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TRENDS IN WEB BASED LEARNING ISSUES IN MATHEMATICS EDUCATION: A BIBLIOMETRIC ANALYSIS

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Abstract

This paper aims to provide an overview of trend issues regarding writings related to web-based learning (WBL) in the scope of mathematics education. This paper comes from 51 writings taken from the Scopus data base for the last 10 years, namely 2013-2023. The method used is bibliometric analysis using the help of Vosviewer and Mendeley. Based on the results of this paper study, it was found that writing about WBL in mathematics education is still low. There were 26 participating countries but the largest country, the United States, only produced 13 writings. In addition, collaboration between countries is still very low. Not only the linkage between countries, the relationship between keywords and WBL in mathematics education is also still few and tenuous. The keywords that are rarely used in writing related to web-based learning are about problem-based learning, high school, academic achievement, course design, flipped classroom, personalized learning, Moodle creativity, which are things that are closely related to learning approaches or methods. This is expected to be an opportunity and challenge in building novelty in future research.

Keywords: Bibliometric Analysis, Web-based learning, Mathematics Education.

Introduction

Technology is increasingly affecting all aspects of human life. Technology can help humans become more effective and maximal in achieving goals. The influence of technology certainly also has a lot of impact in education. Huang, Spector and Yang introduce technology in education as the use of tools, technologies, processes, procedures, resources and strategies to enhance experiences in various learning situations namely formal, informal learning, and so on [1]. Association for Educational Communications and Technology (see www.aect.org): "Ethical assessment and practices in facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources" [2]. The presence of technology in learning is welcomed, giving rise to various writings that examine technology in education. In the figure below it appears that the number of publications on educational technology continues to increase sharply. Just like technology in general, technology in education has also increased sharply until 2022. The development of technology in the world of education gave birth to so many technology-related learning terms. Starting from online learning, mobile learning, web-based learning and

so on. Each of these terms has a relationship and even some of them are difficult to distinguish between one and another.

However, in this paper the study is narrowed down to the context of mathematics education in relation to web-based learning. This paper examines various writings related to Web-based learning carried out within the scope of mathematics education which is still very rarely done. This paper is expected to help researchers or other authors in developing research and writing about web-based learning in mathematics education.

Research Method

This study examines writings about WBL in mathematics education using bibliometric analysis with data base papers derived from https://www.scopus.com/. Bibliometric is a research method based on systematic quantitative research [17]. Bibliometric studies that are well done can build firm foundations for advancing a field in novel and meaningful ways—it enables and empowers scholars to (1) gain a one-stop overview, (2) identify knowledge gaps, (3) derive novel ideas for investigation, and (4) position their intended contributions to the field [18]. This data was collected on October 10, 2023 with the following search:

(TITLE-ABS-KEY ("web-based learning") AND ALL (math)) AND PUBYEAR > 2012 AND PUBYEAR < 2024 AND (LIMIT-TO (SUBJAREA , "MATH") OR EXCLUDE (SUBJAREA , "CHEM") OR EXCLUDE (SUBJAREA , "ENGI") OR EXCLUDE (SUBJAREA , "ARTS") OR EXCLUDE (SUBJAREA , "MEDI") OR EXCLUDE (SUBJAREA , "NURS") OR EXCLUDE (SUBJAREA , "PHYS") OR EXCLUDE (SUBJAREA , "NEUR") OR EXCLUDE (SUBJAREA , "HEAL") OR EXCLUDE (SUBJAREA , "AGRI") OR EXCLUDE (SUBJAREA , "DECI") OR EXCLUDE (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "SOCI"))

Based on the search above, 729 articles were obtained from 1995 to 2023. With the results shown in Fig. 4. the following:

