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How Bibliometric Analysis Using VOSviewer Based on Artificial Intelligence Data (using ResearchRabbit Data): Explore Research Trends in Hydrology Content

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ABSTRACT

The purpose of this study was to analyze and map research in hydrology content. We reviewed 45 articles related to hydrology content published from 2014 to 2024. There are several previous literature review studies analyzing hydrology in engineering. However, we have not found any studies that investigate the projects, topics covered, and benefits of implementing hydrological processes in science education. The research method used was a systematic and bibliometric literature review using VoSviewer with ResearchRabbit database. This study analyzed content characteristics based on publication year, publication type, country of implementation, research approach, education stage, and hydrology content. The findings show that VoSviewer with ResearchRabbit database can be used as a research mapping baseline. In addition, the authors found that hydrological content varies according to the topic discussed, but very few found hydrological studies in the social field, especially education. The benefits of implementing educational hydrology in science education include cognitive benefits, procedural benefits (skills), attitudinal benefits, or a combination of the three benefits.

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1. INTRODUCTION

Bibliometrics is a field of study that analyzes research activities and scientific publications with a quantitative approach. This method collects data from publications such as scientific journals, articles, and citations, and then analyzes the data to find relevant patterns (Nandiyanto *et al*. 2024; Buele 2021; Nandiyanto *et al*. 2021). Bibliometric analysis, for example, can be used to find out how often an article is cited by other researchers (which indicates its impact or relevance) or to identify trends in a research topic over time (Chen *et al*. 2023; Hsieh & Yeh 2023; Sepúlveda-Oviedo *et al*. 2023). In addition, bibliometric data can be used to compare the performance of researchers, institutions, or countries in a particular field of science. Researchers and funding agencies can use this information to make better decisions about resource allocation, find potential collaborators, and understand the dynamics of research in different disciplines. Research on bibliometrics has been well-known (see **Figure 1**), increasing every year. Examples of research in bibliometric are shown in **Table 1**.

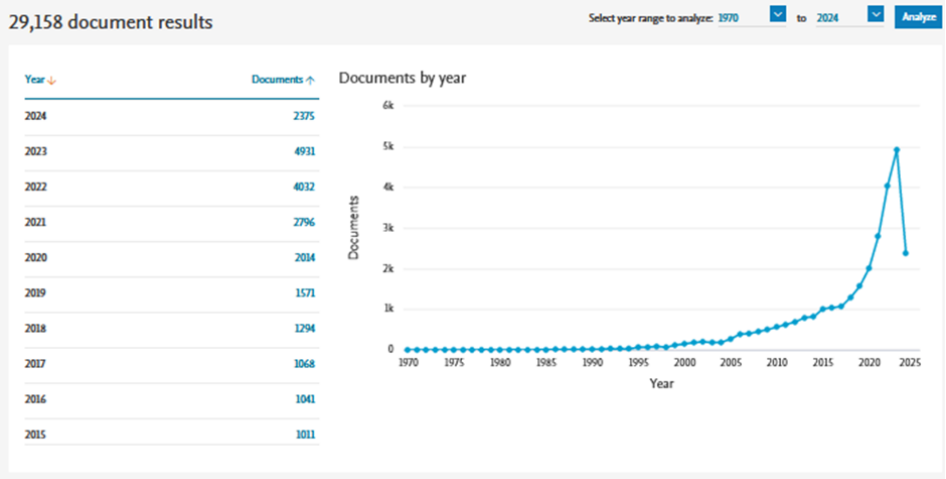

Figure 1. Publication in Scopus database, taken on June 2024, using keyword bibliometric.

Detailed information on how to use the data is explained elsewhere (Azizah *et al*., 2021; Al Husaeni & Nandiyanto, 2022).

Table 1. Previous studies on bibliometric analysis (published in 2023-2024).

No	Title	Reference
1	Sustainable Production-inventory model with multi-material, quality degradation, and probabilistic demand: From bibliometric analysis to a robust model	Utama *et al.* (2023)
2	Phytochemical profile and biological activities of ethylacetate extract of peanut (Arachis hypogaea L.) stems: In-vitro and in-silico studies with bibliometric analysis	Sahidin *et al.* (2023)
3	Biomass-based supercapacitors electrodes for electrical energy storage systems activated using chemical activation method: A literature review and bibliometric analysis.	Hamidah *et al.* (2023)
4	Antiangiogenesis activity of Indonesian local black garlic (Allium Sativum 'Solo): Experiments and bibliometric analysis.	Arianingrum *et al.* (2023)
5	Characteristics of tamarind seed biochar at different pyrolysis temperatures as waste management strategy: experiments and bibliometric analysis.	Rahmat *et al.* (2023)
6	The compleat lextutor application tool for academic and technological lexical learning: Review and bibliometric approach.	Abduh *et al.* (2023)

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Table 1 (continue). Previous studies on bibliometric analysis (published in 2023-2024).

No	Title	Reference
7	How eyes and brain see color: Definition of color, literature review with bibliometric analysis, and inquiry learning strategy for teaching color changes to student with mild intelligence barriers.	Juhanaini *et al.* (2023)
8	Corncob-derived sulfonated magnetic solid catalyst synthesis as heterogeneous catalyst in the esterification of waste cooking oil and bibliometric analysis.	Mardina *et al.* (2024)
9	Prototype of greenhouse effect for improving problem-solving skills in science, technology, engineering, and mathematics (STEM)-education for sustainable development (ESD): Literature review, bibliometric, and experiment.	Solihah *et al.* (2024)
10	Spatial visualization ability assessment for analyzing differences and exploring influencing factors: Literature review with bibliometrics and experiment	Yang *et al.* (2024)
11	Augmented reality for cultivating computational thinking skills in mathematics completed with literature review, bibliometrics, and experiments for students	Angraini *et al.* (2024)
12	Low-carbon food consumption for solving climate change mitigation: Literature review with bibliometric and simple calculation application for cultivating sustainability consciousness in facing sustainable development goals (SDGs)	Nurramadhani *et al*. (2024)
13	Neuroscience intervention for implementing digital transformation and organizational health completed with literature review, bibliometrics, and experiments.	Imaniyati *et al.* (2024)
14	Phylogenetic analysis of Bengkulu citrus based on DNA sequencing enhanced chemistry students' system thinking skills: Literature review with bibliometrics and experiments.	Amida *et al.* (2024)
15	The ship's propeller rotation threshold for coral reef ecosystems based on sediment rate indicators: Literature review with bibliometric analysis and experiments.	Kadir *et al.* (2024)
16	Empowering engineering female students to improve retention and progression: A program evaluation study completed with bibliometric analysis.	Shafiq (2023)
17	Bibliometric analysis of nano metal-organic frameworks synthesis research in medical science using VOSviewer.	Shidiq (2023)
18	Research trends from the scopus database using keyword water hyacinth and ecosystem: A bibliometric literature review.	Nandiyanto *et al*. (2024)
19	Use of blockchain technology for the exchange and secure transmission of medical images in the cloud: Systematic review with bibliometric analysis.	Lizama *et al.* (2024)
20	Chatbot artificial intelligence as educational tools in science and engineering education: A literature review and bibliometric mapping analysis with its advantages and disadvantages.	Al Husaeni *et al*. (2024a)
21	How can technology change educational research? Definition, factors for improving quality of education and computational bibliometric analysis.	Al Husaeni *et al*. (2024b)
22	Effects of sustained deficit irrigation on vegetative growth and yield of plum trees under the semi-arid conditions: Experiments and review with bibliometric analysis.	Laita *et al.* (2024)
23	Bibliometric analysis of high school keyword using VOSviewer indexed by google scholar	Al Husaeni and Nandiyanto (2023)
24	The use of mobile learning in schools as a learning media: Bibliometric analysis	Zafrullah and Ramadhani (2024)
25	Bibliometric analysis using VOSviewer with Publish or Perish of role-play in the teaching and learning.	Kongsaenkham and Chano (2024)

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Table 1 (continue). Previous studies on bibliometric analysis (published in 2023-2024).

No	Title	Reference
26	Global research trends of mathematics literacy in elementary school: A bibliometric analysis.	Farokhah *et al.* (2024)
27	Literature review and bibliometric mapping analysis: Philosophy of science and technology education	Al Husaeni and Munir (2023)
28	Strengthening the role of local community in developing countries through community-based tourism from education perspective: Bibliometric analysis.	Pramanik and Rahmanita (2023)
29	Trends and networks in education for sustainable development (ESD): A bibliometric analysis using vosviewer.	Rasuman *et al.* (2024)
30	Bibliometric analysis using VOSviewer with Publish or Perish of curriculum evaluation using the CIPP model.	Tungtawee and Chano (2024)
31	Bibliometric computational mapping analysis of trend metaverse in education using vosviewer.	Muktiarni *et al.* (2023)
32	Introducing ASEAN Journal for Science and Engineering in Materials: Bibliometric Analysis.	Nandiyanto *et al.* (2024)
33	Introducing ASEAN Journal of Science and Engineering: A bibliometric analysis study	Nandiyanto *et al.* (2023a)
34	Social impact and internationalization of "Indonesian Journal of Science and Technology	Nandiyanto *et al.* (2023b)
35	Is universitas pendidikan indonesia ready for internationalization? A bibliometric analysis in the science and technology-related publications	Nandiyanto *et al.* (2023c)
36	Concept of Computational Fluid Dynamics Design and Analysis Tool for Food Industry: A Bibliometric	Muktiarni *et al.* (2024)
37	Concept of Computational Fluid Dynamics and Its Application in Sport Science: Bibliometric Analysis of Modelling Thermal Comfort in Sport Hall	Rachmat *et al.* (2024)
38	Involving particle technology in computational fluid dynamics research: A bibliometric analysis.	Nandiyanto *et al.* (2023d)

Artificial intelligence (AI) technologies help teachers and students solve problems and improve learning outcomes. By providing a comprehensive overview of AI in teaching mathematics to students at all levels of education, this review aims to add to the discussion (Chen *et al*., 2020; Guan *et al*., 2020; Knox & Knox, 2020; Yang *et al*., 2020). Systematic literature reviews (SLRs) are conducted using established and robust guidelines. We kept up with the most preferred reporting items for systematic reviews and meta-analyses. We found more than 20 studies on artificial intelligence published in ScienceDirect (Buele, 2021), Scopus, Springer Link, ProQuest, & EBSCO Host between 2017 and 2019 (Cruz-Benito *et al*., 2019; Duan *et al*., 2019; Zawacki-Richter *et al*., 2019). The SLR results show that the research sample uses artificial intelligence in mathematics education, robotics, systems, tools, teachable agents, autonomous agents, and a comprehensive approach, all components that can be used in this approach (Buele, 2021).

Advances in AI have opened up many new opportunities in many fields of science, including hydrological research (Chang *et al*., 2023; Volpi *et al*., 2023). With advanced analysis and processing capabilities, artificial intelligence is now an essential tool for processing and analyzing vast and complex data (Vinuesa *et al*., 2020). This article provides a step-by-step guide to conducting an effective AI-based systematic review and producing an in-depth and accurate analysis. Researchers can identify, evaluate, and synthesize hydrological research data more systematically and organized with the help of artificial intelligence. This article will show how AI can improve understanding of hydrological phenomena and assist in evidence-

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based decision-making using practical examples in hydrological research. This discussion will provide valuable information for researchers, practitioners, and policymakers involved in hydrological research. It will also offer a new perspective on using artificial intelligence in scientific research.

Given AI's ability to handle large volumes of data with high speed and accuracy, a systematic review process based on AI enables more in-depth hydrological research (Ala-aho *et al*., 2015; Kirchner, 2016; Muñoz-Carpena *et al*., 2023). The step-by-step process includes thorough data collection, study selection and quality assessment, data extraction, and meta-analysis (Iamtrakul *et al*., 2023). Artificial intelligence can help identify trends, patterns, and relationships in the literature that may have previously gone undetected (Zawacki-Richter *et al*., 2019). AI speeds up the review process and increases the likelihood of gaining new and relevant knowledge.

This analysis is very important for hydrology because water systems are complex and constantly change (Chang *et al*., 2023). This article will provide practical examples of how AI can predict floods, manage water resources, and understand the impacts of climate change on hydrological systems. By blending theory and practice, this article aims to give readers a better understanding of the capabilities and limitations of AI in hydrological research and introduce creative methods to face future challenges in water resources management.

Hydrology education can be improved by incorporating case studies and projects that use artificial intelligence, helping students understand the dynamics and complexity of their environment (Chang *et al*., 2023). Thus, using AI in hydrological research enhances its technical and analytical aspects, broadens the learning horizon, and provides a more interactive and multidisciplinary experience. Furthermore, this article will discuss the use of AI in the learning process, especially in terms of hydrological research. AI enables the development of learning methods to meet specific research needs and provide a better understanding of hydrological data and how it interacts with its environmental factors (Vano *et al*., 2015). In this study, ResearchRabbit was used.

