



Bibliometric Analysis of Higher-Order Thinking Skills Based on Google Scholar, Crossref, and Scopus Database

Yohanis Ndapa Deda

Program Studi Pendidikan Matematika, Universitas Timor, Indonesia

Corresponding author's email: yndapadeda@unimor.ac.id

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ABSTRACT

Higher-order thinking (HOT) skills are needed to analyze, evaluate, and solve problems. HOTS is an essential ability that students must have as a provision for the future and the 21st Century. However, no bibliometric research has linked Crossref, Scopus, and Google Scholar (GS) preferences on Harzing's Publish or Perish (PoP) software. This research aims to identify search preferences in PoP software version 8.9.4554.8721. The sample critical phrases entered in the preference menu are Higher-order thinking skills (HOTS) with a time range from 2018 to 2023. The library study research method used is bibliometric analysis. Metadata in the form of RIS/Refmanager files obtained from PoP is used to visualize data through VosViewer software. CSV data is used to identify top authors and top sources based on each preference. The phrases or keywords used were "HOTS," Mathematics" in GS, Crossref, and Scopus preferences. The results show four clusters of HOTS: ability, student, effect, and category. The top authors cited in Scopus are Hadi et al., Hobri et al. in GS, and Ichsan et al. in Crossref. HOTS needs to be researched more from various perspectives and methods. We recommend that future HOTS research be linked to real life to bridge the quite abstract concept of HOTS.

Keywords: PoP, HOTS, Bibliometric Analysis, GS, Crossref, Scopus

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INTRODUCTION

HOT skills are essential because of the ability to analyze, evaluate, and create solutions to a problem (Anderson et al., [2005](#); Deda et al., [2020](#); Diena, Wilujeng, and Perdana, [2023](#)). HOTS has three crucial components: problem-solving, critical thinking, and creativity (Diena et al., [2023](#); Hwang et al., [2018](#)). HOTS is an essential ability that students must have as a provision for the future and the 21st Century. Recently, publications related to HOTS have continued to increase (He, Singh, and Ebrahim, [2022](#)). Scientific journals continue to evolve, not only on the topic of HOTS. Currently, publications worldwide are easily obtained by searching on Google Scholar, Semantic Scholar, Pubmed, Scopus, Crossref, Web of Science, and other databases. On the other hand, the number of databases that provide publication data benefits the development of science on a topic.

However, not all database sources are open-access and free. Some sources are paid, such as Scopus and Web of Science. Therefore, a method or software is needed to present many libraries from various sources. One solution to get many publications from Google Scholar, Semantic Scholar, Pubmed, Scopus, Crossref, Web of Science, and OpenAlex search databases is through Harzing's Publish or Perish (PoP) (Ellegaard and Wallin [2015](#)). Furthermore, researchers use bibliometric analysis (BA) methods to statistically see the trend and influence of scientific publications on a topic (Donthu et al. [2021](#); Moresi, Pinho, and Costa [2021](#)). Bibliometric analysis (BA) is a research method that presents the trends and impact of a research topic, in addition to knowing the distribution of authors and journals in various countries in a region and the world. BA also provides future research directions to support decision-making and assist policymakers (Donthu et al. [2021](#); Lim, Kumar, and Ali [2022](#)).

Bibliometric analysis is the way to determine a paper's impact on scientific progress (Deda, Disnawati, and Daniel, [2023](#); Suprpto et al., [2021](#)). Research field, document source, publishing output, language source, top authors, number of citations, and author keywords are some bibliometric markers used to analyze trends (Deda et al., [2023](#); Suprpto et al., [2021](#)). He (He et al. [2022](#)) conducted BA research on HoTs using Scopus from 2011 to 2020. His research results say that increasing HOTs in learning activities is essential. In addition, researchers (He et al. [2022](#)) have not combined metadata from Scopus sources with other database sources. The BA conducted by (Deda et al. [2023](#)) has used GS and Scopus as preference sources in PoP. However, (Deda et al. [2023](#)) have not combined it with other preferences also available in PoP, namely Crossref. However, preferences SS and Pubmed, WoS, and Openalex were not used in this study because Openalex and Harzing academic are not yet accessible in PoP. Pubmed has a year restriction like Scopus and GS, but it is not readable when searching title HOTs. For WoS, it is also unreadable on search using PoP. So, this research has a novelty that has not been done by other researchers (He et al. [2022](#)). The study used multiple metadata sources: GS, Crossref, and Scopus. We also use Harzing's PoP App because it provides several preference search options that are both free and paid with quantity restrictions.