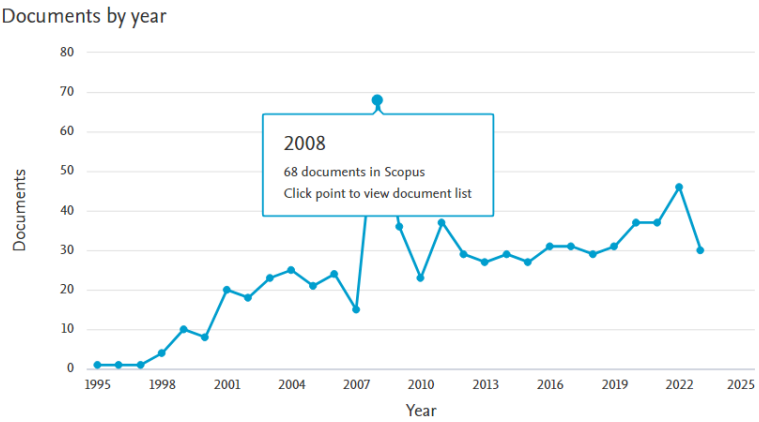

Fig. 4. History of WBL articles in Scopus indexed publications

The above search is then filtered back by criteria "web-based learning" and "math", and then 51 articles about web-based learning were found. In this study sample articles taken in *RIS format from Scopus were processed using VOS viewer software to help visualize and identify trends [19-21]. The Center for the Study of Mathematics and Technology created VOS viewer, a software to create and view bibliometric networks. We can examine the distribution of publications by year and type, trends in the time and type of publication, productive countries and universities, and areas of research being conducted [22]. VOS viewers can also be used to evaluate any form of bibliometric network data, including relationships between publications or journals in terms of citations, collaborations between scholars, and relationships in terms of co-emergence between scholarly works [23].

Results and Discussion

Search results for web-based learning keywords on databased scopus reached 729 articles. Furthermore, it was narrowed down to mathematics education so that there were 51 articles. Furthermore, these 51 articles were reviewed based on 8 keywords, namely year, country, subject area, type of publication, citation, network, overlay and density visualization. The eight keywords were analyzed using bibliometrics assisted by the Scopus application, as data-based writing, Mendeley for writing control and vos viewer to see the network, age and density of writing based on keywords from each writing.

Year of Publication

The publication year is limited to the last 10 years, namely 2013-2023. From the range of years, the spread of publication of writing based on the year as shown in Fig. 5. as follows:

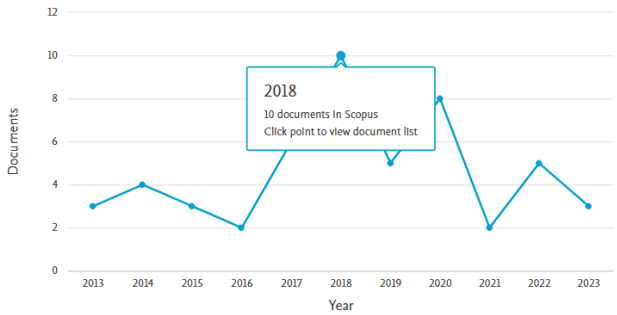

Fig. 5. Article about WBL on mathematics education in a decade

Based on the picture, it appears that the most scopus indexed writings about WBL occurred in 2018, reaching 10 writings. It increased again in 2022, namely as many as 5 scopus indexed writings related to WBL in mathematics education. The dynamics of publishing writings related to WBL in mathematics education is still very minimal, this can be an opportunity to be able to find novelty in the following years' publications.

Country

Country is the second keyword on this analysis. The country in question is the country listed by the author at the time of publishing this paper. Based on the author's country, it was found that 51 of these writings came from 26 countries, namely the United States as many as 13 writings, Taiwan and Turkey as many as 5 writings, China 4 writings, Indonesia 3 writings, Japan, Jordan, Qatar and Thailand as many as 2 subsequent writings, Austria, Belgium, Bosnia and Herzegovina, Canada, Chile, Ghana, Greece, Hungary, Iran, Kuwait, Kyrgyzstan, Malaysia, Nigeria, Saudi Arabia, Slovenia, United Kingdom and Yemen each produced 1 write-up. The differences are presented in the form of a bar chart as shown in Fig 6. the following.

