Android-Based Mathematics Learning Media Development Research: A Bibliometric Analysis using VosViewer

Lusiana Nur Maghfiroh & Joko Soebagyo*

Departement of Mathematics Education, Universitas Muhammadiyah Prof. DR. Hamka, Indonesia

Abstract: The purpose of this research is to determine the title and abstract about Development Of Android Mathematics in 2017-2022. The research data is taken from articles published online through Google Scholar with the keywords development of mathematics. Methods Data collection is done by checking and recording all data information about the number of articles, citations, and authors. The analysis used is full counting in the VOSViewer application. The total number of articles sampled in this study were 1000 articles with the technique of analyzing the image results obtained from the VOSviewer application, including Network visualization, Overlay visualization, and Density visualization. By using VosViewer researchers can visualize several analyzes of a research that researchers want to do

Keywords: bibliometrics, mathematics development, development of android mathematics.

Abstrak: Tujuan dari penelitian ini adalah untuk menentukan judul dan abstrak tentang Development Of Android Mathematics pada tahun 2017-2022. Data penelitian dikutip dari artikel yang diterbitkan secara daring melalui Google Scholar dengan kata kunci development of mathematics. Metode Pengumpulan data dilakukan dengan memverifikasi dan merekam semua data informasi tentang jumlah artikel, kutipan dan penulis. Analisis yang digunakan yakni penghitungan penuh (full counting) dalam aplikasi VOSviewer. Total artikel yang dijadikan sampel pada penelitian ini adalah sebanyak 1000 artikel dengan teknik menganalisis hasil gambar yang diperoleh dari aplikasi VOSviewer, diantaranya Network visualization, Overlay visualization, dan Density visualization. Dengan menggunakan VOSviewer peneliti dapat memvisualisasikan beberapa analisis tentang suatu riset yang ingin dilakukan oleh peneliti.

Kata kunci: bibliometrik, mathematics development, development of android mathematics.

▪ **INTRODUCTION**

Learning is a word based on the word learning, learning in question is a relatively permanent change in behavior or potential as a result of increased experience or practice that leads to changes in behavior. These behavioral changes include knowledge (cognition), skills (psychomotor), and changes in attitudes and behavior (emotions). The notion of learning is a process of interaction between students and educators in a learning environment using materials, delivery methods, learning strategies, and learning resources. (Pane & Dasopang, 2017). Therefore, learning becomes an important process rather than attitudes or learning resources related to the process of interaction between students and educators, and the learning environment.instructional objectives) focused on abilities or skills after participating in the learning process activities. For the formulation of learning objectives, it must contain ABCD, namely:audience(must have the ability) behavior (what behavior is expected) condition (subjects achieved) and degree (at least there is a quality or quantity of action that needs to be achieved) (Sanjaya, 2008).

The role of learning in education is important because of its role in meeting practical needs and in problem solving, especially mathematics. According to Apriyanto, mathematics is one of the subjects that play an active role in realizing an intelligent, civilized, and dignified society through critical attitudes and logical thinking, especially mathematics education (Apriyanto & Hilmi, 2019). It should be acknowledged that the source of knowledge does not only come from the teacher when viewed from the needs of students in exploring wider information. Revolution 4.0 has changed the role of teachers who were previously the only knowledge intermediary for the better in improving accessibility (Yosiana et al., 2021). With the development of a network protocol or commonly called the internet that can reach information, including designing learning and integrating it in various forms, it is a solution to a good process as a functional information delivery tool for teachers to students in the process of delivering the material being taught. Schmidt proves that there has been rapid growth in the last 10 years, resulting in the spread of smartphones and their use for Internet access has made great strides (Penwarden, 2016). The use of technology can increase students' positive attitudes towards mathematics in independent learning, efficacy and motivation, this literature makes technology important in improving student achievement (Radović et al., 2019). These findings imply an increasing number of studies in designing mathematics learning activities, integrating technology in various forms (Murtiyasa et al., 2020)

In previous studies there was research that technology was a new innovation that could improve the quality of education itself. Judging from the existence of vital skills that can be independently used on mobile devices and online resources, what remains is how educational tools represent material and delivery methods as a form of mobile pedagogy. The main goal of the next generation learning system is to use the latest learning systems and the latest technology that provides new learning, training and teaching technologies that are easily accessible to anyone who wants to participate in them (Sarrab & Elgamel, 2013). According to Saienko & Lavish (Saienko & Lavish, 2020), modern educational technologies, platforms and online resources that are integrated into the learning process affect the way materials are delivered and teacher education strategies.

