) studied audio-visual media for young learners and confirmed that developing audio-visual media in learning is necessary. Meanwhile, Lalian (2018) carried out a meta-analysis on the effect of using videos on students' cognitive and affective aspects in mathematics learning. Besides, Santagata et al., (2021) performed a literature review on 35 English peer-reviewed articles to explore theoretical perspectives and the use of video technology by teachers in learning. Furthermore, Huang et al. (2020) examined interest-driven videos created for mathematics learning, while Star & Strickland (2008) investigated the impact of watching videos on teachers' ability to observe learning in classrooms. However, studies on bibliometric analysis of mathematics learning videos have not been conducted yet. The previous bibliometric analysis of audio-visual media includes the analysis of youtube (Noruzi 2017), augmented reality video (Hincapie et al. 2021), and video game-based learning (Wouters and Van Oostendorp 2013). Therefore, this study focuses on bibliometric analysis of mathematics learning videos derived from various articles indexed by Google Scholar.

The articles published and indexed by Google Scholar were analyzed to identify what topics seem to be a concern for publications and the next mathematics learning video topic that offers possibilities for further studies. Bibliometric analysis was used as the methodology to conduct the analysis, which is the approach related to the implementation of Google Scholar records, primarily based on publish or perish (PoP). Afterward, the results from VOSviewer are presented, followed by discussions on the research trend and density, related research topics, and the possibility for future research topics, and finally, conclusions from the literature on previous bibliometric analysis. Bibliometrics is defined as a study of nature and the ongoing process of knowledge formation through publications (Martín-Gutiérrez 2011). Thus, it is a beneficial tool to measure scientific activities and impacts of the publications and citations carried out by individuals, research groups, institutions, or certain countries. Bibliometrics is powerful in providing datasets that may be used by coverage makers, researchers, and different stakeholders to enhance the quality of research (Nandiyanto, Biddinika, and Triawan 2020).

METHODS

The method used in this study was primarily based on the journal article search, developed through a bibliometric analysis of the extracted data from the Google Scholar database. It employs a set of search standards to quantify and qualify the studied topics. It represents a quantitative method to compare the information received (Vega-Malagón et al. 2014), thereby retrieving a unique description and a report on how the different variables tested in a chain of precise duration evolve. This analysis used an approach based on the quantity, quality, and structural signs and generated a research topic interest, in this case, mathematics learning video. This bibliometric analysis provides an in-depth analysis of the current conditions and tendencies associated with mathematics learning video studies. This search was conducted in 2022, in which the Google Scholar database was the primary source of bibliographic data. This bibliometric research adopted the stages proposed by (Julius et al. 2021; Sangwan and Mittal 2015; Shukla, Muhuri, and Abraham 2020).

The metadata of articles recorded in the GS database was downloaded in *.ris format and processed using publish or parish (PoP) software. The year was set from 0 to 2022 using the keyword *mathematics learning video*. The maximum number of results was set to be 300 articles. Then, VOSviewer software was deployed for the bibliographic analysis. This software can visualize the relationship between subjects and citations, group the articles, create publication maps, and describe trends of the existing articles (Hudha et al. 2020; Leung 2019; Pratama, Wardhana, and Nugroho 2020; Xie et al. 2020). The 300 article metadata processed using VOSviewer, it is obtained that the maximum number of occurrences of a term was 10 out of 1579 terms, in which 32 met the threshold, and all of them were selected. We subsequently verified the selected items and deleted five of them, including classroom, research paper, example, role, and lesson.

RESULT AND DISCUSSIONS

A total of 300 article metadata were extracted from Google Scholar until 2022. The development of research on mathematics learning videos has been rapidly increasing, as shown in Figure 1 below.