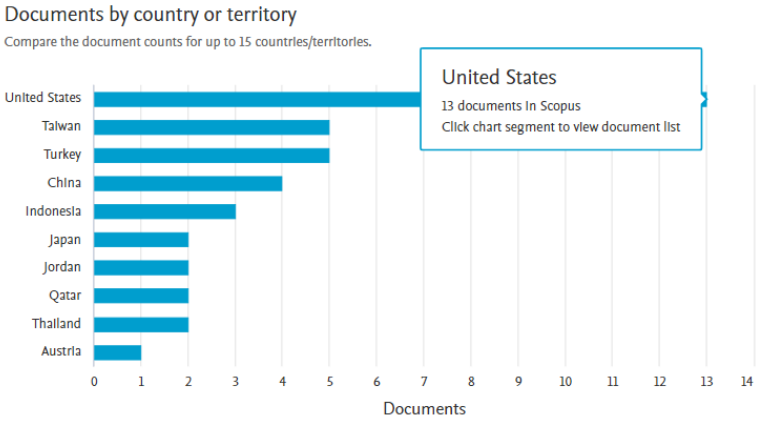

Fig. 6. WBL article on mathematics education by country.

As shown in the picture above, the most countries that produce this article are the United States with 13 writings. The second order comes from Taiwan and Turkey. The fourth place comes from Indonesia and finally the fifth place is Japan, Jordan, Qatar and Thailand. This is in line with research that states America is the country that produces the most WBL-related writings [24]. Compared to other variables, WBL-related articles in the areas of mathematics and social science are still few. This can be a publication opportunity for each country in the world. With the help of Vos Viewer, it seems that the network visualization between countries is still very small. This can also be a research opportunity to produce WBL writing collaboration between countries as shown in Fig. 7. the following.

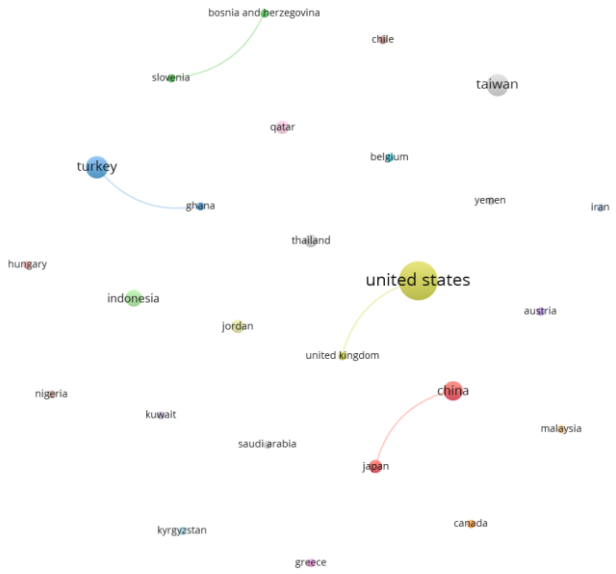

Fig. 7. Network Visualization Country using Vos viewer

Ojokoh et al., (2020) stated that there are many opportunities in conducting research on learning that can be accessed anytime and anywhere, one of which is WBL, because this variable still needs to continuously reduce the duration and maximize the success rate of achieving goals for human welfare.

Subjeck Area

The selection of the article area is done by choosing to enter the keywords mathematics and social science, then the subject of other areas is excluded except psychology and computer science. Based on these keywords, data is obtained as in Fig. 8. as follows.