In an effort to improve the mathematics learning platform, put forward a mobile learning-based learning media that is designed to support students' expected mathematics learning apart from easy access to reach, advanced self-study skills, material that will not be lost in the internet space. In line with Rio Bagus Purnama's opinion, mobile learning can be defined as a facility or service that provides general electronic information and educational content so that students can gain knowledge anytime and anywhere. Apart from being a reference, learning media mobile learningIt is also a challenge to package it attractively so that students can increase their interest in learning mathematics (Purnama et al., 2017). The development of learning media has also begun to be developed and applied to several studies such as those conducted by Siti and Mega in the use of Adobe Flash CS 6 applications, Sri and Deni in developing mobile applications for ring theory material, and the development of a virtual lab researched by Yanuan and his colleagues. Learning with android-based learning media makes students happier in learning because it is packed with games, and students can

learn anytime and anywhere. The influence of high interest and motivation in learning will also increase the learning outcomes obtained by students (Adesti & Nurkholimah, 2020). The evaluation results from learning media are also considered quite feasible if they are represented with interactive materials, animations, and simulations (Suryanti & Sutaji, 2019). The model of design thinking is expected to be a solution in solving a prototype problem that will be used as a mathematical application (Murtianto & Herlambang, 2022).

Several studies have proven that the development of mobile learning media is a good solution in overcoming learning problems, as evidenced by the use of applications in learning on the results of post-test, ptre-test and questionnaires, it turns out that there is an increase in student attitudes in learning activities (Abimanyu, 2016). Therefore, according to the research above, it can be concluded that there is a need for further research on development of mobile mathematics for the development of mathematics on mobile devices which aims to redevelop mathematics learning that is clearer, more interesting, interactive, saves time and effort, and learning can be done anytime, anywhere, without the need to meet face-to-face with the teacher. However, before conducting research, it is necessary to conduct preliminary research on development of mobile mathematics to make it easier for researchers to determine the right topic for discussion. Preliminary research can be done by analyzing bibliography with keywords development of mobile mathematics using VOSviewer.

▪ METHOD

The method used in this research is bibliometric analysis. Bibliographical analysis or bibliometrics method sometimes referred to scientometrics is part of the research evaluation method and in view of the various literatures generated it is possible to bibliography of metrics using different methods (Ellegaard & Wallin, 2015). The population in this study refers to articles on development of mathematics in the range of the year published 2017-2022 which are published in Google Scholar1000 articles from 174 publications on 3 June 2022.Google Scholar (2004) provides a complete and free PDF (Portable Document Format) format that is useful for finding reference materials in making scientific papers and providing other useful information (Rafika et al., 2017). With this method, Google Scholar becomes a recommended source and is issued directly from universities, libraries and also reputable official sites that have access to scientific journals that make it easy to collect data assisted by Publish or Perish (PoP) as a search medium and visualized with VOSviewer.

Research Subject

This research was obtained from the results of articles on development of android mathematics from 2017-2022 on Google Scholar which can be seen in the following table.

Tabel 2. Table of research subject

Result	Explanation
Publication Years	2017-2022
Citation Years	5(2017-2022)
Papers	991
Citations	43371

Cites/year	8674.20
Cites/paper	43.76
Authors/papers	2.57
h-index	101
g-index	169
hI-norm	64
hI-annual	12.80
hA-Index	48

Based on the table above, the publication of international articles on development of mathematics in 2017-2022 on Google Scholar by searching using Publish or Perish found 991 papers, 43371 citations, 8674.20 citations per year, 43.76 citations per paper, 2.57 authors per paper, with 101 citations. -index and 169 g-index, 64 hI-norm, 12.80 hI-annual, and hA-Index.