Therefore, we would like to offer a bibliometric analysis using three preference sources accessible on PoP: GS, Crossref, and Scopus, which are free and accessible through PoP. Thus, this study focuses on HOT research topics in 2018-2023 with four research questions: (i) How many significant clusters are there with the combined GS, Crossref, and Scopus preferences regarding HOTS on PoP? (ii) What are the advantages and disadvantages of GS, Crossref, and Scopus preferences regarding HOTS on PoP?; (iii) Who is the top author based on GS, Crossref, and Scopus related to the HOTS topic?; and (iv) What are the recommendations for future research related to HOTS theme?

METHOD

This research method is bibliometric analysis. This bibliometric analysis stage (Deda et al. 2023), namely (i) Opening Harzing's Publish or Perish (PoP) application and entering the keyword "high order thinking skills" in the title word menu section of Google Scholar, Scopus, and Crossref; (ii) specifying a specific year range, namely from 2018 to 2023. (iii) save metadata by selecting metadata format in Save results as CSV or RIS/RefManager; (iv) Furthermore, filter languages, namely English and Indonesian, and not limited to document types and fields of study; (v) feasibility, namely reviewing titles, abstracts, source titles, and citations; (vi) present RIS / RefManager metadata with the help of the VosViewer application. At this stage, we create a map based on bibliographic data to visualize the co-authorship. Next, Create a map based on text data to visualize a co-occurrence map based on text data in titles, words, keywords, and abstracts. At this visualization stage, the RIS / RefManager metadata files from GS, Crossref, and Scopus are selected to be mapped, respectively. Lastly, they are mapped simultaneously to create a map in VosViewer. LinkURL of RIS data is <https://bit.ly/46NFgAX>, linkURL of CSV data is <https://bit.ly/3uWkBxc>. The RIS and CSV metadata were retrieved at PoP version 8.9.4554.8721 on December 5, 2023. The VoSViewer application analyses the HOTS research preferences source individually and simultaneously. VoSViewer is used for cluster occurrence, co-authorship, and overlay visualization (van Eck and Waltman, 2022).

RESULTS & DISCUSSION

Result

The advantage of GS over Scopus is that it is popular and free and searches all scientific documents to see the number of citations of all our papers presented online. While Scopus only counts the number of citations among documents indexed by Scopus. Figure 1 below shows the metadata snapshot results obtained from GS using HOTS search for 2018-2023.

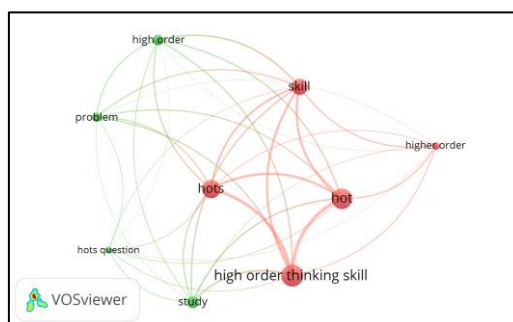


Figure 1. VosViewer of the whole picture of the HOTS from Google Scholar

The Figure 1 snapshot shows that only two clusters appear: HOTS, skills, and higher order (red color) and green color cluster (study, hots question, problem, high order). We input the HOTS Title and

the keywords "HOTS" and "mathematics" and split the search results into two clusters. Figure 2 below shows the preferences search results using the Crossref database.