ResearchRabbit plays a role in scientific mapping, especially with Vosviewer, processing and analyzing complex data to produce informative and intuitive visualizations (Holmes *et al*., 2019). Vosviewer is often used for citation analysis and scientific collaboration, where ResearchRabbit can help discover essential patterns, trends, and relationships in the scientific literature (Cole & Boutet, 2023; Sharma *et al*., 2022). With accurate and structured data input, AI allows Vosviewer to be used as a scientific mapping and learning tool (Cruz-Benito *et al*., 2019; Duan *et al*., 2019; Hwang *et al*., 2020). Therefore, conducting a literature review that discusses hydrology is very important. The results of this study are expected to be helpful as a reference for all stakeholders involved in science education, especially teachers, lecturers, and researchers in the future. They also hope the engineering design process can be used as an alternative learning method. The study aimed to examine 45 articles published from 2014 to 2024 relating to engineering design in science education. Three research questions were used to guide this research process: 1). What are the results of mapping hydrology research using Vosviewer with data from ResearchRabbit? 2). What is the distribution of research in hydrology? and 3). How is the distribution of research based on content characteristics? The research method used in this study was a systematic literature review. We selected 45 articles from reputable journals published from 2014 to 2024.

2. LITERATURE REVIEW

Artificial Intelligence (AI) has become the centerpiece of research and article writing in a wide range of fields, paving the way for deeper innovation and a deeper understanding of the

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complexity of the problems humans face. In article writing, AI is used to analyze big data, identify patterns invisible to the human eye, and generate valuable insights (Basso *et al*. 2015; Böttcher *et al*. 1990; Chang *et al*., 2023; Muñoz-Carpena *et al*., 2023). In research, AI plays a role in finding solutions to complex problems that humans face. AI has helped researchers explore and uncover the secrets of the universe because it can speed up the analysis process and make accurate predictions (Abramo & D'Angelo 2018; Chen *et al*. 2022; Hidayat *et al*. 2022).

Artificial Intelligence (AI) has become the basis for writing articles and research. It also helps us understand various disciplines. For example, in the field of data journalism, AI is often used to process and analyze big data, look for patterns that are invisible to humans, and generate valuable insights (Arici *et al*. 2019; Bywater *et al*. 2019; Chan *et al*. 2019; Hughes-Roberts *et al*. 2019; Karmani *et al*. 2018; Ninaus *et al*. 2019; Tran *et al*. 2019; Zawacki-Richter *et al*. 2018; Pliakos *et al*. 2019). In article writing, AI is used to collect and analyze data from various sources, helping journalists find patterns, trends, and interesting stories that humans might miss (Chen, *et al*. 2020; Han, 2018; Martinez *et al*. 2020). Instead, artificial intelligence is vital to research in finding solutions to complex problems. For example, doctors can use AI to diagnose diseases more accurately by looking at medical images and patient health data (Chen *et al*. 2019; Hidayat *et al*. 2022; Tran *et al*. 2019). In addition, scientists are also researching artificial intelligence. They are looking for ways to improve, control, and better use AI (Chounta *et al*. 2021; Sakulkueakulsuk *et al*. 2018). Researchers and authors are leveraging AI to speed up the analysis process, optimize system performance, and make accurate predictions.

Artificial intelligence (AI) has become a very useful tool for article writing as it simplifies the process of collecting, analyzing, and interpreting data (Arden *et al.,* 2018; Hien *et al.,* 2018; Hwang *et al.,* 2020; Roll *et al.,* 2016). For example, in data journalism, AI can be used to identify relevant trends or patterns and compile current and informative news reports by collecting data from various sources, such as websites and social media. In addition, AI can also be used to automatically generate news content, such as news summaries or weather reports based on available data (Chen *et al.,* 2020; Chounta *et al.*, 2021; Hwang *et al.,* 2020; Yang *et al.,* 2020). Conversely, AI can be used in academia to help authors analyze and compile literature relevant to their research topic (Chen, Zou, *et al.,* 2020; Humble *et al.,* 2019). With advanced search algorithms, AI can help researchers find papers, journals, and other references that may be relevant to their research topic.

In the research domain, AI is also crucial for exploring and solving complex problems in various fields of science. For example, in medicine, AI can be used to analyze medical data, such as MRI or CT scan images, so that doctors can diagnose diseases more accurately and quickly (Beam *et al.,* 2023; Lee *et al.,* 2015; Rajpurkar *et al.,* 2022; Tosato *et al.,* 1988; Yu *et al.,* 2018). In addition, AI can also identify genetic or biomolecular patterns associated with certain diseases, which helps researchers create better drugs or new therapies (Barnes & Barnes 2008; Huser *et al.,* 2011). AI can be used in environmental and natural science fields to model and forecast complex phenomena such as climate change or ecosystems using observational data and computer simulations (McFarquhar *et al.,* 2008; Wishart *et al.,* 2008). As such, AI provides scientists with powerful tools to understand the dynamics of nature and predict the impact of such changes.

AI is not just an analysis and prediction tool; it is also a fascinating subject of research. Scientists are constantly developing and testing various new AI models and algorithms to improve the performance and intelligence of AI systems (Lin *et al.,* 2013; Plevy *et al.,* 2013). Their research includes improved machine learning techniques, better natural language

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processing, and the exploration of new fields such as quantum computing to enhance the intelligence and performance of artificial intelligence. Overall, AI has been a major driver of innovation in article writing and research, paving the way for discoveries, and providing a deeper understanding of the complexity of our world (Han, 2018; Lai, 2020; Zovko *et al.,* 2019). This is due to AI's ability to process data quickly, identify hidden patterns, and make accurate predictions. AI continues to change the way we think and interact with our world.

Artificial intelligence (AI) has become the basis for many creative and analytical processes in the world of article writing and research. AI can be used to analyze data from various sources, such as sensors, databases, or surveys, and find patterns or relationships in data that is larger and more complex than ever before (Arden *et al.,* 2018; Chen *et al.,* 2018; Peters, 2021; Zawacki-Richter *et al.,* 2018). For example, AI can be used to automatically generate article content, such as news summaries or data analysis, which improves the efficiency of content production at scale (Hughes-Roberts *et al.,* 2019; Zhao *et al.,* 2018). AI can also help researchers analyze behavioral patterns or preferences based on data from social media or other online platforms, allowing them to study ongoing social trends and dynamics.

In the field of research, artificial intelligence has changed the way we study and understand various scientific topics. AI allows researchers to process and analyze large amounts of data quickly and efficiently. For example, in the field of molecular biology, AI can be used to analyze genome sequencing or protein structures (Kuo *et al.,* 2018; Zhao *et al.,* 2018). It helps researchers understand the complexity of living organisms and their possible applications for medical or industrial purposes (Jia *et al.,* 2010; Kaproth-Joslin *et al.,* 2015; Panés *et al.,* 2011). In addition, artificial intelligence is also crucial for developing predictive models to understand and forecast complex phenomena such as disease epidemics or climate change (Conan *et al.,* 2003; Fang *et al.,* 2015; Höjer *et al.,* 2015; Kirchner, 2016). Researchers can create models that can analyze historical data and variables to forecast future trends using machine learning and statistical modeling techniques.

AI is not only interesting as an analytical tool; it is also a fascinating subject of research. Scientists continue to develop and test various new AI techniques and algorithms to improve the performance and capabilities of AI systems. For example, research continues to be conducted in machine learning to develop more efficient, robust, and reliable machine learning models for various tasks, such as natural language processing and image recognition (Dixon & Woods *et al.,* 2005; Fang *et al.,* 2015). In addition, researchers study AI in new fields such as quantum computing, where they seek to improve the intelligence and efficiency of AI systems by using quantum principles.

AI has played an important role in improving the efficiency and quality of scientific writing. AI can be used in various stages of writing, from research topic identification to final editing. One of the main contributions of AI in scientific article writing is its ability to help researchers find relevant resources. Using an intelligent search system, AI can sift through thousands of articles and journals to find the most suitable ones for their research subject, saving researchers time and resources.

The data synthesis and analysis stage can also benefit from artificial intelligence. AI can help researchers identify research trends, extract important information from collected resources, and make solid arguments for their scientific work. The use of AI in literature analysis can also help avoid research bias and ensure that the research methodology is fit for purpose (Hsieh & Yeh 2023; Sobb *et al.*, 2023). Finally, artificial intelligence can be used to edit and revise scientific papers with better structure, grammar, and style (Chen *et al.,* 2018; Ivanović *et al.,* 2019; Peters, 2021). Researchers can use AI to get faster and more accurate feedback during the editing process, which helps improve the overall quality of scientific

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articles. In situations like this, using artificial intelligence to write scientific articles is more efficient.

Overall, artificial intelligence has changed the way articles and research are written, opening the door to a new understanding of our world. AI continues to be a key driver of innovation in this field, helping us answer deeper questions about our lives and the universe due to its ability to process data on a massive scale, identify complex patterns, and make accurate predictions.

Artificial Intelligence (AI) has become an important part of many things, such as academic research. Researchrabbit is one such platform that utilizes artificial intelligence in research. It is a research management tool created to help researchers better manage, find, and evaluate scientific literature (Cole & Boutet 2023; Sharma *et al.,* 2022). With the help of AI technology, Researchrabbit can speed up the process of searching and collecting relevant information by referring to the researcher's preferences and interests (Calamante *et al.,* 2015; Van Eck *et al.,* 2014; Sharma *et al.,* 2022).

According to the literature review, Researchrabbit also uses AI to analyze and organize literature. With the platform's ability to analyze and display information from articles and journals that users have collected, users can extract relevant research patterns and trends. By using Researchrabbit's artificial intelligence features, research is not only more efficient but also provides researchers with valuable insights to explore and understand the growing scientific literature.

The use of artificial intelligence on the Researchrabbit platform greatly assists the academic research process. One of the key features of the platform is the ability to provide relevant literature recommendations. The platform can quickly present the most relevant resources by utilizing sophisticated AI algorithms to look at user preferences, search history, and research profiles. This allows researchers to save valuable time searching for literature that suits their needs as well as broaden the scope of their research by finding articles that may not have been found manually.

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By adding AI to the Researchrabbit platform, the journey of academic research becomes much better. The capacity to provide customized literature recommendations is a key feature of the platform. Researchrabbit uses sophisticated AI algorithms to quickly track user preferences, search patterns, and research profiles. This effective method not only allows researchers to save precious time that would otherwise be spent searching for relevant literature but also allows them to discover works that may not have been found in the manual. This article will discuss the process of searching for information related to hydrological content. It will discuss various successful search techniques, relevant resources, and methods to obtain accurate and up-to-date hydrological data.

3. METHODS

3.1. Research Procedure

In conducting this study, there were seven stages of the review process: (1) Defining the research question; (2) Defining the criteria; (3) Developing the review protocol; (4) Selecting;

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(5) Analyzing and interpreting; (6) Producing the article; and (7) Disseminating (Forbes *et al*., 2018; Mengist *et al*., 2020; Pulsiri *et al*., 2018).

3.2 Analysis Tool Preparation

To perform data analysis with VOSViewer, we need to prepare several applications. The first is the mapping tool, accessed through the open-source application VOSViewer (**Figure 2**). In this study, VOSViewer is used as a tool that allows visualization of the data that has been analyzed. The reference manager application is the second tool that must be set up. As shown in **Figure 3**, ResearchRabbit, an AI-based website, is one of the reference websites that can be used. Furthermore, we use Mendeley, as shown in **Figure 4**. Research data is collected through this reference manager application, which will then be analyzed bibliometrically with VOSviewer.