Research Design and Procedures

Data collection in this study was carried out using Publish or Perish software with Google Scholar with the keyword "Development of Android Mathematics" and the results will be stored and then processed visually using VOSviewer software. The analysis technique in this research is bibliometric analysis. Students use several levels on bibliometric maps to find out the results of data visualization which allows for a better understanding of the relationship between disciplines and research fields (Busro et al., 2021). Bibliometrics reviews the literature using statistical and quantitative analysis of published research with a focus on the structure of the articles contained in the bibliography. Software Publish or Perish (PoP) used in this study is a software program that can retrieve and provide academic citations generated from Google Scholar metadata (Barney, 2008). This app is designed to help academics (individuals) communicate the impact of research even with multiple citations. In addition, it can also be used to determine which journals to submit to prepare for job interviews, literature reviews, bibliometric research, or homework before meeting with academic authors (Auliato et al., 2020).

The steps involved in analyzing the data in this study are using Publish or Perish (PoP) software which can be downloaded for free. In bibliometric analysis, research is obtained from data from various sources, such as articles, journals, and other literary works to determine patterns and trends (Batubara et al., 2021). The articles published in this study are 1000 articles with the keywords "Development of Mobile Mathematics" taken with vulnerability in 2017-2022 using Publish or Perish (PoP) as in Figure 1.

Figure 1. Metadata browsing via POP

Based on the search and analysis results, I obtained 1000 article titles containing research development of mobile mathematics which will then be made a map of the development of analytical research using the application VosViewer. PoP database visualization using VosViewer with the keyword "development of mobile mathematics" will then be stored in the RIS type and analyzed by the application VosViewer using the full count method (full counting method) compared fractional counting method to do the mapping of publication trends per year. According to Marianne (Gauffreau, 2021) Full count (full counting) gives publication authors 1 credit each, whereas fractional counting divides 1 credit between publication authors.

Tabla 1. Demographic table of research participants

Publication Year	Number of Article Found
2017	247
2018	234
2019	207
2020	180
2021	45
2022	11
Not Detected	76

At this stage, researchers can condition what they want such as the form of publication, keyword titles, search limits, and the 2017-2022 range. Furthermore, the data is stored in RIS format as follow-up data for the creation of 3 different visualizations, namely network visualization, overlay visualization and density visualization.

▪ **RESULT AND DISSCUSSION**

Meta data generated from 1000 articles that were successfully obtained were selected into 924 journal titles. The following is a graph of the journal in the time interval between 2017-2022 in Figure 2.
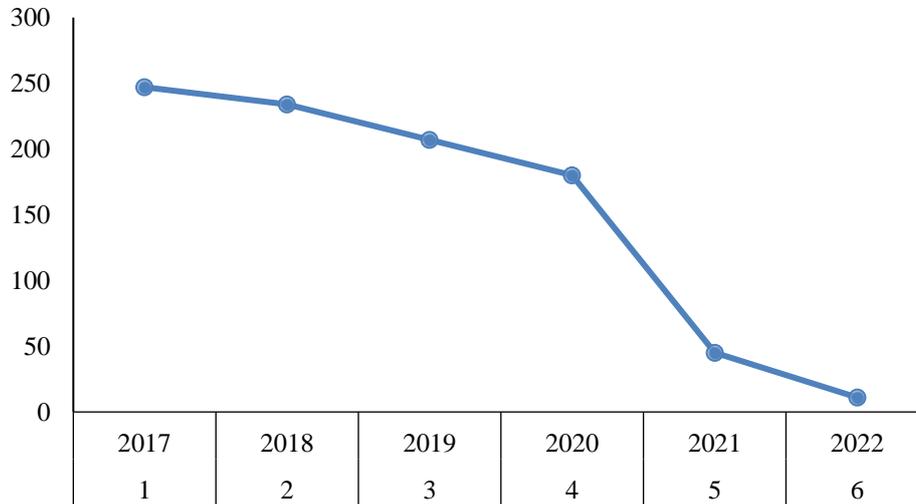

