

Mapping Research on Multimedia Biology: A Bibliometric Analysis

Submitted 14 May 2022 Revised 27 June 2022 Accepted 27 June 2022

Yuyun Yuliani^{1,2}, Didit Ardianto¹, Rita Retnowati^{1*}

¹Department of Science Education, School of Postgraduate, Pakuan University, Bogor, Indonesia

²SMA YPHB, Bogor, Indonesia

Corresponding Email: *ritaretnowati@unpak.ac.id

Abstract

The development of biology as a science and its application in technology that is increasingly rapidly encouraging innovative efforts to use technology results in biology learning. Currently, the biology learning process does not only use a single media but is required to use multimedia. This is done to make it easier for students to understand complex and very complex biological material. The aim of this paper is to provide an extensive bibliometric literature review on "multimedia biology education". Articles found by Publishing or Perish software (PoP) with a Mendeley database. There are 200 articles found from the Google Scholar database from 2017 to 2021 which are analyzed in this study. The selected references are then managed using reference manager software, namely Mendeley. After managing the database, this research classifies and visualizes it using VOSviewer software. Overall, this review provides an appropriate reference point for further research on "multimedia biology education". The search results 100 articles were obtained through the GS database and we found 55 articles were grouped from the GS database from 2017-2021 with the keyword 'biology education multimedia. This study aims to find research gaps for research on multimedia biology.

Keywords: Multimedia, Biology Education, Bibliometric Analysis, VOSViewer

INTRODUCTION

Biology is a branch of science. Biology is the study of living things, both animals, plants, humans and microorganisms, including their relationship to the environment in which they live. Basically, Biology learning needs to be adapted to the previous biologists' way of acquiring knowledge. The same thing is also said in (Yapici, 2016; Arianti and Aminatun, 2019). Therefore, in biology learning, it must be directed to find out and act so that it can help students to gain deeper mastery of concepts. In general, students have a poor perception of Biology. Therefore, this negative assumption needs to be eliminated and it is necessary to change the mindset of students about this negative assumption. Although so far learning biology subjects have used technology, but this utilization has not been optimal. For this reason, it is necessary to develop an appropriate learning media for biology subjects to change the mindset of students. New generation are willing to use social media and mobile apps in the courses and make internet projects involving multi-media tools (Yapici, 2016). Multimedia-based teaching materials in science learning have a significant effect on students' cognitive learning outcomes (Khoiriah, Jalmo and Abdurrahman, 2016). The selection of learning media is in accordance with the characteristics of the subject and the objectives of learning. Accuracy in the selection of media affects learning outcomes and the success of

students participating in the teaching and learning process. Based on the results of experience when teaching in class, the cause of the low learning outcomes of biology subjects, one of which is the lack of use of interactive multimedia-based learning. Information technology can be used to develop learning models. One of the advantages that can be obtained through the use of android as a medium in learning is that students are able to understand concepts in depth. Some educational researchers state that technology has the potential to improve the quality of learning. (Mtebe and Mbwilo, 2021).

Learning media is one of the important aspects in the educational process, according to Schramm in Sudrajat (2008) learning media is a messenger technology that can be used for learning purposes. In addition, the media has various benefits, including helping teachers in delivering their teaching materials, the media is also seen as a communication tool that bridges between abstract ideas and the real world. The use of media also makes the process of interaction, communication and delivery of material between teachers and students so that it can take place appropriately and efficiently. Along with the development of technology, today there are various kinds of learning media, one of which has many advantages over other media, namely computer multimedia because any information in the form of writing, audio, and images can be shown simultaneously. Several studies have shown that the use of interactive multimedia can increase mastery of concepts (Ferawati, 2011), learning achievement, and critical thinking skills). This is in line with (Karakoyun and Yapıcı, 2016; Goff *et al.*, 2017; Muthmaini *et al.*, 2018; Wulandari and Anhar, 2019; Mtebe and Mbwilo, 2021). Based on the results of experience and evaluation of the low learning outcomes of students in biology subjects, it can be caused by: (1) Conventional learning models which cause students to be passive and memorize facts, concepts, principles, laws and formulas. (2) There are misconceptions and learning conditions that do not pay attention to the preconceptions possessed by students. In addition, the low learning outcomes of biology subjects are also thought to be due to the lack of use of innovative and interactive learning media. Based on the description above, it is important to conduct research that focuses on the development of interactive learning media in order to improve students' understanding of concepts. In this study, interactive multimedia learning was developed to improve students' understanding of concepts in biology subjects, especially in abstract material. In this digital era, student learning at the elementary school to tertiary level is very much needed, which is called technology literacy with the aim of increasing understanding of certain subject areas.