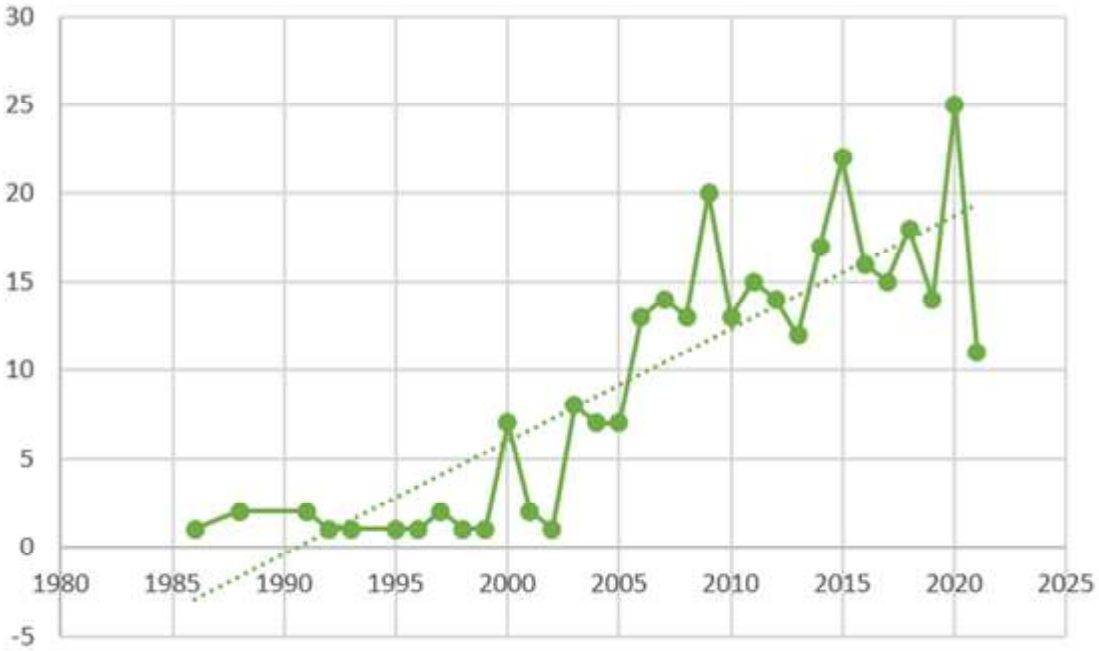

Figure 1. The increase in the number of publications by year

Several publishers have published articles on mathematics learning videos, but five publishers with the most published articles are selected, as listed in Table 1. Among them, the publisher that has numerously published articles related to mathematics learning videos is Springer, with 52 articles.

Table 1. Publishers with the most published articles

No.	Publisher	The number of published articles
1	Springer	52
2	Elsevier	24

3	Taylor & Francis	22
4	journals.sagepub.com	19
5	ERIC	10

The articles have been published in various journals and indexed by Google Scholar. They also possess different citation counts. Some articles have more than five thousand citations. Table 2 lists several articles on mathematics learning videos with the highest number of citations, more than a thousand citation.

Table 2. Articles with the highest number of citations

The number of citation	Authors	Title	Year
6469	H Borko	Professional development and teacher learning: Mapping the terrain	2004
1589	DW Shaffer, KR Squire, R Halverson, ...	Video games and the future of learning	2005
1287	SJ Derry, RD Pea, B Barron, RA Engle, ...	Conducting video research in the learning sciences: Guidance on selection, analysis, technology, and ethics	2010
1267	EA Van Es, MG Sherin	Mathematics teachers'"learning to notice" in the context of a video club	2008
1265	M G Sherin, EA Van Es	Effects of video club participation on teachers' professional vision	2009
1203	H Borko, J Jacobs, E Eiteljorg, ME Pittman	Video as a tool for fostering productive discussions in mathematics professional development	2008
1127	RA Berk	Multimedia teaching with video clips: TV, movies, YouTube, and mtvU in the college classroom.	2009
1095	R Rosas, M Nussbaum, P Cumsille, V Marianov, ...	Beyond Nintendo: design and assessment of educational video games for first and second grade students	2003
1069	MG Sherin, SY Han	Teacher learning in the context of a video club	2004