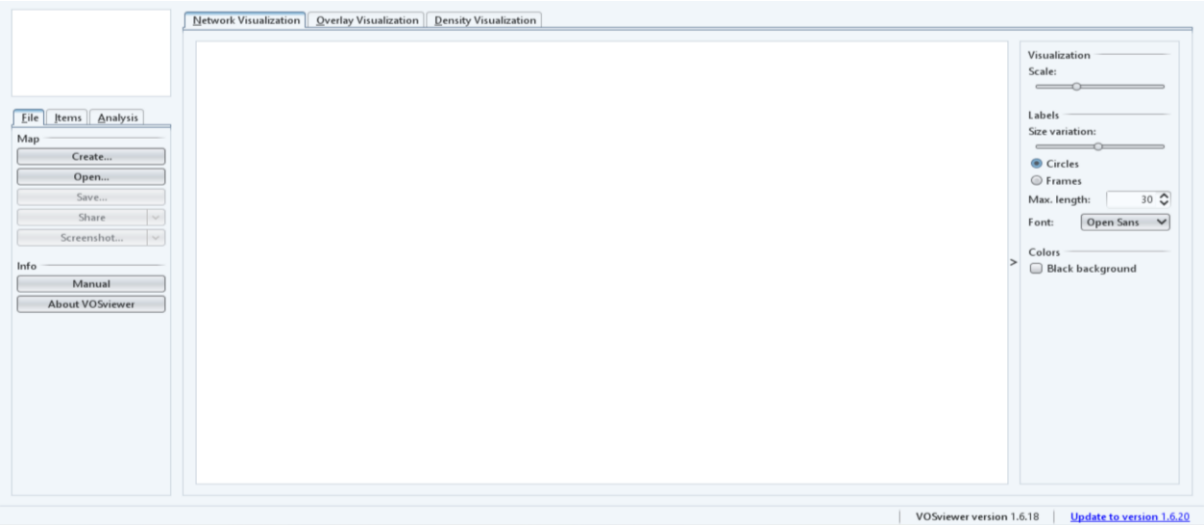

Figure 2. VOSviewer application.

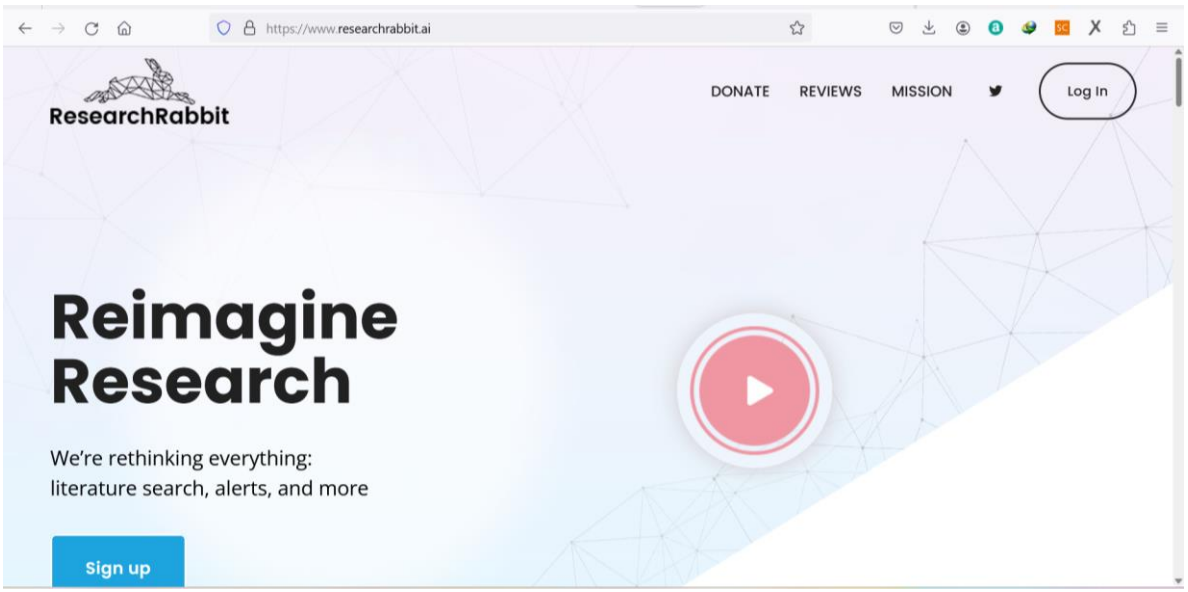

Figure 3. ResearchRabbit Machine

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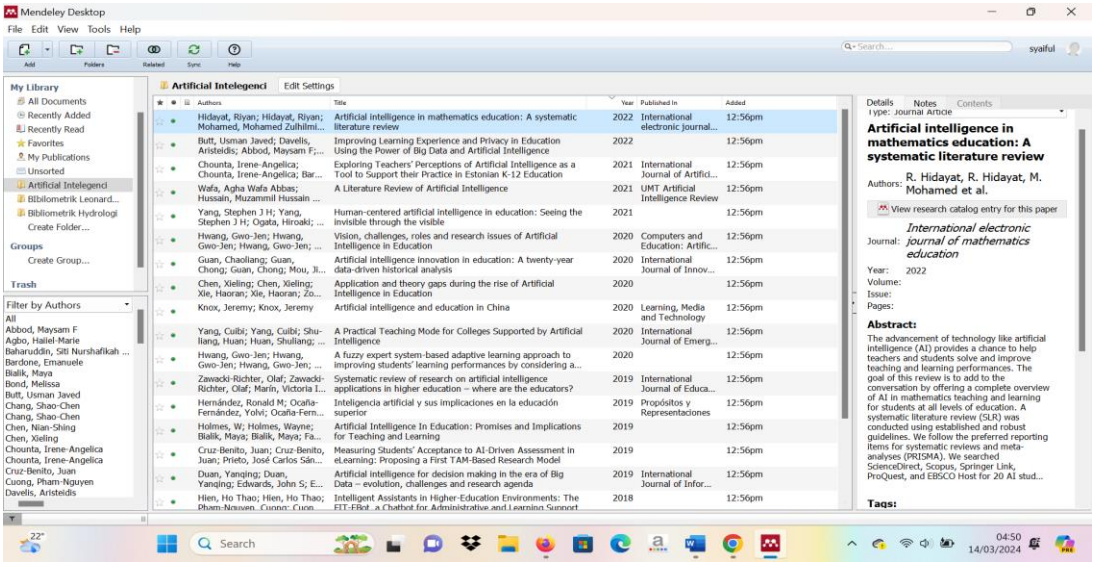

Figure 4. Mendeley Application.

3.3 Data Retrieval

This research utilized global hydrology journal publications. ResearchRabbit is a web reference manager used in this research to conduct a literature review on the chosen theme (Cole & Boutet, 2023). Therefore, databases with similar research themes were obtained. ResearchRabbit collects bibliometric records for each study to be used and knows which authors are the most cited and the oldest and latest year of an article. **Figure 5** shows that ResearchRabbit has provided research data sources that can be automatically integrated into Google Scholar, Google Scholar Profile, PubMed, Microsoft Academic, Scopus, and Web of Science (Cole & Boutet, 2023; Sharma *et al*., 2022).

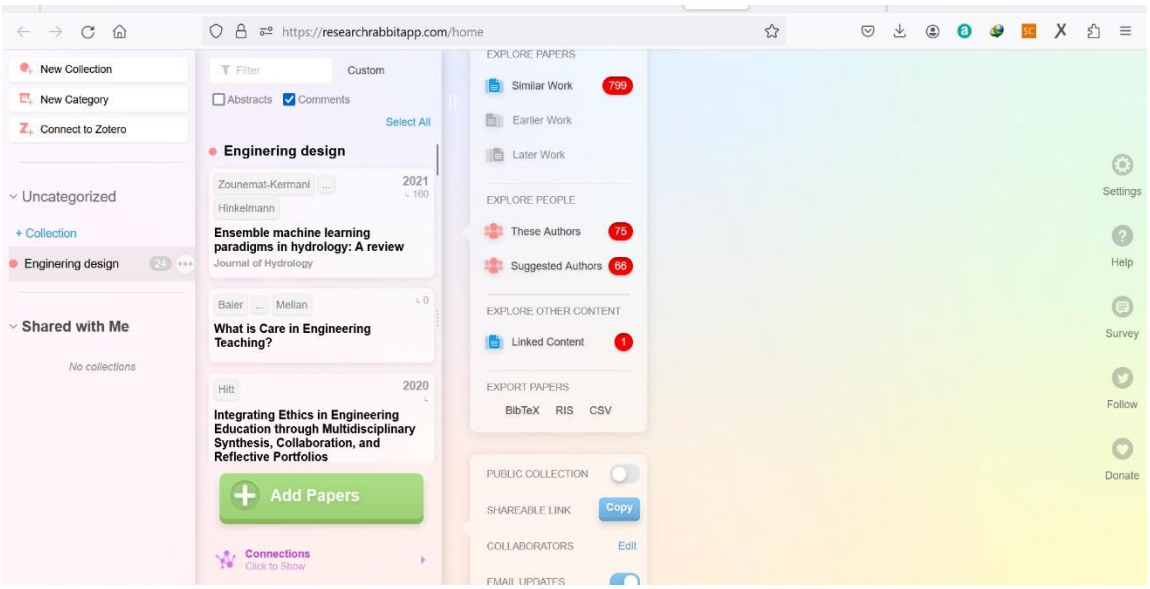

Figure 5. Mapping of data sources on ResearchRabbit.

3.4 Research Data Mapping

The VOSviewer digital mapping application was used for data mapping in this study. The data collected was customized with the desired keywords. After that, the data was entered into VOSviewer and combined into an interconnected data map.

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3.5 Data Analysis Technique

The data collected for this study were analyzed through a descriptive approach. They were classified in tables and figures using the established research structure. Then, the data is thoroughly discussed and connected with previous research. This research focuses on the characteristics of the content, the projects and topics covered, and the relationship of hydrological research.

4. RESULTS AND DISCUSSION

This section discusses how to analyze the results of data mapping using VOSviewer with data on developing the number of journal publications with the selected hydrology theme from 2014-2024.

4.1. Data Used

Data for this study will be retrieved through ResearchRabbit. Each ResearchRabbit article that meets the research search theme will be backed up into a file, which can be used with VOSviewer. The following is the procedure used to obtain the data.

4.1.1. Open web researchrabbit

The first step to getting data through ResearchRabbit is to open the web, as shown in **Figure 6**. Once ResearchRabbit is open, we can see the initial window of the application, as shown in **Figure 7**.

4.1.2. Click Bottom at the new collection

Figure 8 shows the folder name that we use as the title of the article that we will search for in ResearchRabbit. The next step at this stage is to create a folder title, as shown in **Figure 9**.

4.1.3. Click search on ResearchRabbit

As shown in **Figure 10**, there is a section for entering keywords in **Figure 11**. In this research, we searched for the hydrology theme. As shown in **Figure 12**, the publication name contains the title of the hydrology article we selected. Next, as shown in **Figure 13**, the page appears. Next, we select the option to compare the number of articles of similar type to those of other types. We chose similar work with 1889 data options in **Figures 14 and 15**. If we want to download the relationship, then we can choose download, as shown in **Figure 16**.

4.1.4. Search Result

Next, we download the data in BibTeX, RIS, or CSV format, as shown in **Figure 17**. In this section, I chose the RIS format file and saved it to my computer, as shown in **Figure 18**. Once we obtain the data, we can view the generated written work. ResearchRabbit search results will be displayed in graphical form, similar to the VosViewer data processing results display. These graphs allow us to explore the literature more interactively and find better research routes. ResearchRabbit's interactive conceptual map helps us find literature relevant to our research topic and provides a more dynamic perspective.

DOI: https://doi.org/10.17509/ajse.v4i2.71567
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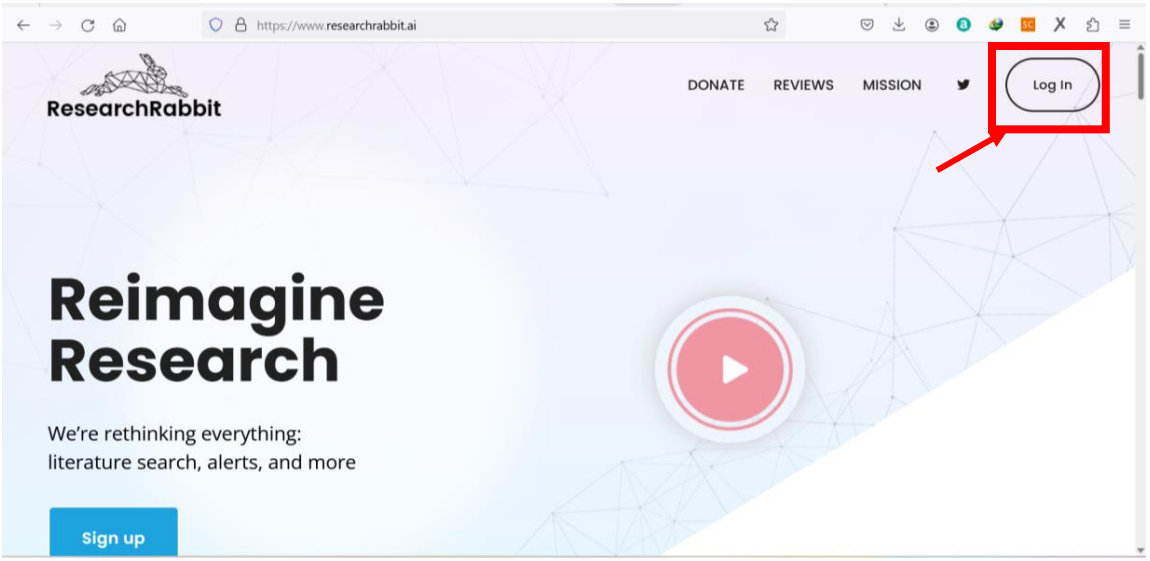