This article is organized into four parts. The first part is an introduction, followed by a discussion of the research methodology that has been carried out. The third section discusses the results and discussion. The fourth section discusses the conclusions. The purpose of this study is to consolidate the literature on multimedia in biology and determine trends related to multimedia research in biology education so that it can be seen whether research on multimedia in biology education is still relevant and allows for development. Considering the reasons stated above, this paper aims to fill the research gap by providing an extensive bibliometric analysis of the literature in relation to multimedia in biology education that similar opinion expressed by (Bruckermann *et al.*, 2017; Setyowati, 2020).

METHOD

This study used descriptive qualitative method. Qualitative descriptive method is a research method that utilizes qualitative information and is described descriptively. This science began to be developed by experts around the 1970s. One of the books that marked this era was "The Discovery of Grounded Theory" written by Glaser and Strauss in 1967 (Packer-Muti, 2016)). Descriptive research is a type of research whose findings are not obtained through statistical procedures or other forms of calculation. Some of the strengths of using qualitative methods for research are in the "assessment and testing" of language such as, eliciting deeper insights into designing, managing, and interpreting assessments and tests; and explore test takers' behaviors, perceptions, feelings, and understandings. Some of the disadvantages are, for example, the smaller sample size and time consuming. Quantitative research methods, on the other hand, involve larger samples, and do not require a relatively longer time for data collection (Rahman, 2016). This is in line also that qualitative research aims to answer questions related to the development of understanding dimensions of meaning and experience of human life and the social world (Wohlrapp, 2014).

The Figure 1 is the stages of the qualitative descriptive research method used:



Figure 1 Flowchart of a bibliometric research

The database used in this search is Google Scholar (GS) as the database determination stage. This is done because GS provides convenience with an abundant number of databases. In the define search keywords stage, the first step taken was a literature search conducted in October 2021 with the keywords 'Multimedia Biology Education'. Google Scholar was chosen because it is currently the largest database and Publish or Perish was chosen because it proved to be the most effective way to search for articles on Google Scholar (Baneyx, 2008). In the third stage, search results, this search is limited to 100 articles published in the period 2017-2021. Especially for 'journal' and the words 'title and abstract'. The results are compiled in a Research Information System (RIS) format to include all important article information such as paper title, author name and affiliations, abstracts, keywords, and references.

At the statistical data compilation stage, we used RIS and data analysis was carried out by classifying the data by publisher, publication source, and year of publication. The last stage, bibliometric analysis in this study using PoP software, and to analyze and visualize the bibliometric network used VOSViewer software.

RESULTS AND DISCUSSION

With the help of Publish or Perish, 100 Google Scholar articles were obtained in the 2017-2021 issue range. Ecenaz Alemdag and Kursat Cagiltay are the researchers with the most citations, namely 142 citations in their article entitled “A systematic review of eye tracking research on multimedia learning” published in October 2018 as shown in Figure 2.