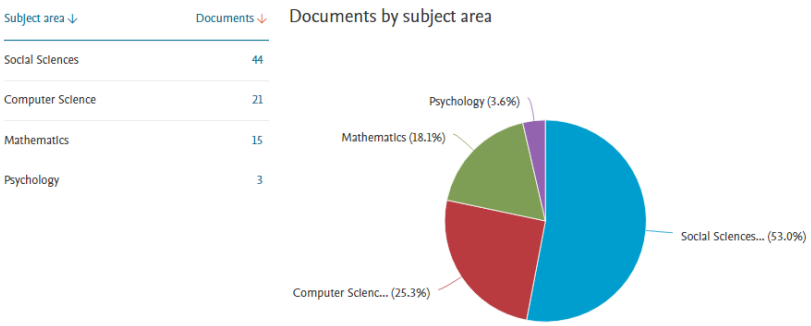

Fig. 8. WBL Article on Mathematics Education by Area Subject

Based on the figure above, it appears that of the 51 articles there are 53% of writings from the area of social science, 25.3% come from computer science, 18.1% come from the area of mathematics and 3.6% in the area of psychology. This means that the social science area dominates WBL out of 51 articles related to mathematics and social

science. An interesting thing that can be seen is that WBL's involvement in coloring the area of psychology is still low at 3.6%, which is 3 out of 51 writings. This certainly provides an opportunity to conduct development studies related to WBL with psychology.

Types of Publications

The next review is on the form or type of article. As many as 58.8% of these articles are articles originating from journals from a total of 51 articles. Furthermore, book chapters as much as 19.6%, Conference Paper as much as 17.6% and writing from books as much as 3.9%. The data are presented in Fig. 9. as follows.

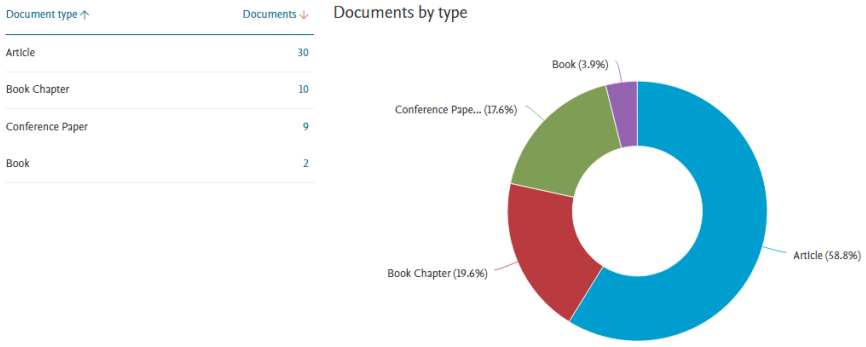

Fig. 9. WBL Articles on Mathematics Education by Publication Type

Based on the picture above, it appears that WBL discussions in book form and at conferences are also still low at 3.9%. However, it can continue to be developed along with various other forms of writing. Because when compared to other articles, publications related to WBL are still relatively low.

Citations

Citations are a marker that an article helps enlighten other readers, and the understanding gained becomes a foundation or is developed into a new writing. The citations from the data of 51 articles appear in Fig. 10. next:

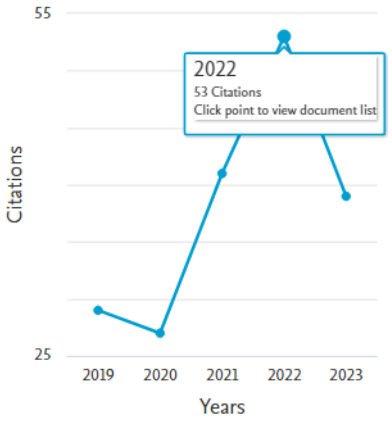

Fig. 10. WBL Article on Mathematics Education Based on Number of Citations Each Year

Based on the picture above, it appears that the most citations were in 2022, this indicates that in 2022, during the COVID-19 period, the author was inspired again to make writing about WBL as a basis for theory or further idea development. The lack of citations can also be a writing opportunity, namely producing writing about WBL in the field of mathematics education that can enlighten readers.