Figure 6. Login to search ResearchRabbit.ai

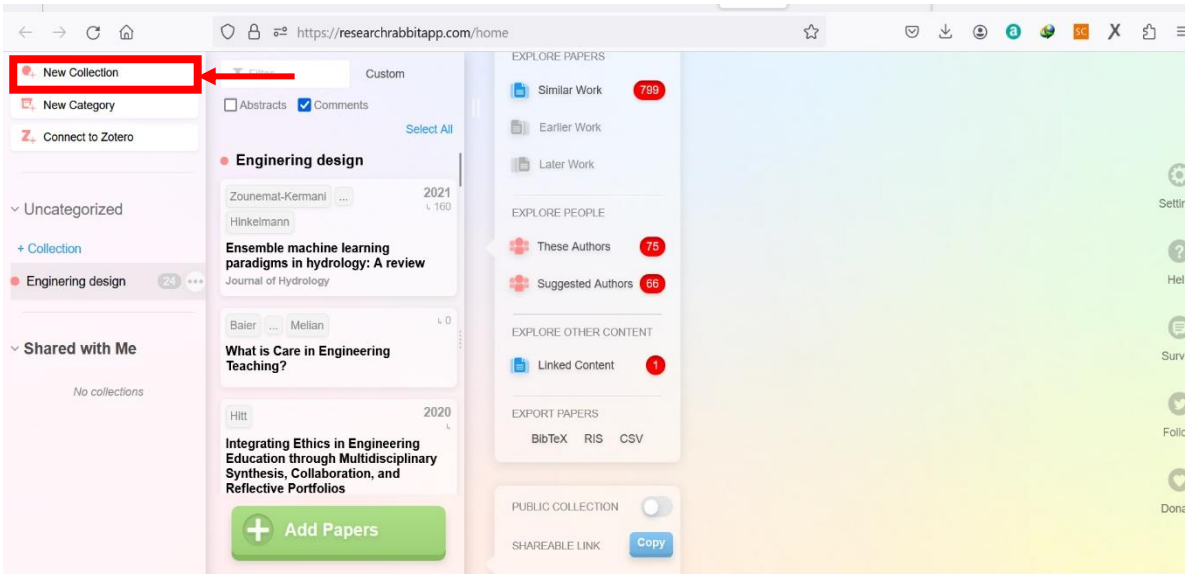

Figure 7. The initial window ResearchRabbit.ai

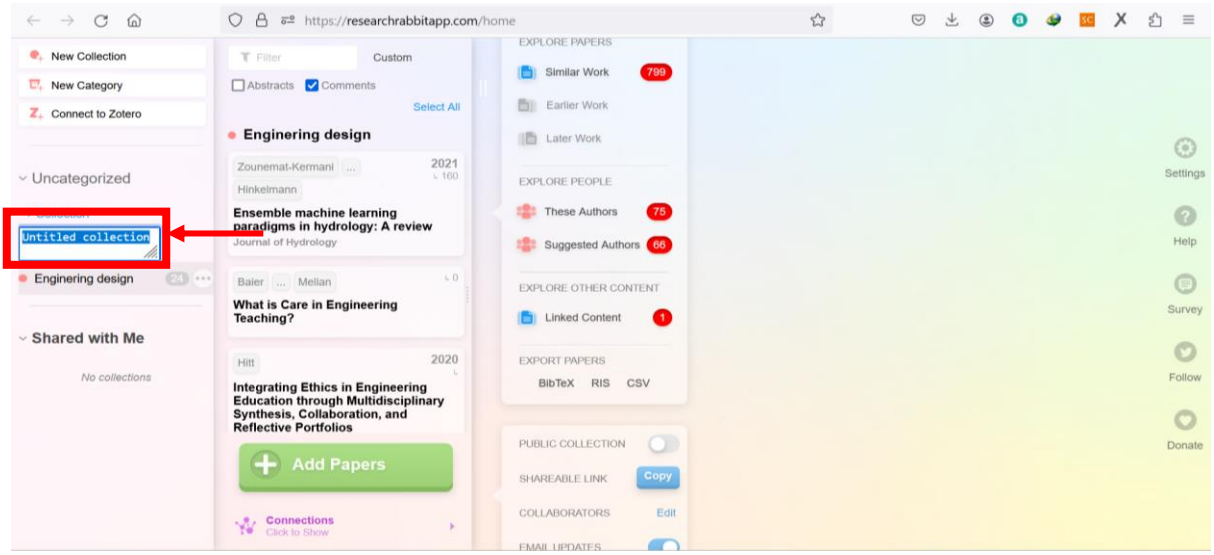

Figure 8. The initial window ResearchRabbit.ai

DOI: https://doi.org/10.17509/ajse.v4i2.71567
p- ISSN 2776-6098 e- ISSN 2776-5938

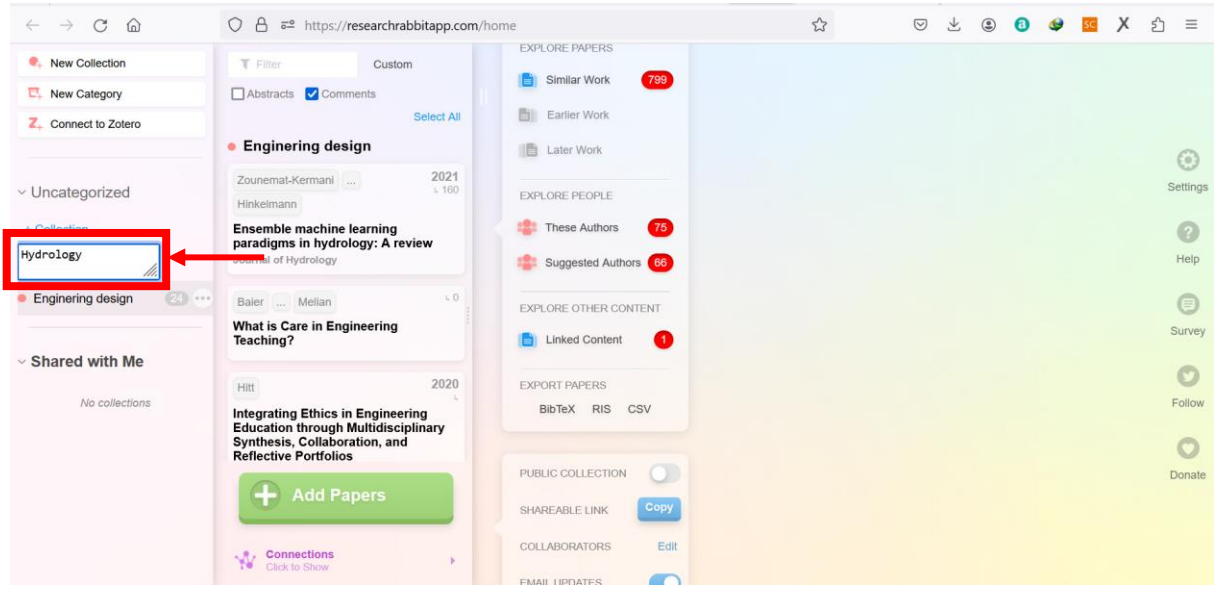

Figure 9. Add Title on data collection.

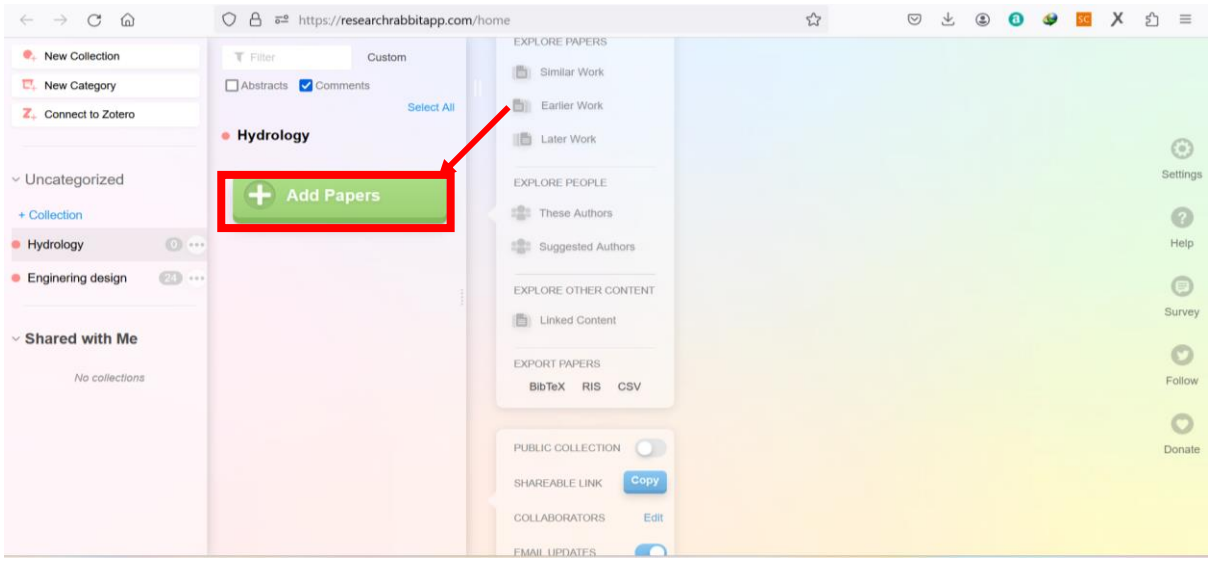

Figure 10. Click Add Paper for the search topic

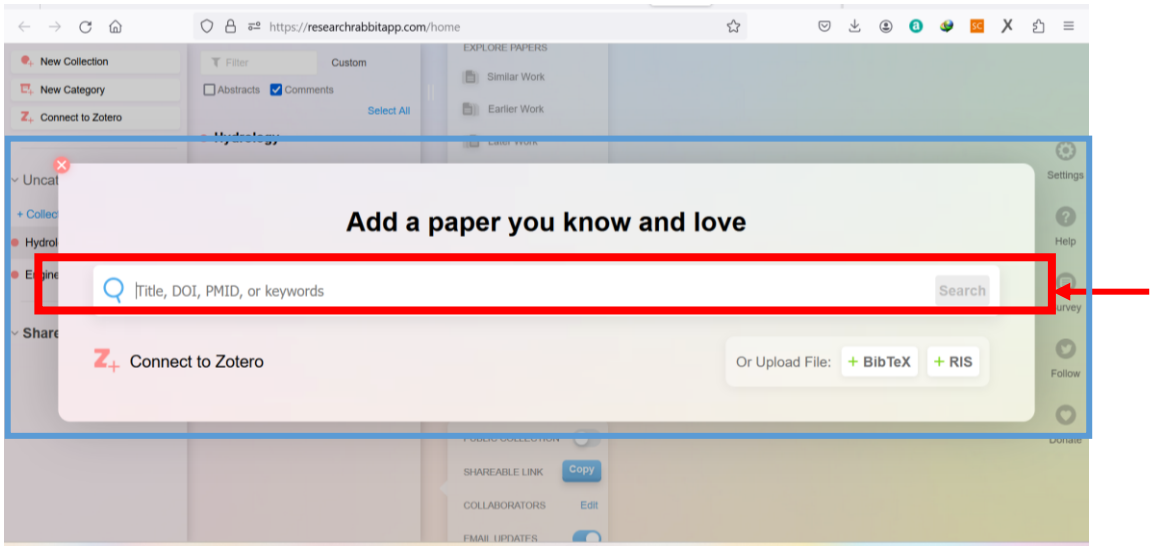

Figure 11. Add a title for the search topic.