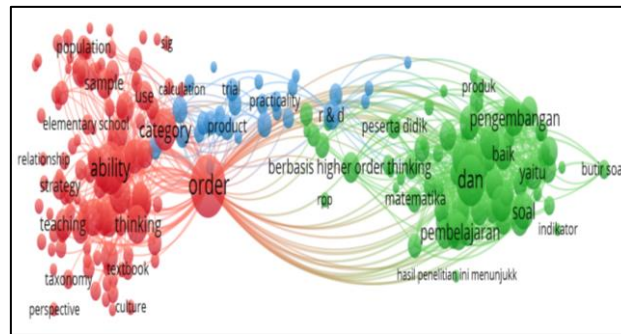


Figure 2. VosViewer of the whole picture of the HOTS from the Crossref database

Figure 2 shows three clusters: words with red, blue, and green groups. We input the HOTS Title and the keywords "HOTS" and "mathematics," making the search results into three clusters. The number of clusters is more than the GS source preferences.

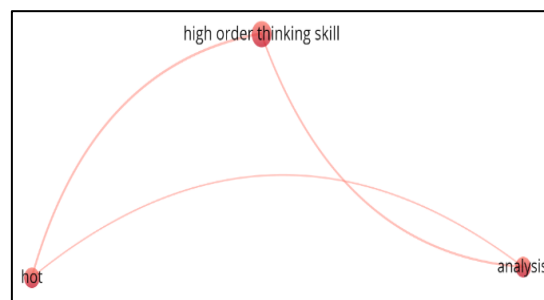


Figure 3. VosViewer of the whole picture of the HOTS from Scopus

Figure 3 shows that only one cluster appears, HOTS and analysis (red). We input the HOTS Title, keywords "HOTS" and "mathematics," and the range from 2018 to 2023 to make the search results into one cluster. The preferences search results using the Scopus database are the least from GS and Crossref. Figure 4 below is a snapshot of the three combined RIS files, namely from GS, Crossref, and Scopus, at once inserted in the VosViewer software.

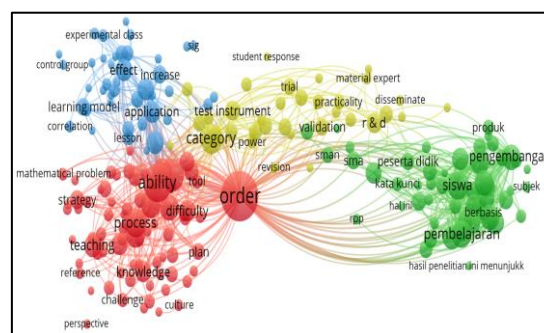


Figure 4. VosViewer of combined GS, Crossref, and Scopus preferences

Figure 4 shows that four clusters appear, namely red, blue, yellow, and green keyword clusters. The combined results of three preference sources in PoP provide more rigorous and comprehensive results. When connecting more than two preference sources in PoP software, we get optimal results and present more comprehensive results.

Discussion

Based on the snapshot results using VosViewer, we found that one cluster uses the Scopus Preferences source, two use the Google Scholar Preferences source, and three use the Crossref Preferences source. However, when we combined the three sources, we obtained four significant clusters in Figure 4, namely the red clusters in Figure 5 (ability, order, mathematics, high-level thinking skill, process, concept, creative teaching, observation, approach, learning process, strategy, creativity, qualitative research, practice, obstacle, difficulty, plan, etc.), green cluster in Figure 4 (student, teacher, higher order thinking based, curriculum, material, development, research, reliability, hot, mathematics, high school, etc.), blue clusters in Figure 4 (effect, learning model, creative thinking skill, significant effect, experimental class, influence, sample, application, action, etc.), and yellow clusters in Figure 4 (category, r&d, high category, response, reliability, teaching material, difficulty level, product, trial, validation, feasibility, material expert, etc.).