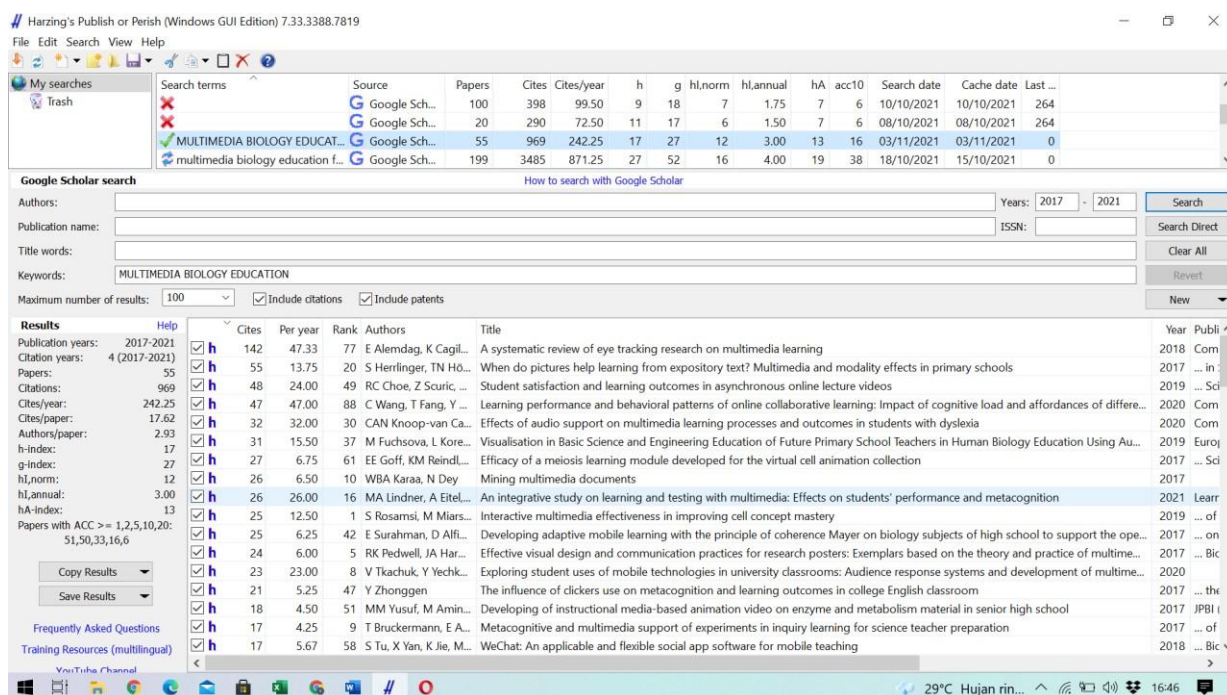


Figure 2 Result of Publish or Perish with Multimedia Biology Education Keyword

And from the data that has been captured, it can be obtained that the metric data obtained are as shown in Table 1.

Table 1 Metric Data

<i>Metrics Data</i>	<i>Initial Search</i>	<i>Refinement Search</i>
Source	Multimedia	Multimedia
	Biology	Biology
	Education	Education
Publication year	2017-2021	2017-2021
Papers	100	55
Citations	1215	1145
Cites / year	303.7	286.2
	5	5
Cites / paper	12.15	20.82
Authors/paper	2.56	2.84
h_index	18	18
g_index	30	30
hI_norm	13	13
hI_annual	3.25	3.25
ha_index	13	13

The researchers try to present the most relevant contributions in this research. The steps taken were to take 10 articles with the keyword “Multimedia Biology Education” which had the highest citation value. The results are obtained as in Table 2.

Table 2 Top ten articles cited

No.	Publication		Author	Title	Journal	Cites	Publisher
	Year						
1	2018		A Alemdag, K Cagiltay	A systematic review of eye tracking research on multimedia learning	Computer and education	142	Elsevier
2	2017		S. Herrlinger, TN Hoffler, M Opfererman	When do pictures help learning from expository text? Multimedia and modality effect in primary school	Science Education	55	Springer
3	2019		RC Choe, ZScuric, E Eshkol, S Crusier	Student satisfaction and learning outcomes in asynchronous online lecture video	Science Education	48	Am soccell bio
4	2020		C Wang, T Fang, G Yu	Learning performance and behaviour pattern of online collaborative learning	Computer and education	47	Elsevier
5	2017		EE Gofit, KM Reindl, C Johnson	Efficacy of meiosis learning module developed of virtual cell animation collection	Computer and education	27	Am soccell bio
6	2021		MA Linder, A eitel, J Barentien	An Integrative study on learning and testing with multimedia	Learning and instruction	26	Elsevier
7	2017		RK Pedwell, JA Hardy	Effective visual design and communication practise for research poster	Biology education	24	Wiley
8	2017		T Brukkerman, E Ashhermann	Metacognitive and multimedia support of experimenting inquiry learning for science teacher Preparation	International journal of science education	17	Taylor and Francis
9	2018		J Jenkinsen	Molecular biology meets the learning science	Journal of molecule biology	15	Elsevier
10	2018		F Karakoyun, U Yapici	Use of slow motion in biology teaching	International education studies	3	CSSE