DOI: https://doi.org/10.17509/ajse.v4i2.71567
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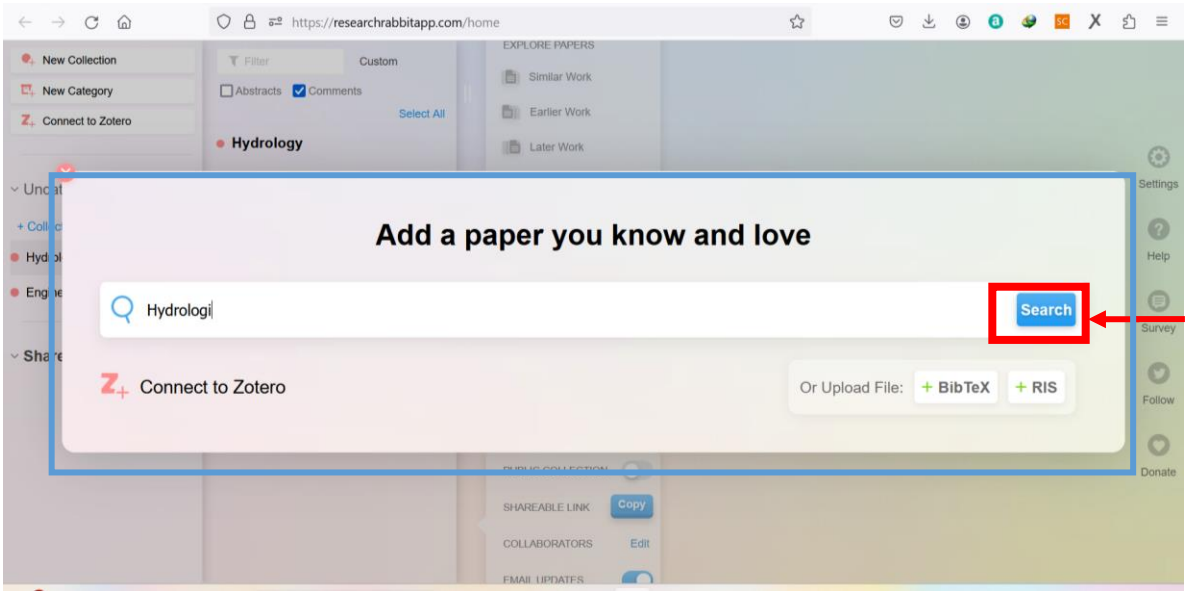

Figure 12. Click Search for the search topic.

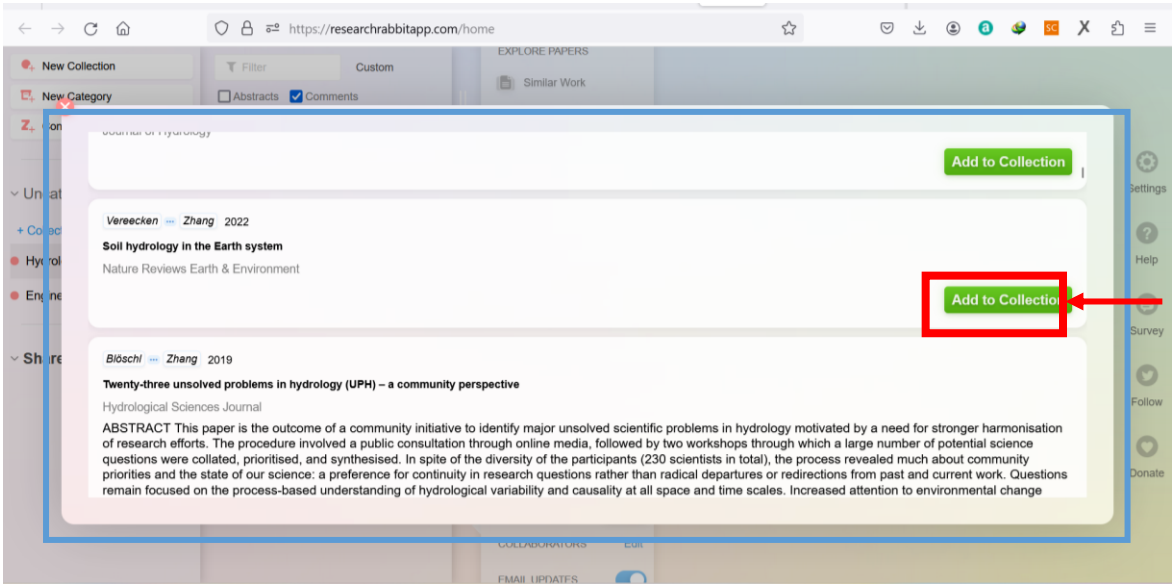

Figure 13. Choose the title article.

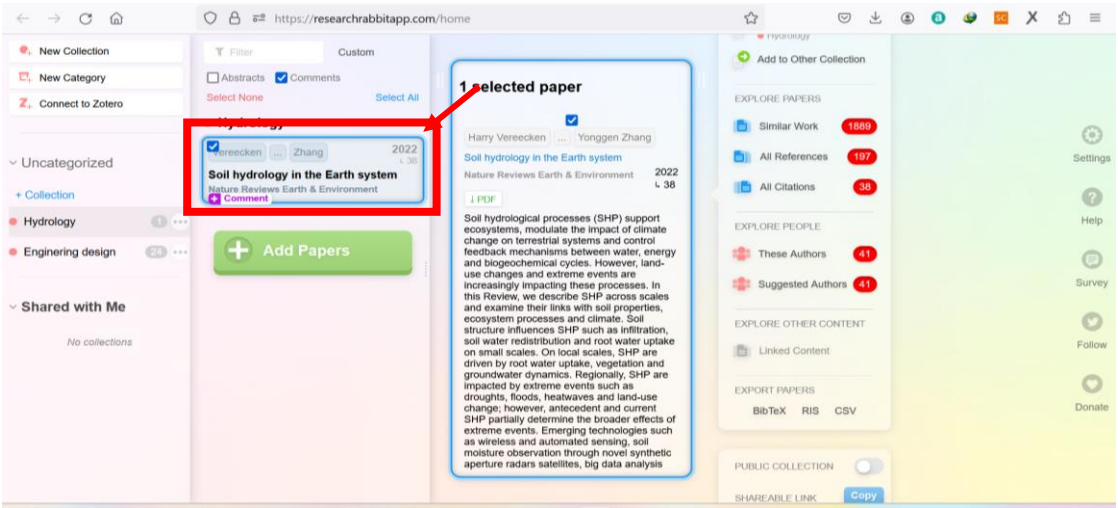

Figure 14. Selected paper to add other collections.

DOI: https://doi.org/10.17509/ajse.v4i2.71567
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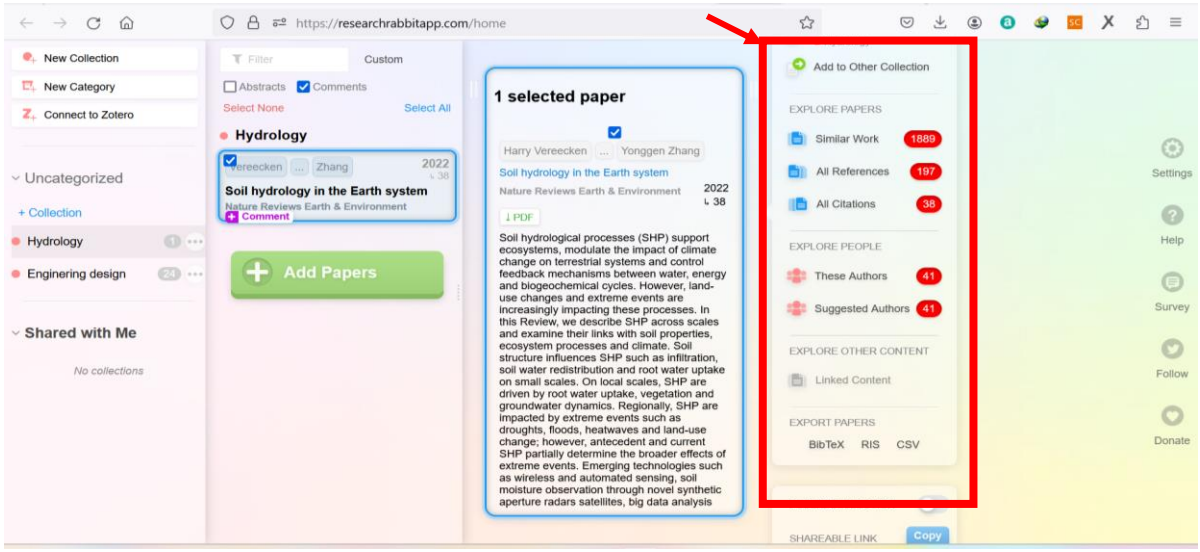

Figure 15. Add to other collections.

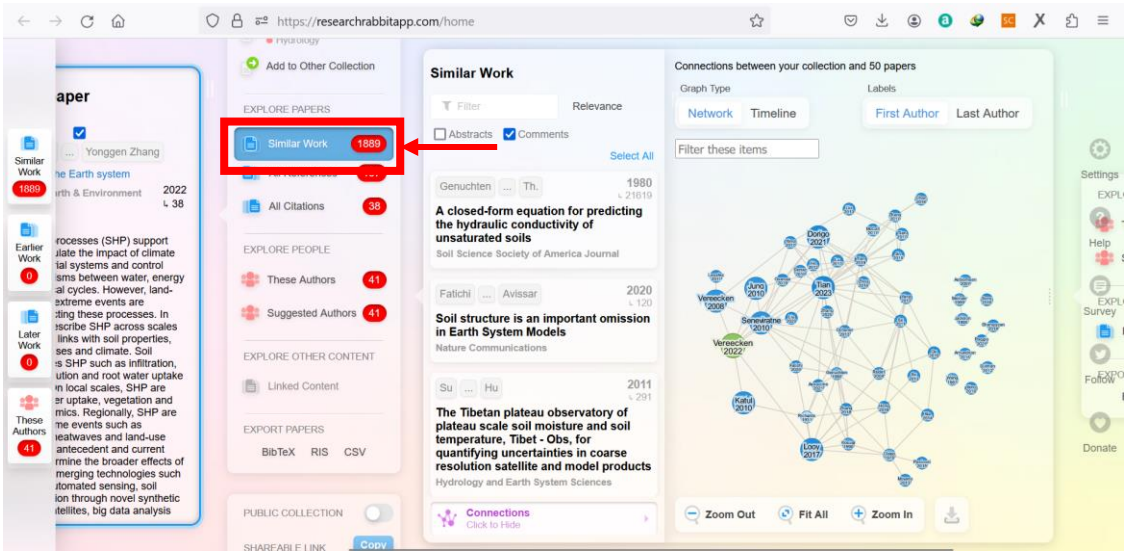

Figure 16. Choose Similar Work.

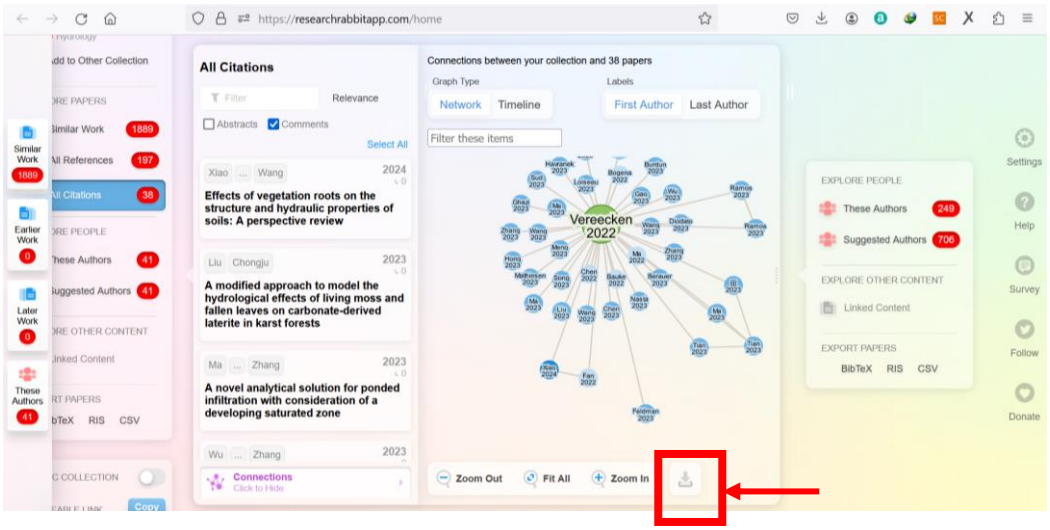

Figure 17. Bottom download connection paper.