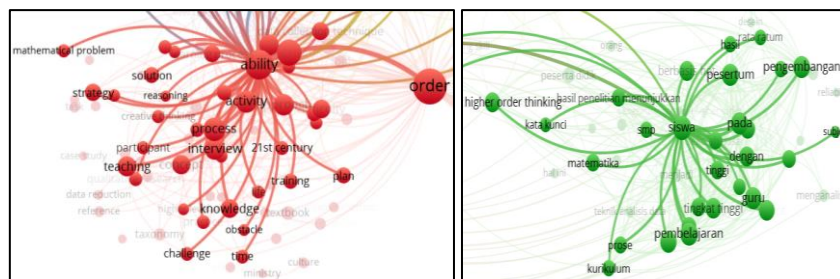


Figure 5. zoom out of the red cluster (left) and green cluster (right) from Figure 4

The advantage of Scholar Google sources is that GS enters documents selectively. The advantage of ScholarGoogle compared to Scopus is that it searches all scientific papers to see the number of citations of all our online documents. The weakness of GS is that it has many non-peer-reviewed sources. However, GS is still widely used because it is popular and accessible and allows for a maximum of 1000 studies in the PoP application. Crossref also has a maximum limit of 1000 articles on PoP. Preferences search using Scopus is paid and allows a maximum of only 200 articles on PoP. However, the CSV metadata from the Crossref source is the most complete of the Scopus source and Google Scholar. When viewed from the VosViewer snapshot output in Figures 1 to 3, it is clear that Crossref is better than GS and Scopus because it gives rise to more and more significant clusters. So, it can be said

that if you only want to analyze citations (Kiduk and Meho, [2006](#)) and how authors collaborate on hot topics, then the best preference choice is a Crossref source.

Furthermore, for CSV data analysis from PoP can get complete information details such as citations, authors, titles, years, sources, publishers, article URLs, GS Rank, Query Date, article DOIs, ISSNs, Citation URLs, Volume, Issue, Beginning page, End Page, ECC, Citations Per Year, Citations Per Author, Author Count, Age, Abstract, Full-Text URL, and Related URLs are given (Firdaus et al., [2022](#)). However, in Scopus preferences, Publisher, ArticleURL, Abstract, FullTextURL, and RelatedURL data are unreachable. Meanwhile, Source, DOI, ISSN, CitationURL, Volume, Issue, Startpage, and EndPage are inaccessible in GS preferences on PoP. Type documents also only read CITATION, HTML, and PDF in GS. GS has not been able to read Document types, such as articles, books, and proceedings types, such as Scopus and Crossref preferences. The weakness of the Crossref source is that Cites URL and RelatedURL are not readable. The three choices GS, Scopus, and Crossref can be used as Preferences search on PoP for bibliometric analysis because RIS and CSV data results can identify the most contributing, cited, and published journals. However, CSV and RIS/Refmanager from PoP cannot directly read the author's country of origin and the language used in the case of the article being studied.

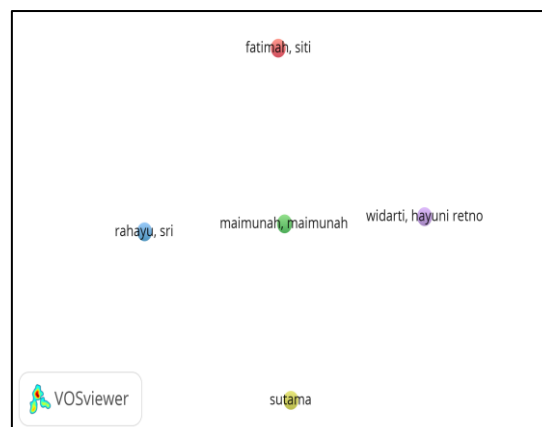
Based on the search strategy in this study, it can be said that the better and more accessible preferences on PoP are Crossref sources. However, the best and free way to conduct bibliometric analysis using preferences on PoP is to combine the search results of more than two preferences available on PoP (Deda et al., [2023](#)). In addition, RIS data cannot stand alone or is not sufficiently discussed separately, and it should be discussed together with CSV data to get more comprehensive information and reduce the bias in answering research questions (Deda et al. [2023](#); Martín-Martín et al. [2021](#)).