Figure 2. Number of publications by year

The resulting meta data graph shows a significant change in 2020 to 2021. The presumption of this decline is the preparation for online learning and the less possible situation due to the Covid-19 pandemic. Furthermore, the researchers also got the research results which have been summarized in the graph in Figure 3.
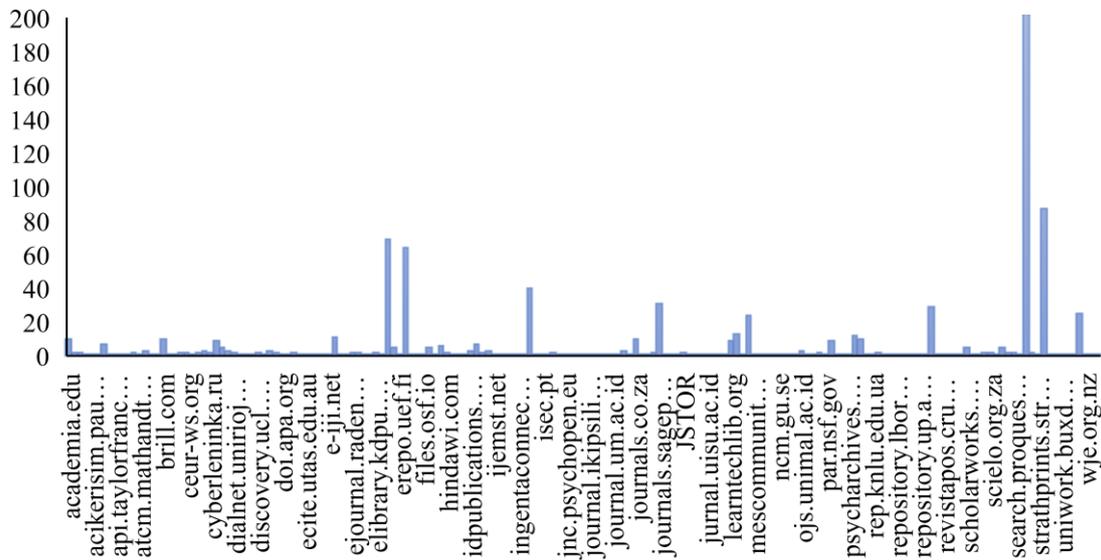

Figure 3. Number of publishers by year

The highest number of journal publications is on the Springer platform, which is 209 articles. In addition, there are several publications that are also widely used, such as Taylor & Francis with 87 articles, Elsevier with 69 articles, ERIC 64 articles and many more. After going through the PoP stage, the data is stored in RIS format and analyzed by the application VOSviewer using the full counting method. The analysis to be generated with VOSviewer will be network visualization, overlay visualization, and density visualization. In this study, we will use VOSviewer to visualize research network maps based on keywords, or collaborative words and network maps based on authors (Judge, 2020). The use of this visualization is clearly stated in the journal developed by Hidayat (2020): "*On the Network Visualization map, there are settings to choose from. In this study, the visualization scale is 0.77, the label size is 0.5, with a round label shape, the maximum length of the label is 50. To adjust the size, relationship strength, color, and line shape using the default settings. For cluster colors also use the default settings. The normalization method used is the Fractionalization method with layout and clustering settings using the default settings and for the Density Visualization map, there are two density options, namely item density and cluster density, where the density color settings follow the default settings*".

Visualization with the keywords development of mobile mathematics can be seen in the form of Network visualization (figure 4), Overlay visualization (figure 5), and Density visualization (figure 6) below.
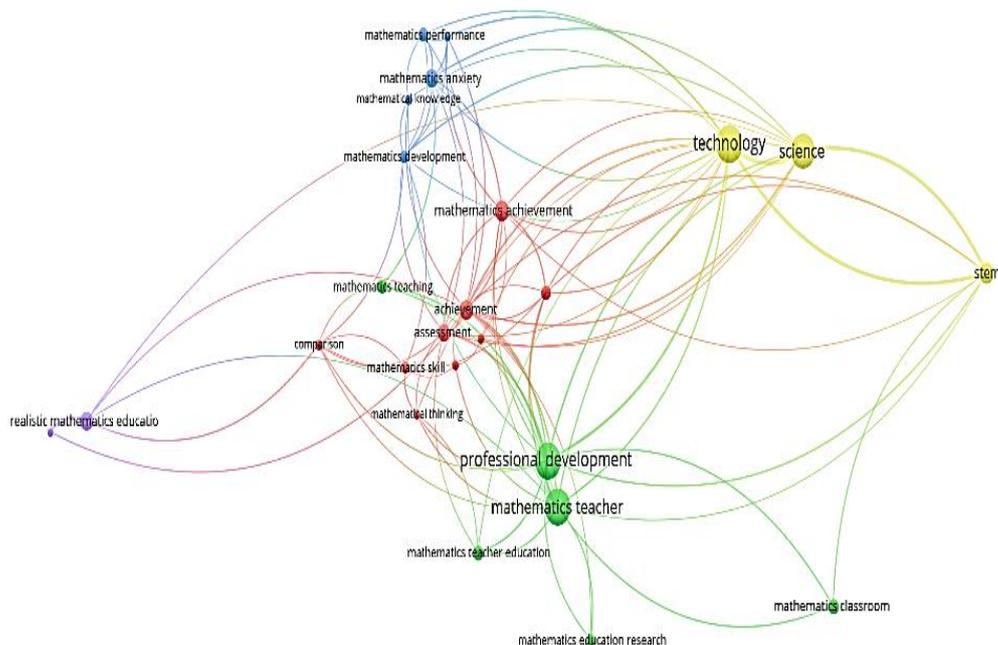