DOI: https://doi.org/10.17509/ajse.v4i2.71567
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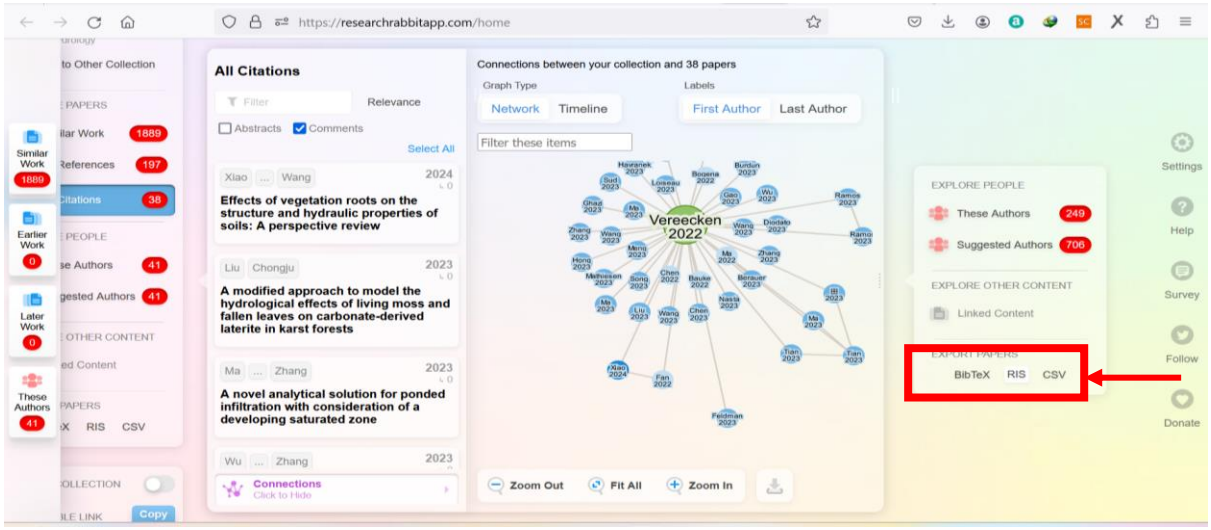

Figure 18. Download data file format RIS.

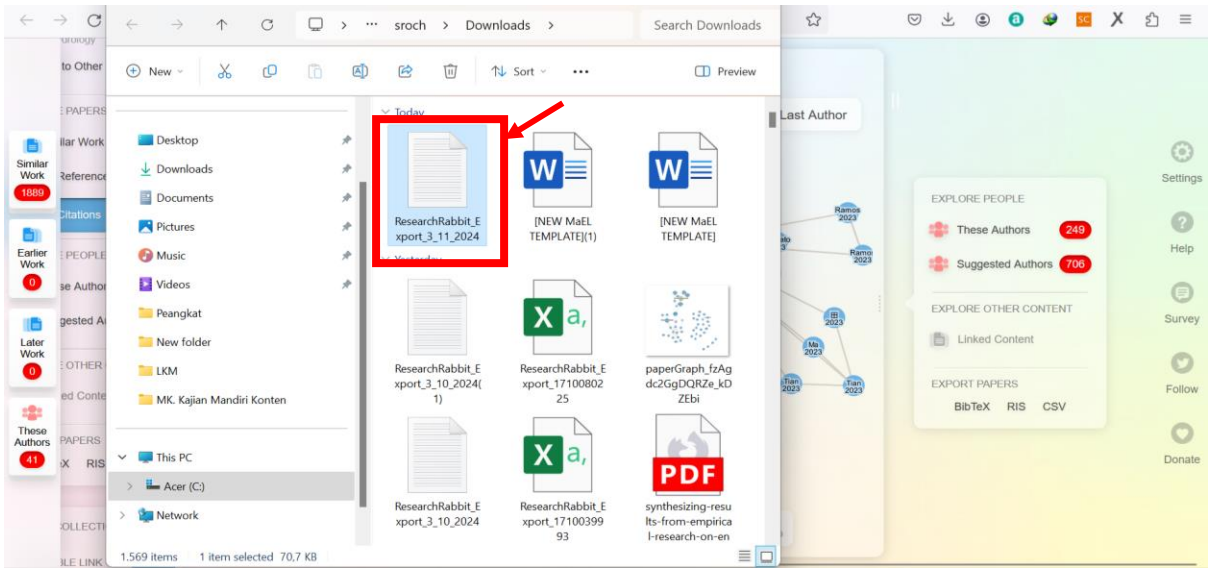

Figure 19. Save file RIS on Our PC.

First, we selected the articles from the years 2014–2024. Then, it was mapped using VOSviewer. The results from ResearchRabbit present metadata rather than full text, including the author's name, title, year, published journal, and the article's publisher in RIS format. **Table 2** presents the search data from ResearchRabbit utilized in the VOSviewer analysis of this study. We retrieved 45 articles based on descriptive filters. We only collected data from articles published within the last 10 years, specifically from 2014 to 2024. **Table 2** displays the resulting data.

Table 2. Hydrology research data.

No	Title	Publisher	Year	Count authors	Citation	Reference
1	Application of machine learning and emerging remote sensing techniques in hydrology: A state-of-the-art review and current research trends	Journal of Hydrology	2024	2	0	Saha (2024)

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Table 2 (continue). Hydrology research data.

No	Title	Publisher	Year	Count authors	Citation	Reference
2	Accelerating Subglacial Hydrology for Ice Sheet Models with Deep Learning Methods	Geophysical Research Letters	2024	2	0	Verjans (2024)
3	Deep learning in hydrology and water resources disciplines: concepts, methods, applications, and research directions	Journal of Hydrology	2024	2	0	Tripathy (2024)
4	Comparing the use of all data or specific subsets for training machine learning models in hydrology: A case study of 5evapotranspiration6 prediction	Journal of Hydrology	2023	6	1	Shi *et al.* (2023)
5	Nonlinear control of climate, hydrology, and topography on streamflow response through the use of interpretable machine learning across the contiguous United States	Journal of Water and Climate Change	2023	2	0	Wu (2023)
6	Deep learning for earthquake hydrology? Insights from the karst Gran Sasso aquifer in central Italy	Journal of Hydrology	2023	4	4	Scorzini (2023)
7	Hybrid and Integrative Evolutionary Machine Learning in Hydrology: A Systematic Review and Meta-analysis	Archives of Computational Methods in Engineering	2023	5	0	Mahdavi *et al.* (2023)
8	Past, present and future of the applications of machine learning in soil science and hydrology	Soil and Water Research	2023	3	3	Wang (2023)
9	Water agricultural management based on hydrology using machine learning techniques for feature extraction and classification	Acta Geophysica	2023	5	0	Lin *et al.* (2023)
10	Comparison of deep learning models and a typical process-based model in glacio-hydrology simulation	Journal of Hydrology	2022	5	9	Chen *et al.* (2022)
11	Multiorder hydrologic Position for Europe — a Set of Features for Machine Learning and Analysis in Hydrology	Scientific Data	2022	3	1	Nölscher *et al.* (2022)
12	Assessments of students' gains in conceptual understanding and technical skills after using authentic, online learning modules on hydrology and water resources	Frontiers in Education	2022	3	0	Byrd *et al.* (2022)

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Table 2 (continue). Hydrology research data.

No	Title	Publisher	Year	Count authors	Citation	Reference
13	Application of Machine Learning and Remote Sensing in Hydrology	Sustainability (Switzerland)	2022	1	6	Mohammadi (2022)
14	Machine learning in vadose zone hydrology: A flashback	Vadose Zone Journal	2022	2	6	Ghanbarian (2022)
15	Corrigendum to "Combining time varying filtering based empirical mode decomposition and machine learning to predict precipitation from nonlinear series"	Journal of Hydrology	2022	3	0	Song *et al.* (2022)
16	Prioritizing Engagement of a Diverse Student Cohort in Online Hydrology Learning at the University of Western Australia	Frontiers in Education	2022	4	1	Thompson *et al.* (2022)
17	Sharing Experiences in Designing Professional Learning to Support Hydrology and Water Resources Instructors to Create High-Quality Curricular Materials	Frontiers in Education	2022	5	2	Gallagher *et al*. (2022)
18	The Data Synergy Effects of Time-Series Deep Learning Models in Hydrology	Water Resources Research	2022	5	23	Fang *et al.* (2022)
19	Explore Spatio-Temporal Learning of Large Sample Hydrology Using Graph Neural Networks	Water Resources Research	2021	3	27	Sun *et al.* (2021)
20	Sandtank-ml: An educational tool at the interface of hydrology and machine learning	Water (Switzerland)	2021	5	4	Gallagher *et al*. (2021)
21	Deep Learning for Isotope Hydrology: The Application of Long Short-Term Memory to Estimate High Temporal Resolution of the Stable Isotope Concentrations in Stream and Groundwater	Frontiers in Water	2021	3	3	Sahraei *et al*. (2021)
22	Sandtank-ml: An educational tool at the interface of hydrology and machine learning	Water (Switzerland)	2021	5	4	Gallagher *et al*. (2021)

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Table 2 (continue). Hydrology research data.

No	Title	Publisher	Year	Count authors	Citation	Ref.
23	Deep Learning for Isotope Hydrology: The Application of Long Short-Term Memory to Estimate High Temporal Resolution of the Stable Isotope Concentrations in Stream and Groundwater	Frontiers in Water	2021	3	3	Sahraei *et al.* (2021)
24	Applications of deep learning in hydrology	Deep Learning for the Earth Sciences: A Comprehensive Approach to Remote Sensing, Climate Science and Geosciences	2021	2	24	Shen an Lawson (2021)
25	Ensemble machine learning paradigms in hydrology: A review	Journal of Hydrology	2021	5	202	Zounemat *et al.* (2021)
26	A workflow to address pitfalls and challenges in applying machine learning models to hydrology	Advances in Water Resources	2021	2	17	Gharib (2021)
27	Editorial: Broadening the Use of Machine Learning in Hydrology	Frontiers in Water	2021	3	42	Shen *et al.* (2021)
28	Retraction notice to “Machine learning approaches for estimation of sediment settling velocity”	Journal of Hydrology	2021	4	0	Zhu *et al.* (2021)
29	A comprehensive review of deep learning applications in hydrology and water resources	Water Science and Technology	2020	5	198	Sit *et al.* (2020)
30	Two-Stage History Matching for Hydrology Models via Machine Learning	Advances in Intelligent Systems and Computing	2020	3	2	Tjia *et al.* (2020)
31	Groundwater estimation from major physical hydrology components using artificial neural networks and deep learning	Water (Switzerland)	2020	5	80	Afzaal *et al.* (2020)
32	Learning by doing: enhancing hydrology lectures with individual fieldwork projects	Journal of Geography in Higher Education	2019	1	9	Van Loon (2019)
33	CRML: A Convolution Regression Model with Machine Learning for Hydrology Forecasting	IEEE Access	2019	5	13	Chen *et al.* (2019)

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Table 2 (continue). Hydrology research data

No	Title	Publisher	Year	Count authors	Citation	Ref.
34	Streamflow Hydrology Estimate Using Machine Learning (SHEM)	Journal of the American Water Resources Association	2018	2	31	Petty (2018)
35	Development of student-centered modules to support active learning in hydrology	ASEE Annual Conference and Exposition, Conference Proceedings, 2016-June	2016	4	0	Habib *et al* (2016)
36	Enhancing the T-shaped learning profile when teaching hydrology using data, modeling, and visualization activities	Hydrology and Earth System Sciences	2016	4	14	Sanchez *et al*. (2016)

4.2. The Development of Publications Regarding Hydrology

Table 3 shows the development of hydrology research according to search results in the ResearchRabbit database. The ResearchRabbit database displays 45 studies discussing hydrology. As Figure 19 shows, the number of studies related to learning media varies but tends to increase. While research interest on this subject is on the rise, there is only a decline in 2017 and 2023. We consider your bell to be complete by the end of December, so we have not included data for 2024. In 2014, several research articles appeared, and in 2015, the same number was obtained. In 2016, the number became 2, and in 2017, the number dropped to 1. There was a significant increase from 2017 to 2022 with 27 articles. This data made it possible to identify significant patterns in the scientific literature that were pertinent to the research topic and allowed for the exploration and analysis of current trends and advancements in the field of hydrology.

Table 3. The development of research on Hydrology.

Number	Year	Count Article
1	2024	3
2	2023	8
3	2022	11
4	2021	9
5	2020	5
6	2019	2
7	2018	2
8	2017	1
9	2016	2
10	2015	1
11	2014	1
Count		45

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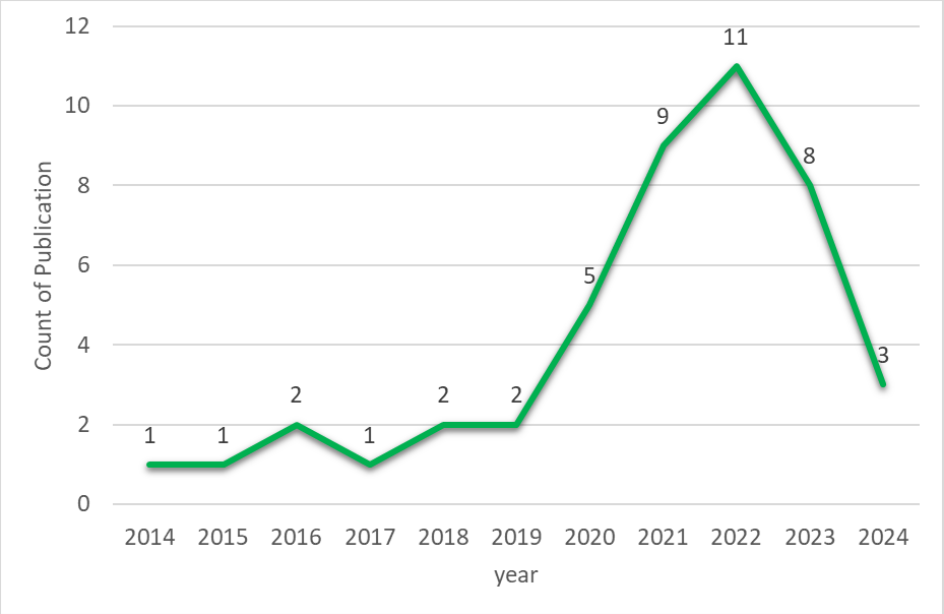

Figure 19. Graph of the level of research development on Hydrology.