The visualization display of the data network on GS data related to the keyword "Multimedia Biology Education" which has been refined in the search can be seen in Figure 3, the overlay visualization can be seen in Figure 4, and the density visualization is in Figure 5.

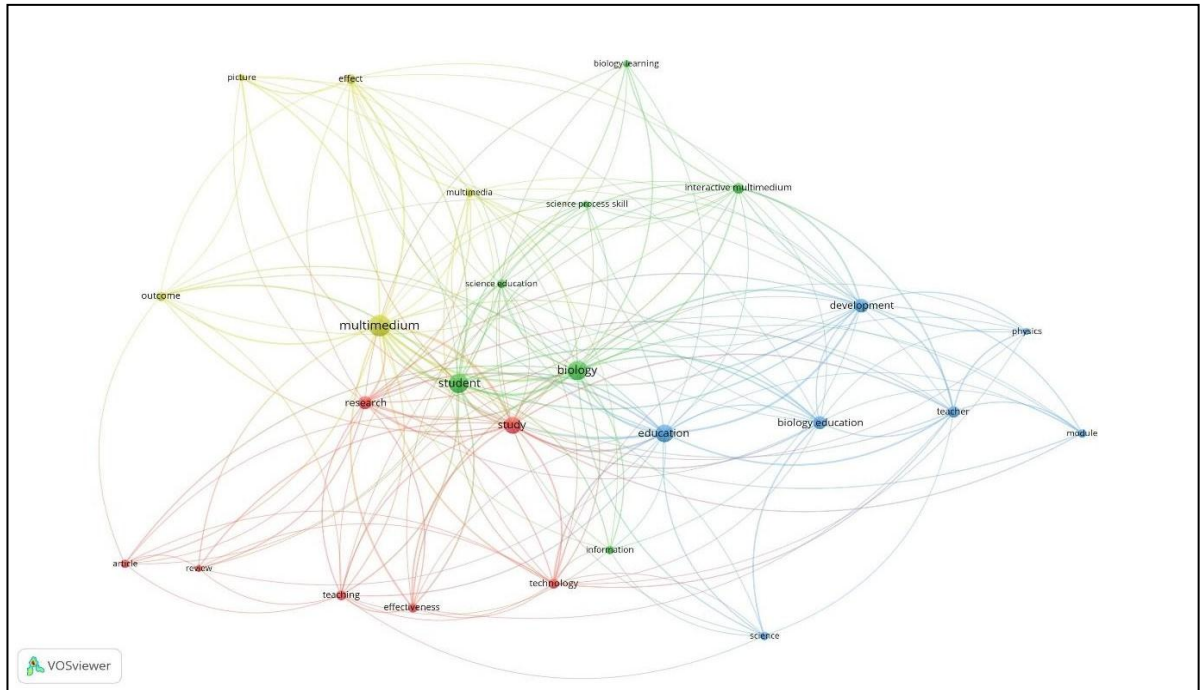


Figure 3 Network visualization of the google scholar database

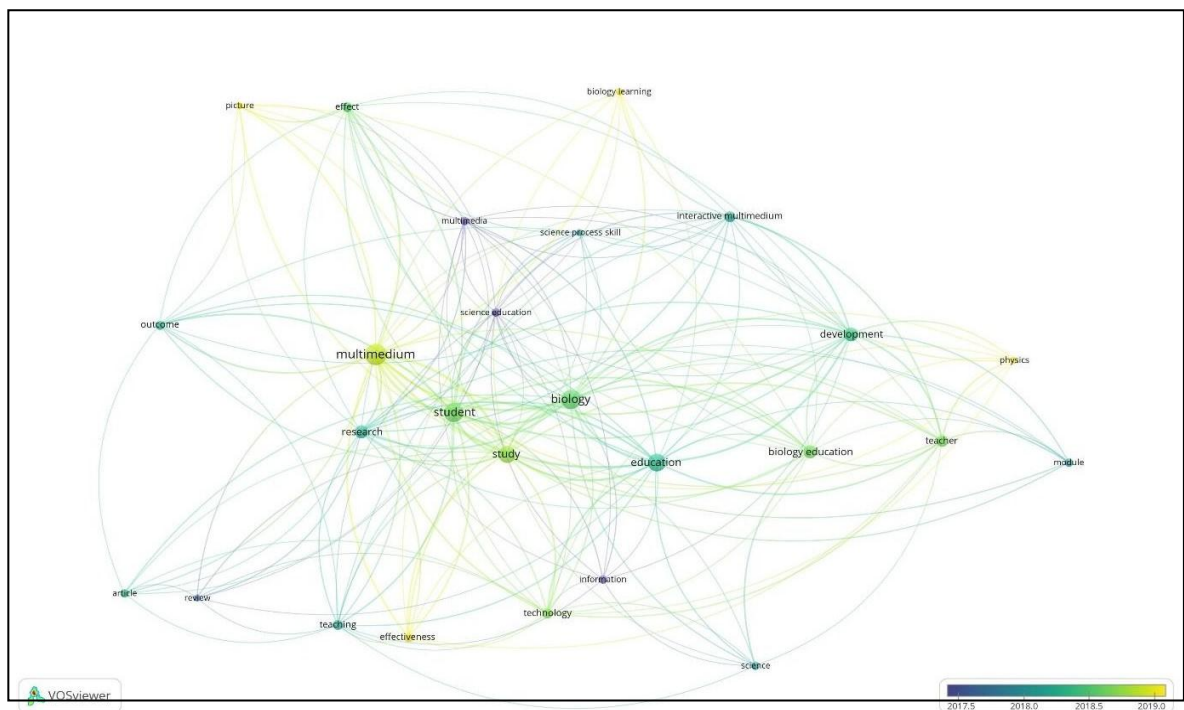


Figure 4 Overlay visualization of the google scholar database

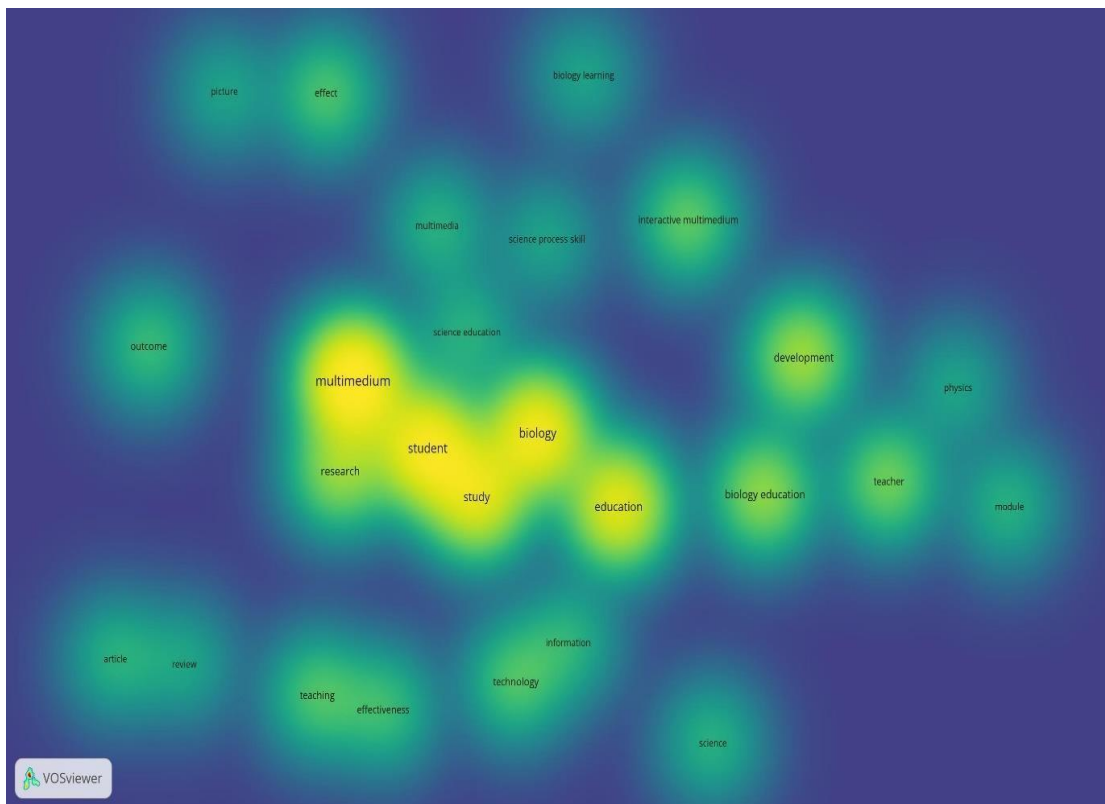


Figure 5 Density visualization of the google scholar database

From the search results using the VOSviewer, it was concluded that in the research "biology education multimedia" in Figure 1 shows there are 4 clusters marked with yellow, red, green and blue colors, each of which is mutually exclusive there is a connection. For figure 2, it shows the year the research was conducted, for the darkest color was carried out in 2017 and the young semkan are more contemporary. Figure 3 shows that research that has been extensively researched is marked by bold colors and large letters, while research that is still rare is marked with lighter colors and smaller letters, this provides an overview for researchers to determine topics that have not been widely discussed. so that further research is expected to be the latest and up to date research so that it is in accordance with the times. The keywords that appear in each cluster that represent the Blended learning study path can be seen in Table 3.