Figure 4. Network visualization
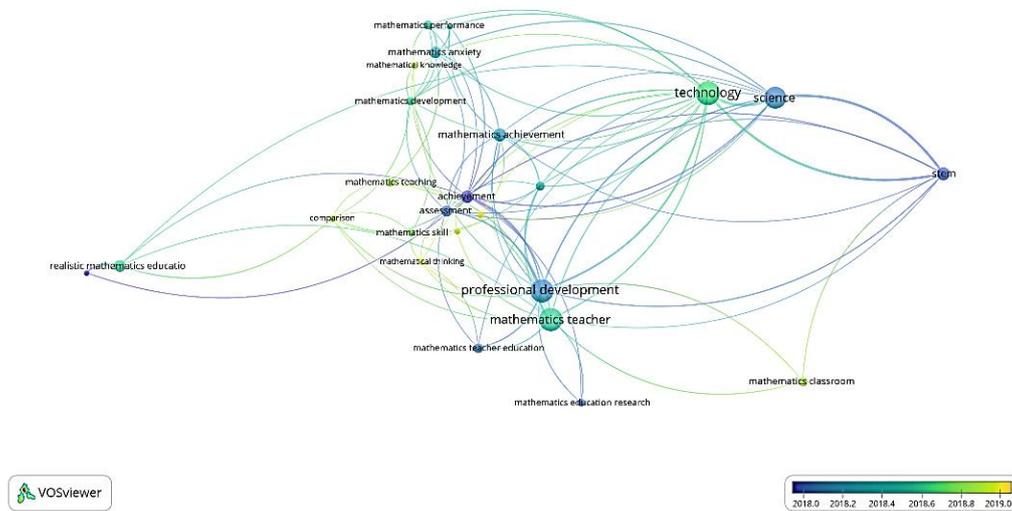
Figure 5. Overlay visualization