Based on Table 1, the most cited author based on the Crossref preference source is Ichsan et al. (36) from Indonesia, the most cited author based on the GS preference source is Hobri et al. (76) from Indonesia, and the most cited author based on Scopus preference source is Hadi et al. (47) from Indonesia. Table 1 above states one example of an illegible publisher using Scopus preferences. At the same time, Crossref and GS preferences are legible.

Based on VOSviewer overlay visualization, the research related to HOTS occurred most in 2021. The top studies in 2021 are (Sutama et al. [2021](#)), obtained from a Scopus source, and (Susilowati and Sumaji [2021](#)) from a GS source. However, no significant new research has been conducted in the last two years (2022-2023). This means that research related to HOTS is still open and unique to be researched. For example, research that uses local wisdom to bridge students' understanding of HOTS.

Table 1. Top Cities based on GS, Scopus, and Crossref Preferences source

Authors	Title	Source	Cites	Preferences
(Ichsan et al. 2019)	“HOTS-AEP: Higher Order Thinking Skills from Elementary to Master Students in Environmental Learning”	“European Journal of Educational Research”	36	Crossref
(Hobri, Septiawati, and Prihandoko 2018)	“HOTs in contextual teaching and learning of mathematics based on lesson study for learning community”	“International Journal of Engineering & Technology”	27	Crossref
(Pratama and Retnawati 2018)	“Urgency of HOTS Content Analysis in Mathematics Textbook”	“Journal of Physics: Conference Series”	27	Crossref
(Hobri et al. 2018)	“HOTs in contextual teaching and learning of mathematics based on lesson study for learning community”	“International Journal of Engineering & Technology”	76	GS
(Susilowati and Sumaji 2021)	“Intersection of critical thinking with HOTS based on Bloom's taxonomy.”	“JURNAL SILOGISME: Kajian Ilmu “	40	GS
(Febriyani, Yunita, and Damayanti 2020)	“An analysis on HOTS in compulsory English textbook for the twelfth grade of Indonesian senior high schools”	“Journal of English”	29	GS
(Hadi et al., 2018)	“The difficulties of high school students in solving higher-order thinking skills problems”	“Problems of Education in the 21st Century”	47	Scopus
(Sutama et al. 2021)	“The development of student worksheets based on higher order thinking skill for mathematics learning in junior high school”	“Journal of Physics: Conference Series”	10	Scopus
(Feriyanto and Putri 2020)	“Developing Mathematics Module Based on Literacy and HOTS Questions to Train Critical Thinking Ability of High School Students in Mojokerto”	“Journal of Physics: Conference Series”	5	Scopus

**Figure 6.** Co-authorship based on GS, Scopus, and Crossref

Co-authorship analysis with a minimum number of documents of 5 obtained from 2680 authors, there are five who meet the limit of having total link strength, namely Siti Fatimah, Maimunah, Sri Rahayu, Sutama, and Hayuni Retno Widarti (see Figure 6). Based on the visualization results of Vosviewer in Figure 6, there is no joint authorship among the five authors. The result of Figure 6 means that research collaboration related to HOTS topics is still open. Overall, this research has limitations, namely the period from 2018 to 2023; there are still 25 days that will take place in 2023. In addition, this research is limited to HOTS topics. Therefore, research on optimizing the use of PoP is still open and needed to determine the weaknesses and advantages of preferences in PoP. Nevertheless, the results of this study provide a new perspective related to HOTS research.