The PoP metadata of authors for mathematics learning video articles were stored in RIS type and then analyzed in VOSviewer using the full counting method. The maximum number of researchers for each article is 30, while the minimum number of articles from each researcher is five. As a result, out of 557 detected researchers, only 12 researchers did meet the criteria, as presented in Figure 2 below :

Verify selected authors

Selected	Author	Documents	Total link strength
☑	jacobs, j	7	9
☑	borko, h	6	7
☑	hiebert, j	8	7
☑	sherin, mg	15	6
☑	stigler, jw	6	6
☑	es, ea van	8	5
☑	seago, n	6	5
☑	blomberg, g	5	4
☑	givvin, kb	6	4
☑	seidel, t	6	3
☑	santagata, r	7	2
☑	stockero, sl	5	2

Figure 2. The most productive authors

The visualization of mathematics learning videos displayed by VOSviewer was derived from binary calculations, in which a minimum number of occurrences is 10. Out of 1579 terms, 32 satisfied the criteria. After verified, the existing terms were re-selected and remained only 25 terms. VOSviewer then generated three different visualizations: network visualization (see Figure 3), overlay visualization (see Figure 4), and density visualization (see Figure 5).

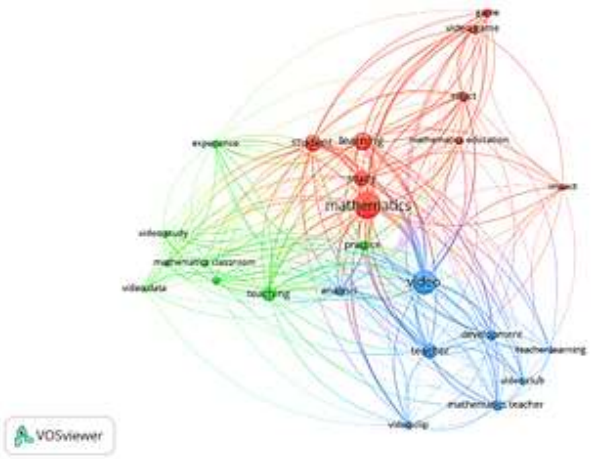

Figure 3. Network Visualization

Twenty-five terms were then grouped into three closely related clusters. The cluster distribution is demonstrated in Table 3.

Table 3. Cluster dan Items

Cluster	Color	Items
1	Red	Effect, game, impact, learning, mathematics, mathematics education, student, study, video game
2	Green	Experience, mathematics classroom, mathematics lesson, practice, teaching, video data, video recording, video study

3	Blue	Analysis, development, mathematics teacher, teacher learning, Video, video clip, video club

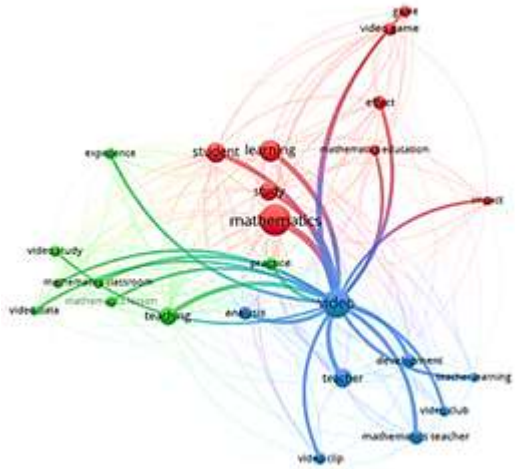

Figure 4. The relationship between terms

In detail, Figure 4 depicts the strength of the relationship between terms.