Table 3 Keywords that represent each cluster

No	Cluster	Elemen
1	Cluster 1 (red)	Article, effectiveness, multimediu, research, review, study, teaching, technology
2	Cluster 2 (green)	Biology, biology learning, information, interactive multimediu, medium, science education, science proces skill, student
3	Cluster 3 (blue)	Biology education, development, education, module, science, teacher
4	Cluster 4 (yellow)	Effect, field, multimedia, picture

From the red overlay data, it shows that research with this keyword has been researched for a long time, what is updated is the yellow one with keywords such as effectiveness, multimedia, picture and several others that we can use as a reference. Meanwhile, based on the density visualization, a light color indicates the words used have been studied extensively, but a dark color indicates a high possibility for further research or development. A lot of research that has been done based on the data in Tasa is about multimedia, students, biology and education which are marked in yellow. Meanwhile, from the data, it was found that research gaps that can still be done are about the use of multimedia-based modules that can be developed to improve student learning outcomes.

CONCLUSION

From the results of data processing above, it can be concluded that biology education multimedia is a theme that can still be developed because of the large number of students the other side of biology education multimedia that has not been touched such as from electronic modules, electronic teaching materials and others. Hopefully the results of this analysis can be useful and can be used to determine the theme of the next research.

The limitation of this research is the subjective assessment, especially in determining keywords and determining the desired range of years so that errors in judgment or selection may still occur. In addition, considering that the database used in the search only uses Google Scholar, the search results are limited to Google Scholar.

This research is the answer to research (Huda 2020) which suggests adding more samples to be analyzed so that on this occasion the author adds to the sample to 200 articles which were previously 100 pieces. For further research, the authors suggest adding a larger

sample or comparing the results obtained if the number of samples is different or adding to the same search topic or also comparing the results of the analysis using bibliometric analysis methods using other software such as BibExcel and HistCite or other.