4.3. Bibliometric Map Research on Hydrology

The ResearchRabbit search results produced 45 hydrology research documents. We exported these documents into RIS format and then loaded them into VOSViewer. The research mapping procedure is as follows:

a. Open the VOSviewer Application

The first step is to open the VOSviewer application that has already been installed on the device. Once you open it, the initial VOSviewer window will appear, as shown in Figures **20, 21 and 22**.

b. Click the create button to start creating a new mapping

Once VOSviewer is opened, click Create to start a new mapping. **Figure 23** illustrates that you can create a map using three types of data: text data, bibliographic data, and network data. Because of the research title, we created the map based on text data for this study. After that, click the next button.

c. Selecting and determining data sources

In the next step of creating the research map, **Figure 24** shows four data source options: VOSviewer for reading data, a bibliographic database, a reference manager, and ResearchRabbit for downloading data. Select the RIS section in **Figure 25**, then insert the downloaded file by pressing the three-dot button. Then, click the next button to proceed to the next step.

d. Selecting the field to extract

Next, as shown in **Figure 26**, the "Select columns" page appears. This page displays three types of data options that can be extracted: title and abstract columns, abstract columns, and title and abstract columns. Thus, VOSviewer maps each keyword extracted from the titles and abstracts of the collected articles. Once done, click the next button.

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e. Select the calculation method

The counting method selection is depicted in **Figure 27**. Full counting and binary counting are the two available methods. Binary counting displays the data as a value of 0 or 1, which means if the same word appears in the title repeatedly, then the value is one. On the other hand, full counting displays the number of times it appears as it appears.

f. Select Threshold

The Select Threshold page is used to set how many words must appear to be displayed in the folder, as shown in **Figure 28**. In this study, these words must appear at least three times, so the corresponding keywords and words that appear at least three times are included in the mapping. **Figure 29** shows the number of words found.

g. Verify the selected requirements and Click the Finish Button.

Figure 30 illustrates the process of selecting words for the created research mapping and then clicking the "Finish" button. **Figure 31** shows the results of the research on theme mapping in digital learning media. Consider the suggested words: Based on words that have appeared previously in the literature, Vosviewer can suggest new words. These recommendations are useful for refining your search queries and finding relevant papers. Using Mapping Results: After verifying the words, you can view the VOSviewer mapping results to learn the relationship between the words and the paper.

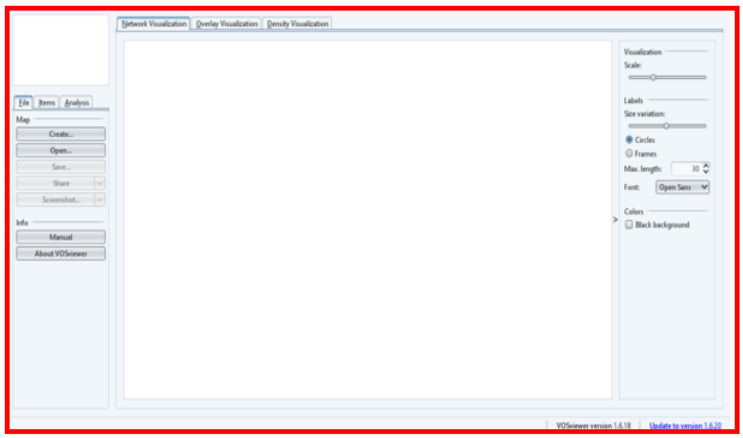

Figure 20. Create a map in VOSviewer.

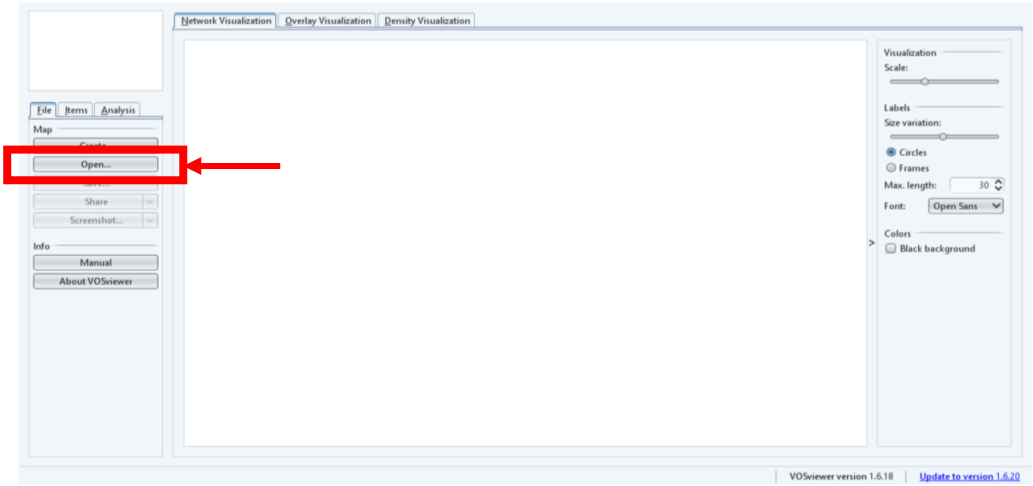

Figure 21. Click Create to new analysis

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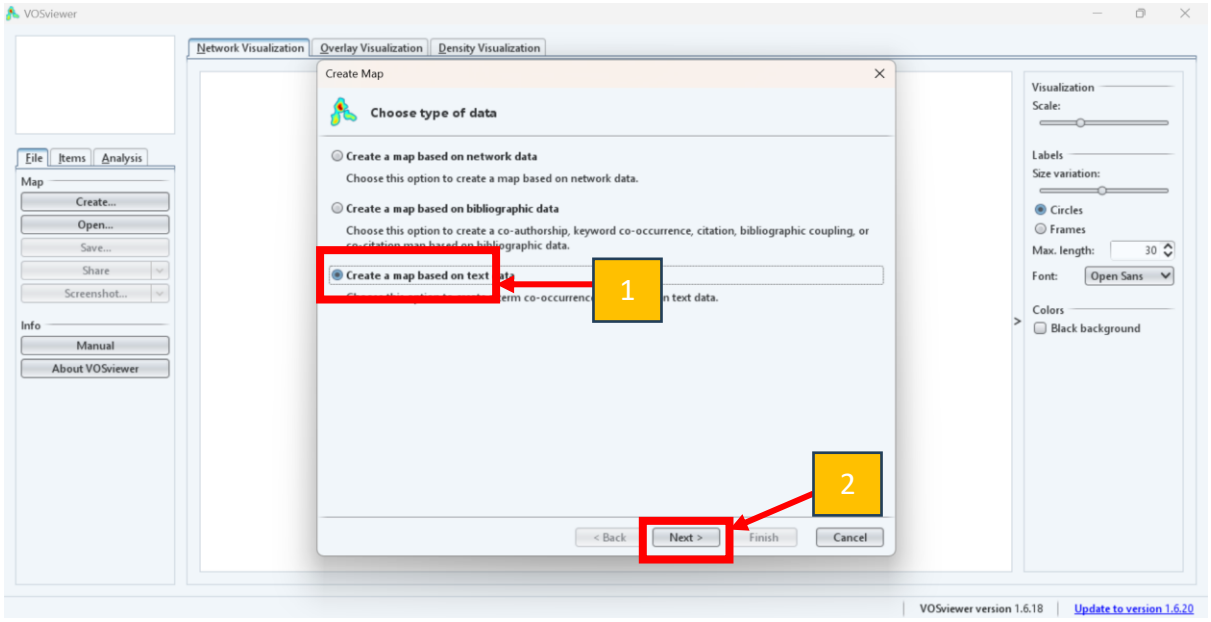

Figure 22. Create a map in VOSviewer

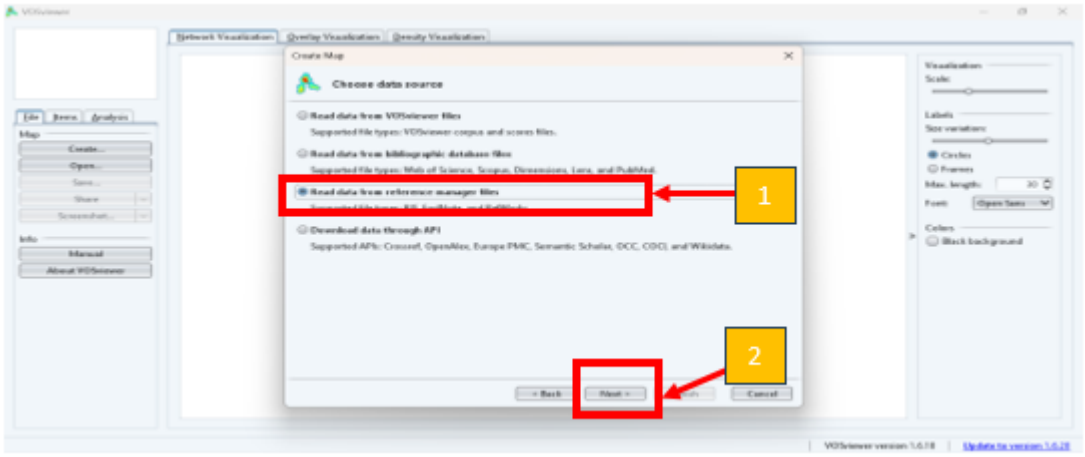

Figure 23. Selection of data sources on VOSviewer.

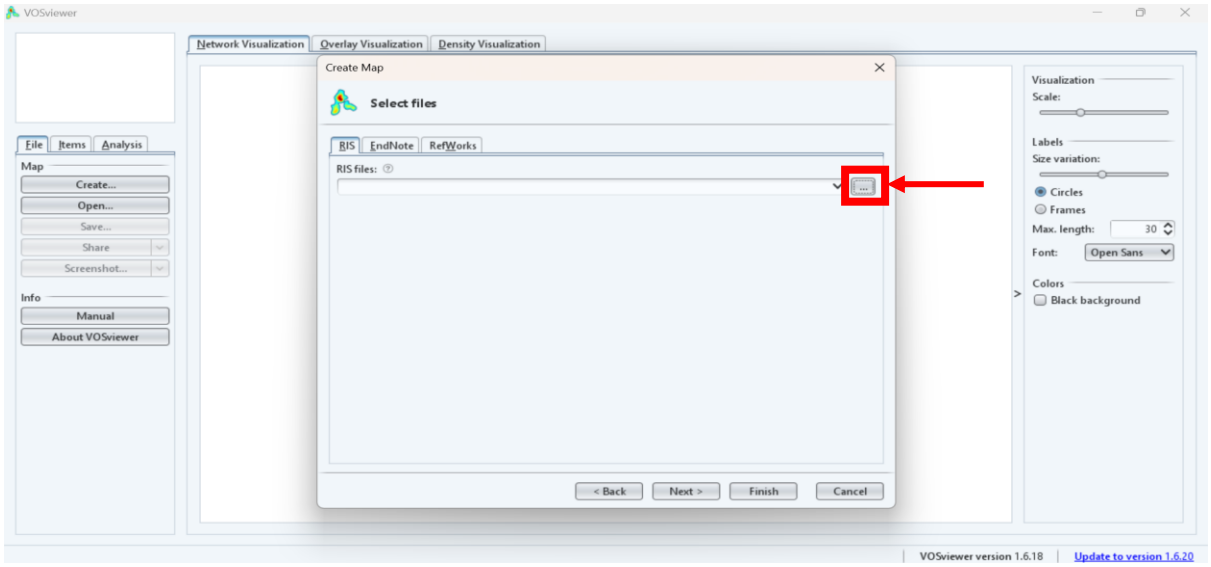

Figure 24. Selection of the file to be used as the source of mapping data in VOSviewer.