CONCLUSION

Based on the results, we can conclude four clusters of HOTS: ability, student, effect, and category. The top authors cited in Scopus are Hadi et al., Hobri et al. in GS, and Ichsan et al. in Crossref. HOTS needs to be researched more from various perspectives and methods. We recommend that future HOTS research be linked to real life to bridge the quite abstract concept of HOTS.

REFERENCES

- Anderson, Lorin W., David Krathwohl, Peter Airasian, Kathleen A. Cruikshank, Richard E. Mayer, Paul Pintrich, James Rath, and Merlin C. Wittrock. 2005. "Review Reviewed Work(s): A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives Complete Edition A Revision of Bloom's Taxonomy of Educational Objectives Complete Edition." Source: Educational Horizons 83(3):154–59.
- Deda, Yohanis Ndapa, Hermina Disnawati, and Otaget Daniel. 2023. "Research Trends on Lesson Study Based on Google Scholar and Scopus Database: A Bibliometric Analysis." 35(1):54–75. doi: 10.23917/varidika.v1i1.22663.
- Deda, Yohanis Ndapa, Astry Hepriana Ratu, Stanislaus Amsikan, and Oktovianus Mamoh. 2020. "Analisis Kemampuan Siswa Dalam Menyelesaikan Soal Ujian Nasional Matematika SMP/MTs Berdasarkan Perspektif Higher Order Thinking Skills (HOTS)." JUPITEK: Jurnal Pendidikan Matematika 3(1):1–6. doi 10.30598/jupitekvol3iss1pp1-6.
- Diena, Indah Annisa, Insih Wilujeng, and Prisca Arzita Perdana. 2023. "Science Learning Based on Higher Order Thinking Skill and Its Supporting Components." Jurnal Penelitian Pendidikan IPA 9(9):681–86. doi: 10.29303/jppipa.v9i9.4169.
- Donthu, Naveen, Satish Kumar, Debmalya Mukherjee, Nitesh Pandey, and Weng Marc Lim. 2021. "How to Conduct a Bibliometric Analysis: An Overview and Guidelines." Journal of Business Research 133:285–96. doi: 10.1016/j.jbusres.2021.04.070.
- Ellegaard, Ole, and Johan A. Wallin. 2015. "The Bibliometric Analysis of Scholarly Production: How Great Is the Impact?" Scientometrics 105(3):1809–31. doi: 10.1007/s11192-015-1645-z.
- Febriyani, Rezita Ayu, Wisma Yunita, and Indah Damayanti. 2020. "An Analysis on Higher Order Thinking Skill (HOTS) in Compulsory English Textbook for the Twelfth Grade of Indonesian Senior High Schools." Journal of English Education and Teaching 4(2). doi: 10.33369/jeet.4.2.170-183.