Network Visualization

In the keyword network visualization, shows how related writing is to one another based on the keywords used in each writing. From the 51 articles in this paper, a picture is obtained as shown in Fig. 11. as follows:

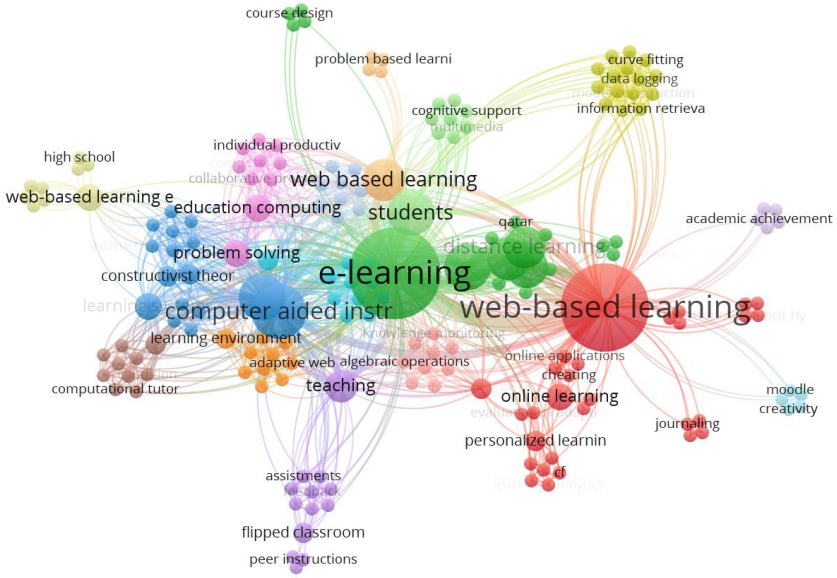

Fig. 11. Network Visualization using Vos Viewer about WBL in Mathematics Education

From image visualization, it appears that e-learning and web-based learning are two keywords that are widely used in this paper. In addition, from the image it also appears that there are many other keywords that have not been explored further, such as problem-based learning, high school, academic achievement, course design, flipped classroom, personalized learning, moodle creativity and others [25]. These keywords are faded in color and far from frequently used keywords. This means that there are still few studies that assess the relationship between these keywords or variables. This is again a writing opportunity with wide novelty.

Overlay Visualization

In the review, Overlay Visualization is shown by color. The darker color indicates the age of the writing is longer than the others, while the lighter color indicates that the keywords of the writing are more current than other writing. The results of the Overlay visualization in this article appear in Fig. 12. as follows:

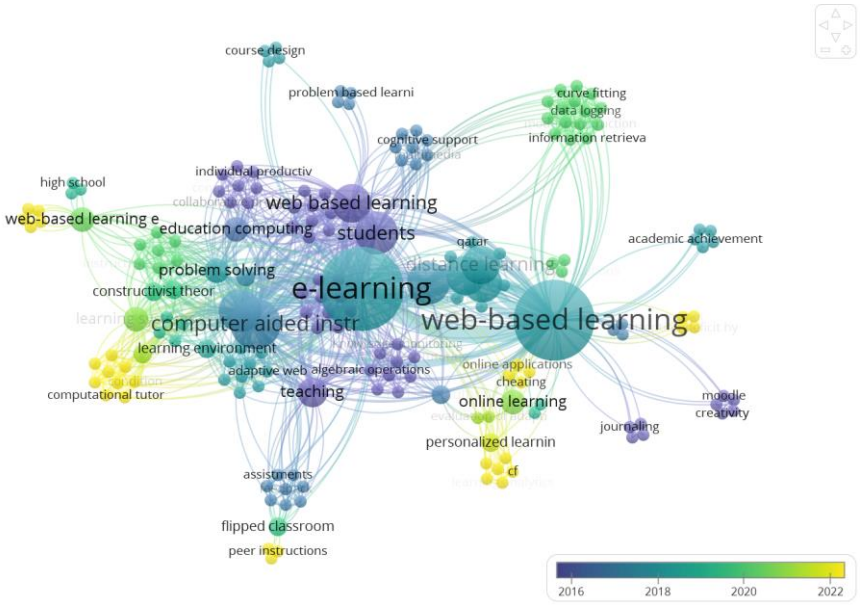

Fig. 12. Overlay Visualization using Vos Viewer about WBL in Mathematics Education