REFERENCES

- Arianti, Y. and Aminatun, T. (2019) "An analysis of outdoor learning towards students' outcomes in learning biology," *Journal of Physics: Conference Series*, 1241(1). doi: 10.1088/1742-6596/1241/1/012061.
- Bruckermann, T. *et al.* (2017) "Metacognitive and multimedia support of experiments in inquiry learning for science teacher preparation," *International Journal of Science Education*, 39(6), pp. 701–722. doi: 10.1080/09500693.2017.1301691.
- Goff, E. E. *et al.* (2017) "Efficacy of a meiosis learning module developed for the virtual cell animation collection," *CBE Life Sciences Education*, 16(1), pp. 1–12. doi: 10.1187/cbe.16-03-0141.
- Hudha, MH, Hamidah, I., Permanasari, A., Abdullah, AG, Rachman, I., & Matsumoto, T. (2020). Pendidikan rendah karbon: Sebuah tinjauan dan analisis bibliometrik. 9(1), 319- 329. [https:// doi.org/10.12973/eu-jer.9.1.319](https://doi.org/10.12973/eu-jer.9.1.319)
- Karakoyun, F. and Yapıcı, İ. Ü. (2016) "Use of Digital Storytelling in Biology Teaching," *Universal Journal of Educational Research*, 4(4), pp. 895–903. doi: 10.13189/ujer.2016.040427.
- Khoiriah, Jalmo, T. and Abdurrahman (2016) "The effect of multimedia-based teaching materials in science toward students' cognitive improvement," *Jurnal Pendidikan IPA Indonesia*, 5(1), pp. 75–82. doi: 10.15294/jpii.v5i1.5793.
- M. Zainal Arifin¹, Fasli Jalal², Makmuri³.(2021). Analisis Bibliometrik dan Visualisasi Tren Penelitian Pembelajaran Campuran dengan PoP dan VOS Viewer. *Jurnal Pendidikan Komputer dan Matematika Turki* Vol.12 No.11 (2021), 2010-2014
- Mtebe, J. S. and Mbwilo, B. (2021) "Faktor-Faktor yang Mempengaruhi Penggunaan Konten Multimedia yang Ditingkatkan oleh Guru di Sekolah Menengah di Tanzania Abstrak."
- Muthmaini, N. *et al.* (2018) "Validitas Multimedia Pembelajaran Interaktif pada Pembelajaran Biologi Materi Sistem Koordinasi Kelas XII SMA Siswa Sekolah," pp. 320–325.
- Packer-Muti, B. (2016) "A Review of Corbin and Strauss' Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory," *The Qualitative Report*, 14(2), pp. 140–143. doi: 10.46743/2160-3715/2009.2838.
- Rahman, M. S. (2016) "The Advantages and Disadvantages of Using Qualitative and Quantitative Approaches and Methods in Language 'Testing and Assessment' Research: A Literature Review," *Journal of Education and Learning*, 6(1), p. 102. doi: 10.5539/jel.v6n1p102.

- Setyowati, L. (2020) ‘Pengenalan Bibliometric Mapping sebagai Bentuk Pengembangan Layanan Research Support Services Perguruan Tinggi’, *JPUA: Jurnal Perpustakaan Universitas Airlangga: Media Informasi dan Komunikasi Kepustakawanan*, 10(1), p. 1. doi: 10.20473/jpua.v10i1.2020.1-9.
- Wohlrapp, H. R. (2014) “Research,” *Logic, Argumentation and Reasoning*, 4, pp. 55–91. doi: 10.1007/978-94-017-8762-8_2.
- Wulandari, E. and Anhar, A. (2019) “Analisis Kebutuhan Pengembangan Multimedia Pembelajaran Interaktif Materi Protista dan Jamur Siswa Kelas X Senior,” pp. 98–102.
- Yapici, İ. Ü. (2016) “Effectiveness of Blended Cooperative Learning Environment in Biology Teaching: Classroom Community Sense, Academic Achievement and Satisfaction,” *Journal of Education and Training Studies*, 4(4), pp. 269–280. doi: 10.11114/jets.v4i4.1372.