- Feriyanto, F., and R. O. E. Putri. 2020. "Developing Mathematics Module Based on Literacy and Higher Order Thinking Skills (HOTS) Questions to Train Critical Thinking Ability of High School Students in Mojokerto." in *Journal of Physics: Conference Series*. Vol. 1594.
- Firdaus, Ivan Rivan, Mona Fiametta Febrianty, Patriana Nurmansyah Awwaludin, Marisa Noviyanti Fajrah Ilsa, Yudi Nurcahya, and Kuston Sultoni. 2022. "Nutritional Research Mapping for Endurance Sports: A Bibliometric Analysis." 2(78):2022.
- Hadi, Samsul, Heri Retnawati, Sudji Munadi, Ezi Apino, and Nidya F. Wulandari. 2018. "The Difficulties of High School Students in Solving Higher-Order Thinking Skills Problems." *Problems of Education in the 21st Century* 76(4). doi 10.33225/pec/18.76.520.
- He, Xiangjun, Charanjit Kaur Swaran Singh, and Nader Ale Ebrahim. 2022. "Quantitative and Qualitative Analysis of Higher-Order Thinking Skills in Blended Learning." *Perspektiv Nauki I Obrazovanja* 59(5):397–414. doi: 10.32744/pse.2022.5.23.
- Hobri, Ice Septiawati, and Antonius Cahya Prihandoko. 2018. "High-Order Thinking Skill in Contextual Teaching and Learning of Mathematics Based on Lesson Study for Learning Community." *International Journal of Engineering and Technology (UAE)* 7(3). doi: 10.14419/ijet.v7i3.12110.
- Hwang, Gwo Jen, Chiu Lin Lai, Jyh Chong Liang, Hui Chun Chu, and Chin Chung Tsai. 2018. "A Long-Term Experiment to Investigate the Relationships between High School Students' Perceptions of Mobile Learning and Peer Interaction and Higher-Order Thinking Tendencies." *Educational Technology Research and Development* 66(1). doi: 10.1007/s11423-017-9540-3.
- Ichsan, Ilmi Zajuli, Diana Vivanti Sigit, Mieke Miarsyah, Ahmad Ali, Wiwin Pramita Arif, and Trio Ageng Prayitno. 2019. "HOTS-AEP: Higher Order Thinking Skills from Elementary to Master Students in Environmental Learning." *European Journal of Educational Research* 8(4). doi: 10.12973/eu-jer.8.4.935.
- Kiduk, Yang, and Lokman I. Meho. 2006. "Citation Analysis: A Comparison of Google Scholar, Scopus, and Web of Science." *Proceedings of the ASIST Annual Meeting* 43. doi: 10.1002/meet.14504301185.
- Lim, Weng Marc, Satish Kumar, and Faizan Ali. 2022. "Advancing Knowledge through Literature Reviews: 'what,' 'why,' and 'how to Contribute.'" *Service Industries Journal* 42(7-8):481–513. doi: 10.1080/02642069.2022.2047941.
- Martín-Martín, Alberto, Mike Thelwall, Enrique Orduna-Malea, and Emilio Delgado López-Cózar. 2021. "Google Scholar, Microsoft Academic, Scopus, Dimensions, Web of Science, and OpenCitations' COCI: A Multidisciplinary Comparison of Coverage via Citations." *Scientometrics* 126(1). doi: 10.1007/s11192-020-03690-4.
- Moresi, Eduardo Amadeu Dutra, Isabel Pinho, and António Pedro Costa. 2021. "Bibliometric Analysis: A Quantitative and Qualitative Approach." *Proceedings of the 18th CONTECSI International Conference on Information Systems and Technology Management* 1. doi: 10.5748/18contecsi/pse/lis/6736.
- Pratama, G. S., and H. Retnawati. 2018. "Urgency of Higher Order Thinking Skills (HOTS) Content Analysis in Mathematics Textbook." in *Journal of Physics: Conference Series*. Vol. 1097.
- Suprpto, Nadi, Sukarmin Sukarmin, Rinie Pratiwi Puspitawati, Erman Erman, Dian Savitri, Chih Hsiung Ku, and Husni Mubarak. 2021. "Research Trend on TPACK through Bibliometric Analysis (2015-2019)." *International Journal of Evaluation and Research in Education* 10(4):1375–85. doi: 10.11591/IJERE.V10I4.22062.
- Susilowati, Yayuk, and Sumaji Sumaji. 2021. "Interseksi Berpikir Kritis Dengan High Order Thinking Skill (HOTS) Berdasarkan Taksonomi Bloom." *JURNAL SILOGISME: Kajian Ilmu Matematika Dan Pembelajarannya* 5(2). doi: 10.24269/silogisme.v5i2.2850.
- Sutama, Harun Joko Prayitno, Sabar Narimo, Naufal Ishartono, and Diana Purwita Sari. 2021. "The Development of Student Worksheets Based on Higher Order Thinking Skill for Mathematics Learning in Junior High School." in *Journal of Physics: Conference Series*—vol. 1776.
- Van Eck, Nees Jan, and Ludo Waltman. 2022. "Manual for VOSviewer Version 1.6.18." Leiden: Univeriteit Leiden (January).