Based on the images, it appears that e-learning is one of the oldest deaf topics compared to other writings following web-based learning and so on, while the latest keywords are about personalized learning, peer instruction and others.

Density Visualization

Density Visualization explains the density of these keywords from various other writings. The density can be seen from the yellow and even red color. Yellow indicates that the keywords in the writing are dense, but red indicates that the keywords are even denser. In this paper, there is a picture of density as shown in Fig. 13. as follows:

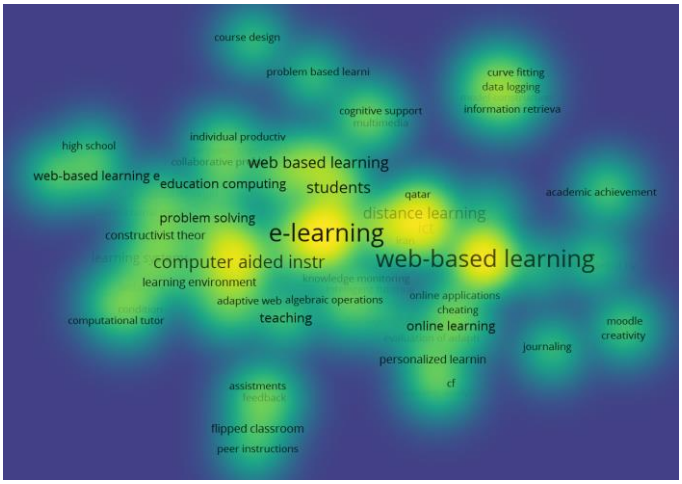

Fig. 13. Density Visualization using Vos Viewer about WBL in Mathematics Education

Based on the image in Fig. 13. There are no variables or keywords that are red so that the density of research appears in the yellow color attached to the keywords e-learning and web-based learning. But other keywords are still at a low density of green

and even blue, which is almost invisible. This means that these keywords are still very rarely used. Studies such as e-learning including WBL are studies that still need to be developed in depth [26].

Conclusions

Based on the bibliometric analysis that has been done, we can draw conclusions about WBL in mathematics education reviewed in the last 10 years, namely 2013-2023.

The conclusions are as follows:

- The number of publications every year, namely from 2013-2023, is still small, so it is still needed to develop studies on WBL, especially in mathematics education.
- The country that produces the most writings about WBL in mathematics education is the United States with 13 writings. It was even found that networking between countries is also very low and needs to be developed.
- The subject area that has the most writing about WBL is social science and the subject area that has the least is psychology. This is interesting because it looks at the relationship between humans and technology.
- The types of publications and citations in this paper are still not diverse and there are still few that are used as citations in subsequent writings. This information is expected to trigger the birth of other quality writings in various forms of publication.
- Networking, Overlay, and Density Visualization provide an overview in the same vein, namely increasing keywords about flipped classroom, personalized learning, moodle creativity, course design in terms of linkage with WBL variables. Then the variable of personalized learning, peer instruction becomes a variable that can be seen as a trend of research issues related to WBL. Furthermore, in terms of density, it provides information that the author must be careful in making novelty in studies on WBL and e-learning because it is a keyword that falls into the solid category.

Based on all the studies above, the next recommendation is to see the benefits of WBL in today's mathematics learning. Pay attention to whether there are good things from WBL that have not been studied and known by teachers. This is a challenge and also an opportunity considering the number of keywords or variables that are also not widely used.

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