Based on images which are data on the number of visualizations from articles with several subjects with the keyword "Development of Android Mathematics" indexed by Google Scholar in 2017 up to the last 5 years. After being verified and grouped, it can be seen that the topic "development of mobile mathematics" generate view network visualization in 3 different clusters, the cluster shows the prevalence of the relationship that can be seen through the nodes on network, overlay and density visualization. The closer the nodes in the visualization, the closer they will be. If the node is bigger, then the terms have been studied a lot. Furthermore, if the item terms are in one cluster, of course the relationship between the two items is very strong in studies that have been carried out. Appearance overlay visualization on the 5th picture with the word mathematics development shows a green color that tends to be bright, this shows that this topic only emerged in the 2018s and is closely related to the word mathematics achievement, mathematics skills, mathematics knowledge and mathematics anxiety. To find out research trends, you can use overlay visualization, where in this visualization research that has a darker color, then the research is quite past. While a brighter subject indicates that the research is the latest or current research.
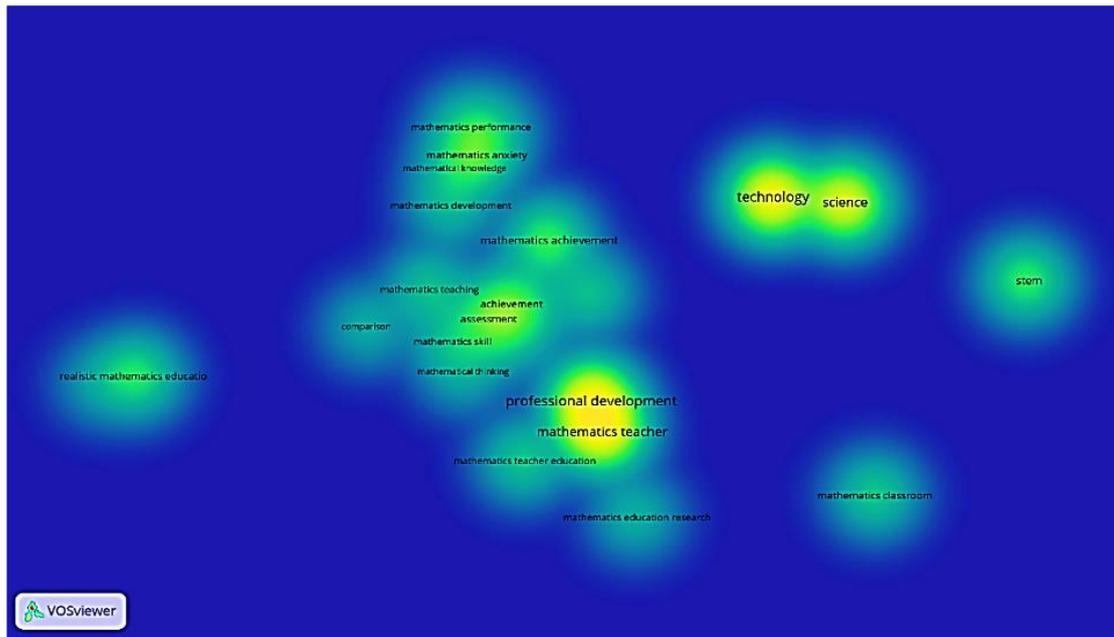
Figure 6. Density visualization

Furthermore, to find out the density of research topics, it can be seen in the results density visualization in figure 6. The brighter the resulting subject, the higher the density level and it can be said that the research has often been studied. Whereas the darker the subject, the less researchers study it. In Figure 6 it can be identified that the point professional development and mathematics teacher has been widely studied in research, but research with the topic of mathematics development still very dim and not related to other keywords like technology or mobile learning which is still very rare. This shows that research with the topic "development of mobile mathematics "with keywords "mathematics development "have the opportunity to be researched in the future.

▪ **CONCLUSION**

Based on the results of the analysis of acquisition data regarding Development of Mobile Mathematics using VOSviewer, it is known that the keyword "mathematics development" only started appearing in the 2018s and experienced a decrease in the number of publications in 2021 in the 2017-2022 timeframe. Researchers hope that with significant technological developments and changes in the learning process by adjusting learning media to be clearer, efficient, interesting, interactive, time and energy efficient and take place anytime and anywhere. Suggestions for future research using the VOSviewer application can make it easier to link the research you want to research with other variables in accordance with the suggestions in visualizing the results of the analysis of a research you want to research. So that the display shown can be a good reference to support relevant research and have a connection with the existing sample.

▪ **REFERENCES**

Abimanyu, A. (2016). Mathematics mobile learning with TPACK framework Terbit. Journal of Correct, 1321, 2016.

Anita Adesti, & Siti Nurkholifah. (2020). Pengembangan Media Pembelajaran Berbasis Android Menggunakan Aplikasi Adobe Flash Cs 6 Pada Mata Pelajaran Sosiologi. Edutainment, 8(1), 27–38. https://doi.org/10.35438/e.v8i1.221

Apriyanto, M. T., & Hilmi, R. A. (2019). Media pembelajaran matematika (mobile learning) berbasis android. Seminar Nasional Penelitian Pendidikan Matematika (SNP2M), 115–124.

Aulianto, D. R., Yusup, P. M., & Setianti, Y. (2020). Pemanfaatan Aplikasi " Publish Or Perish " Sebagai Alat Analisis Sitasi Pada Jurnal Kajian Komunikasi Universitas Padjadjaran. Book Chapter Seminar Nasional MACOM III "Communication and Information Beyond Boundaries, July, 873–880.