Subsequently, the overlay visualization is displayed in Figure 5 below:

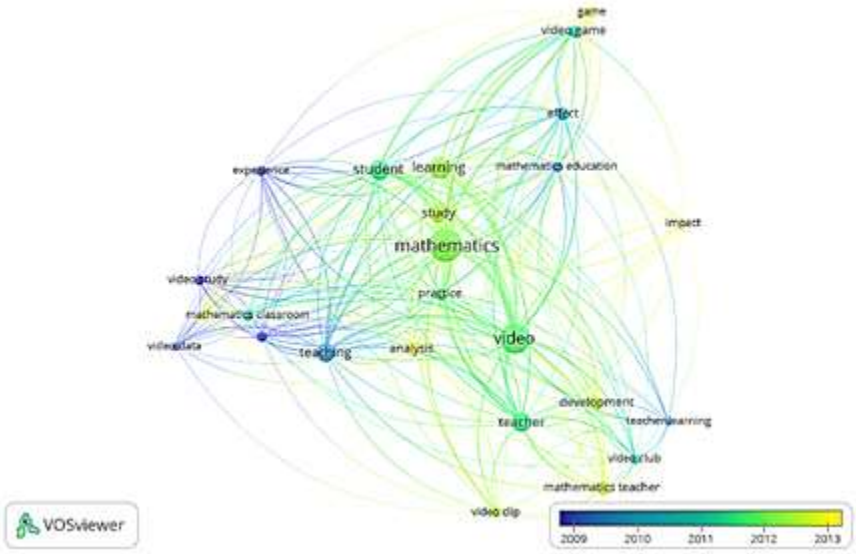

Figure 5. Overlay visualization

The graph illustrates that publications on mathematics learning videos dramatically increased in the early 2000s but declined in the late 2020s. It is likely resulting from the onset of the globalization era. Technology advancement turns out to be a prestige and an indicator of a country's development. A country is considered to be developed if it embraces high technology. On the other hand, the countries failing to adapt to technology are often referred to as failed countries (Ngafifi 2014). The rapid development of technology is also contributed by the era of

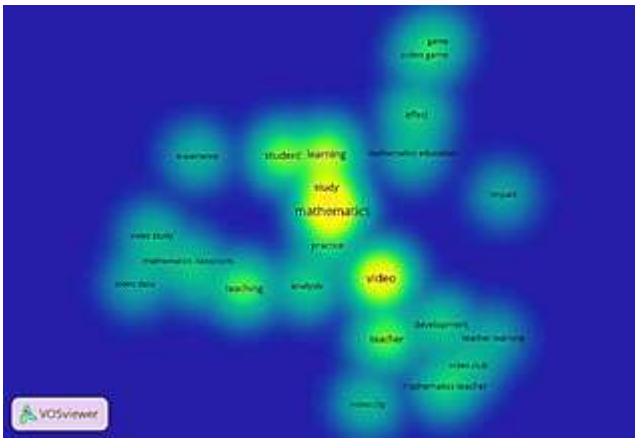

Figure 6. Density visualization

the industrial revolution 4.0, indicated by the rise of computers and the internet or the digital world. Consequently, the use of digital media in education keeps increasing, and the relevant studies have been growing as well.

The publisher that mostly published mathematics learning video studies is Springer, with 52 publications. It is followed by Elsevier and Taylor & Francis in the second and third place with 24 and 22 publications, respectively. Meanwhile, Elvesier ranks first for publishing applied mathematics research, with 112 articles. It is considered the largest publisher among the top 10 publishers who publish such research. Moreover, Springer is a logical, specialized, and restorative portfolio worldwide, giving analysts in the scholarly community, logical education and corporate R&D offices with quality substances through inventive data, items, and administrations (Springer 2022).

The most cited article, with 6469 citations, was published in 2004, entitled "Professional development and teacher learning: Mapping the terrain," written by Borko Hilda from Stanford University. This article maps out research on the teacher professional development topic. The study suggests several important directions and strategies to broaden horizons regarding teacher professional development that has been unexplored yet (Borko 2004). On the other hand, other most cited articles have only a thousand citations, including eight articles published in the 2000-2010 period. Furthermore, the most prolific author who has written 15 articles on mathematics learning videos is Miriam G. Sherin (Karsenty and Sherin 2017). He is a professor in the School of Education and Social Policy and the Learning Sciences Department at Northwestern University.

The map for the articles can be constructed by VOSviewer. The relationship of several articles is depicted in various types of visualizations, such as mapping using zooming, scrolling, and searching-systems. Thus, more detailed information on the relationship among the published articles will be obtained (Karim and Soebagyo 2021). In this study, the 25 terms that had been verified were then grouped into three different clusters. The cluster shows the prevalence of the relationship that can be observed through the nodes in the network, overlay, and density visualizations. The visualizations can be utilized to urge focus on the portrayal of a bibliometric structure (Waltman, van Eck, and Noyons 2010). The closer the nodes in the visualization are, the closer the relationship will be. Also, the larger the nodes are, the more the terms have been studied. Furthermore, if two terms belong to one cluster, the relationship between the terms is incredibly

strong in previous studies. For example, the term *experience* closely relates to the terms *mathematics classroom, mathematics lesson, practice, teaching, video data, video recording,* and *video study*.

The information about research trend mapping can be obtained through overlay visualization. In this visualization, the term employed in past research will appear in a darker color. While the term with a bright color like yellow indicates its existence in the current research trend regarding mathematics learning video. In this case, the current topics include *impact, analysis, development, video recording,* and *games*. One may conclude that the development of mathematics learning video or analysis on the use and the impact of mathematics learning video is a topic that still needs to study further. In addition, studies on mathematics learning videos associated with games are considered a future research trend. This topic has been studied by several researchers, such as Niess & Walker (2010) with his research title "Digital videos as tools for learning mathematics", Tan et al. (2021), who discussed the use of video learning to improve students' mathematical abilities, and Rauf & Fauziah (2021), who reviewed the use of mathematics learning video during the Covid-19 pandemic at Junior High School of Datuk Ribandang, Makassar, Indonesia.

Density visualization portrays the saturation of the research topic. The bigger node and the brighter color imply the higher saturation level of research. To illustrate, the yellow color around the terms *learning, student, study, video,* and *mathematics* is a sign of widely studied topics. On the other hand, green nodes like *mathematics education, mathematics classroom,* and *video recording* are research topics that still seems potential to study.

The previous explanation gives us an insight into a research gap and the possibility to study mathematics learning videos more deeply. It is obvious that the key themes in a study or scope of knowledge can be identified through overlay and density visualizations (Liu et al. 2015). Therefore, the data can be served as a starting point to conduct further research.

■ CONCLUSIONS

The published studies on mathematics learning videos have dramatically increased from the beginning of 2000 through the end of 2020. The most cited article was written by Borko, entitled "Professional development and teacher learning: Mapping the terrain," with 6469 citations, and published by Sage publisher. The publisher who mostly published scientific articles on mathematics learning videos is Springer, with 52 publications. The most prolific researcher is Miriam G. Sherin, with 15 published articles. The terms *video* and *mathematics* have a relatively strong relationship in the visualizations. Current research trends related to mathematics learning videos involve topics such as *impact, analysis, video recording, games,* and *development*. Since these topics have not yet been widely studied, it is a great opportunity to conduct future research on these topics, specifically during the pandemic.

These results highlight a great opportunity to conduct a study of math learning videos on related topics. Therefore, the data can be used as a starting point for future research. The limitations of this study are, this study is generally based on a limited number of keywords and also be constrained by the narrow database (GS) used to collect articles. Second, although this study uses formal software (PoP software, VOSviewer, and Microsoft Excel) as tools, it is subject to the author's subjective evaluation and can lead to errors. For future research, it is attempted by using larger samples, also use a comparison of various recommended bibliometric analysis results (such as BibExcel and HistCite).

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