Batubara, H. S., Goatman, M., Simatupang, W., & Watrianthos, R. (2021). Pemetaan Bibliometrik Terhadap Riset pada Sekolah Menengah Kejuruan Menggunakan VOSviewer. Edukatif : Jurnal Ilmu Pendidikan, 4(1), 233–239. https://doi.org/10.31004/edukatif.v4i1.1818

Busro, B., Mailana, A., Sarifudin, A., Ushuluddin, F., Sunan, U., Djati Bandung, G., & Al-Hidayah Bogor, S. (2021). Pendidikan Islam dalam Publikasi Internasional … Pendidikan Islam dalam Publikasi Internasional: Analisis Bibliometrik pada Database Scopus. Jurnal Edukasi Islami Jurnal Pendidikan Islam, 10(01), 413–426.

Ellegaard, O., & Wallin, J. A. (2015). The bibliometric analysis of scholarly production: How great is the impact? Scientometrics, 105(3), 1809–1831. https://doi.org/10.1007/s11192-015-1645-z

Gauffreau, M. (2021). Counting methods introduced into the bibliometric research literature 1970–2018: A review. Quantitative Science Studies, 2(3), 932–975. https://doi.org/10.1162/qss_a_00141

Hakim, L. (2020). Analisis Bibliometrik Penelitian Inkubator Bisnis Pada Publikasi Ilmiah Terindeks Scopus. Procuratio: Jurnal Ilmiah Manajemen, 8(2), 176–189. http://www.ejournal.pelitaindonesia.ac.id/ojs32/index.php/PROCURATIO/article/view/677

Murtianto, Y. H., & Herlambang, B. A. (2022). Development of User Interface and User Experience in Virtual Lab Mathematics Applications Using Design Thinking Methods. 17(1), 261–272.

Murtiyasa, B., Jannah, I. M., & Rejeki, S. (2020). Designing mathematics learning media based on mobile learning for ten graders of vocational high school. Universal Journal of Educational Research, 8(11), 5637–5647. https://doi.org/10.13189/ujer.2020.081168

Pane, A., & Darwis Dasopang, M. (2017). Belajar Dan Pembelajaran. FITRAH:Jurnal Kajian Ilmu-Ilmu Keislaman, 3(2), 333. https://doi.org/10.24952/fitrah.v3i2.945

Penwarden, R. (2014). THE RISE OF THE SMARTPHONE @BULLET How to leverage the emergence of mobile in data collection @BULLET Tips for mobile friendly survey creation. https://fluidsurveys.com/wp-content/uploads/2014/11/The-Rise-Of-The-Smartphone.pdf

Purnama, R., Sesunan, F., & Ertikanto, C. (2017). Pengembangan Media Pembelajaran Mobile Learning Berbasis Android Sebagai Suplemen Pembelajaran Fisika SMA Pada Materi Usaha Dan Energi. Jurnal Pembelajaran Fisika Universitas Lampung, 5(4), 138457.

Radović, S., Marić, M., & Passey, D. (2019). Technology enhancing mathematics learning behaviors: Shifting learning goals from "producing the right answer" to "understanding how to address current and future mathematical challenges." Education and Information Technologies, 24(1), 103–126. https://doi.org/10.1007/s10639-018-9763-x

Rafika, A. S., Putri, H. Y., & Widiarti, F. D. (2017). Analisis Mesin Pencarian Google Scholar Sebagai Sumber Baru Untuk Kutipan. Journal CERITA, 3(2), 193–205. https://doi.org/10.33050/cerita.v3i2.657

Saienko, N., & Lavish, Y. (2020). Mobile assisted learning for self-directed learning development at technical university: SWOT analysis. Universal Journal of Educational Research, 8(4), 1466–1474. https://doi.org/10.13189/ujer.2020.080440

Sarrab, M., & Elgamel, L. (2013). MObile LEarning (M-L Earning) and. International Journal of Distributed and Parallel System, 3(4), 31–39.

Suryanti, S., & Sutaji, D. (2019). Pengembangan Teori Ring Mobile Application (Terima App): Media pembelajaran berbasis android untuk meningkatkan aksesibilitas pembelajaran Teori Ring. DIDAKTIKA : Jurnal Pemikiran Pendidikan, 25(2), 147. https://doi.org/10.30587/didaktika.v25i2.883

Yosiana, Y., Djuandi, D., & Hasanah, A. (2021). Mobile learning and its effectiveness in mathematics. Journal of Physics: Conference Series, 1806(1). https://doi.org/10.1088/1742-6596/1806/1/01208