DOI: https://doi.org/10.17509/ajse.v4i2.71567
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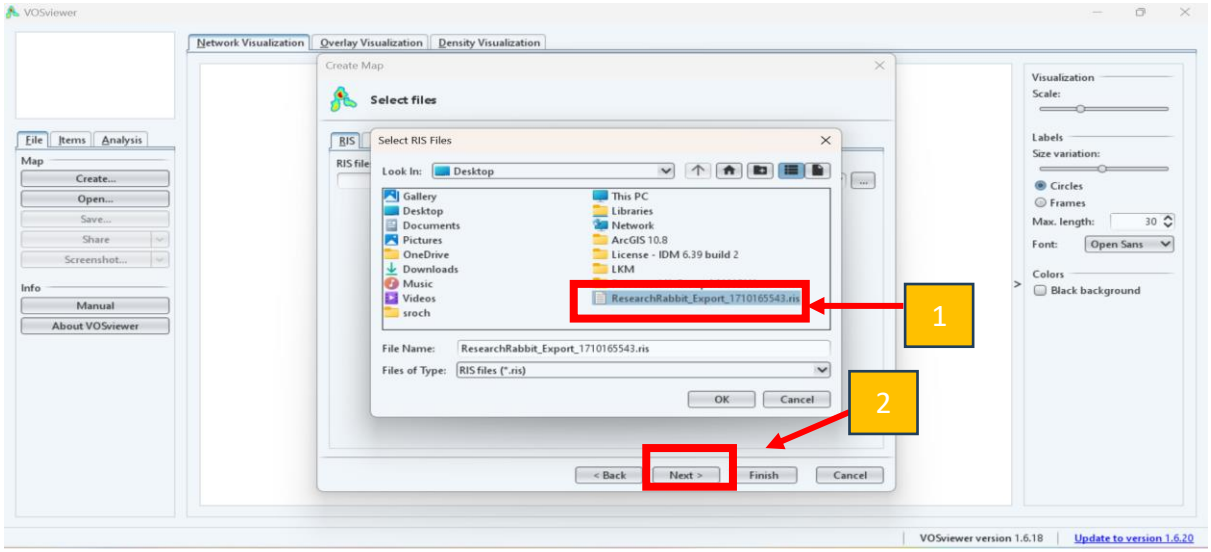

Figure 25. Select File from PC.

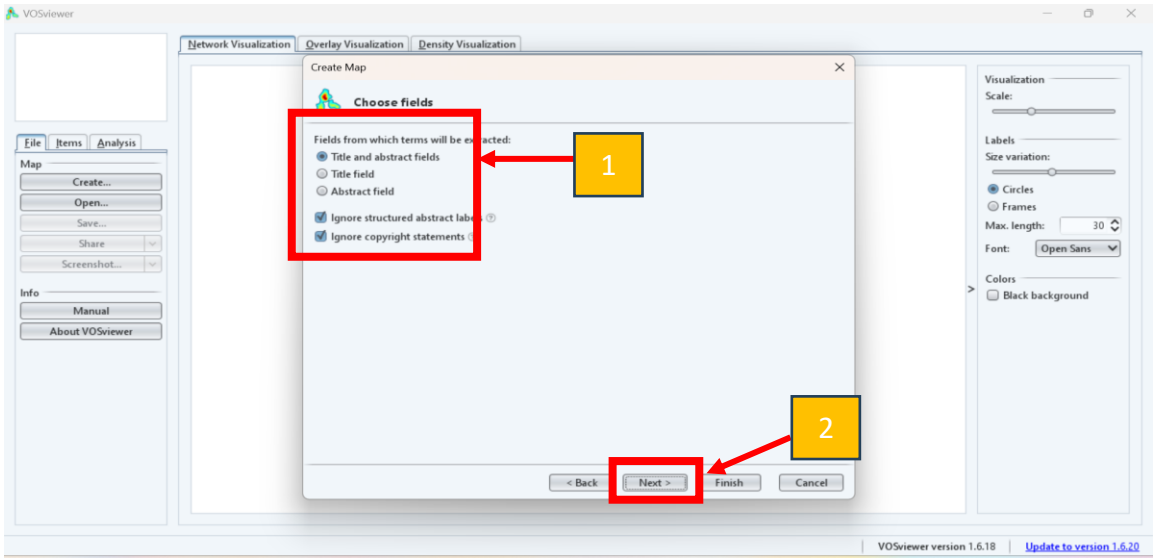

Figure 26. Selection of the type of data to be extracted into a map on VOSviewer.

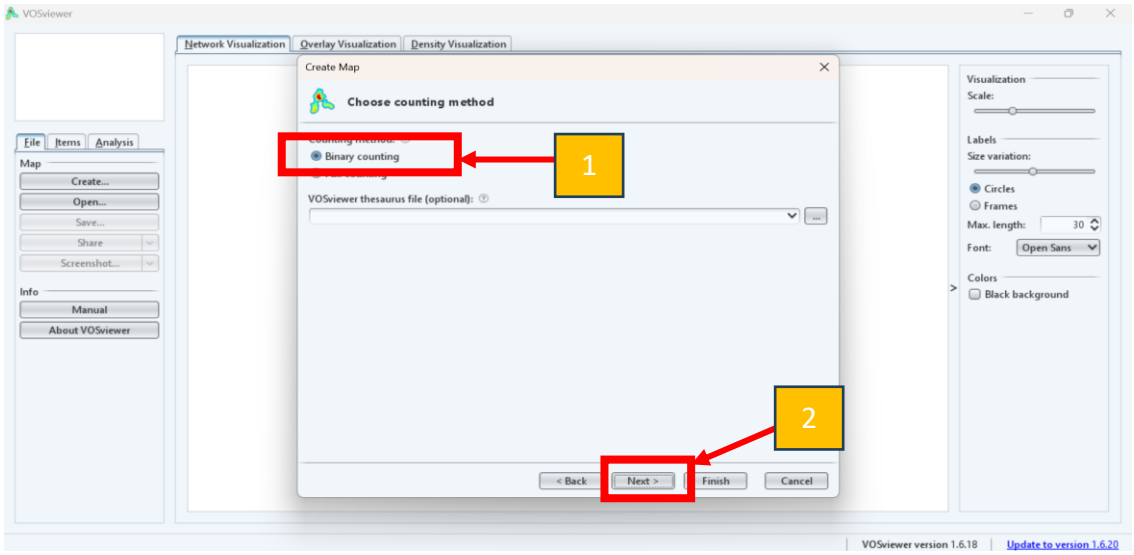

Figure 27. Choosing the counting method in VOSviewer.

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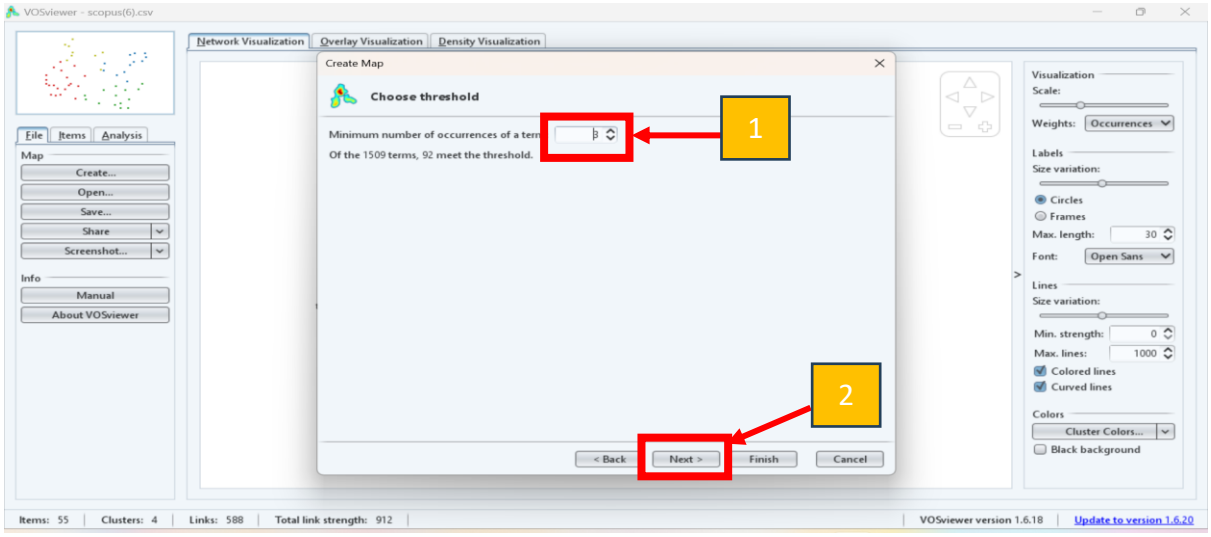

Figure 28. Choosing the threshold section on VOSviewer.

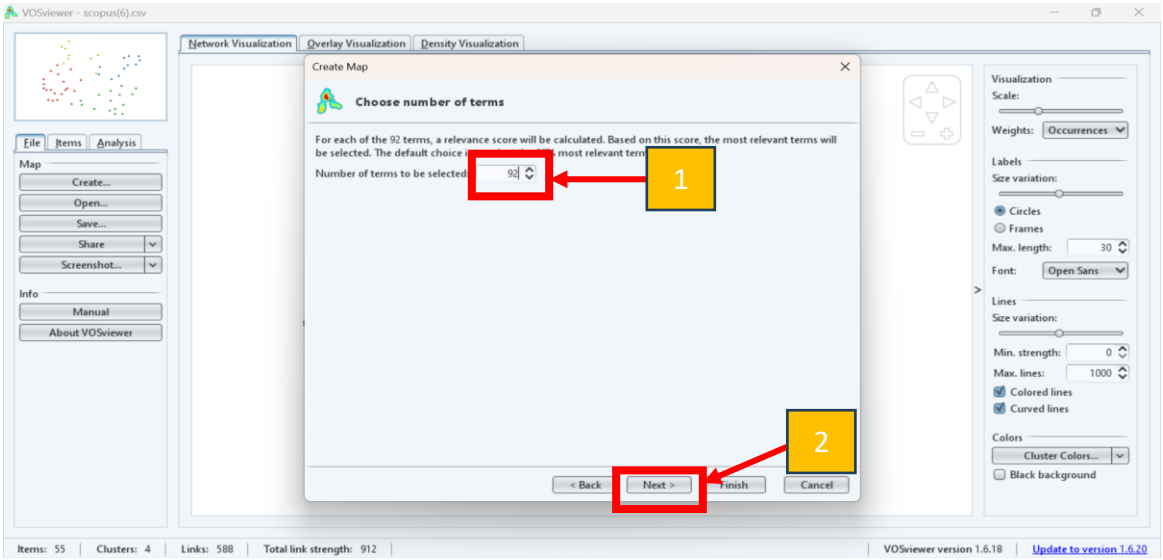

Figure 29. Putting the number of terms.

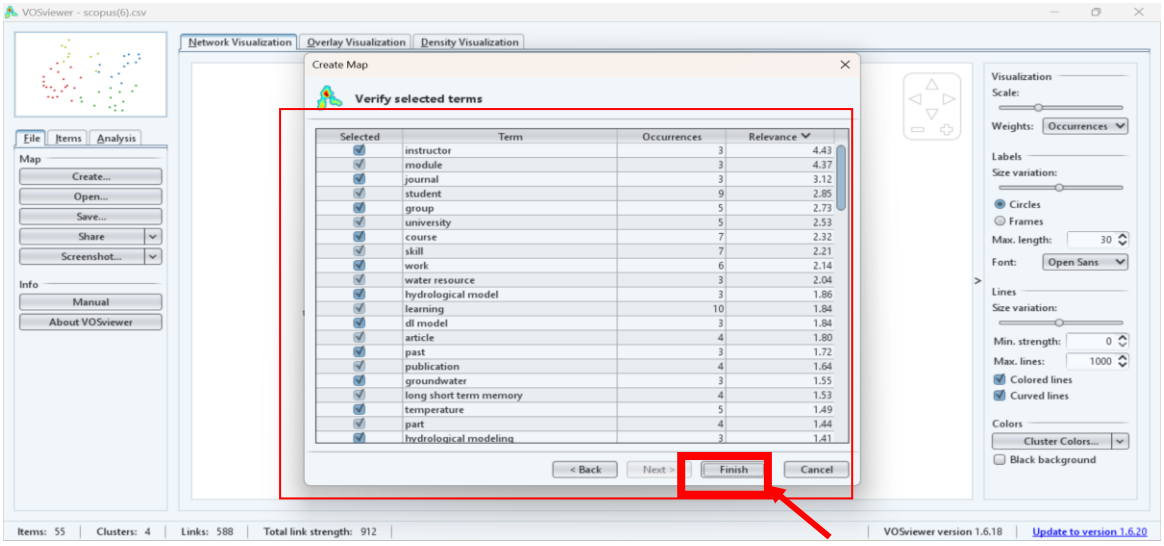

Figure 30. Verification of word selection on VOSviewer.

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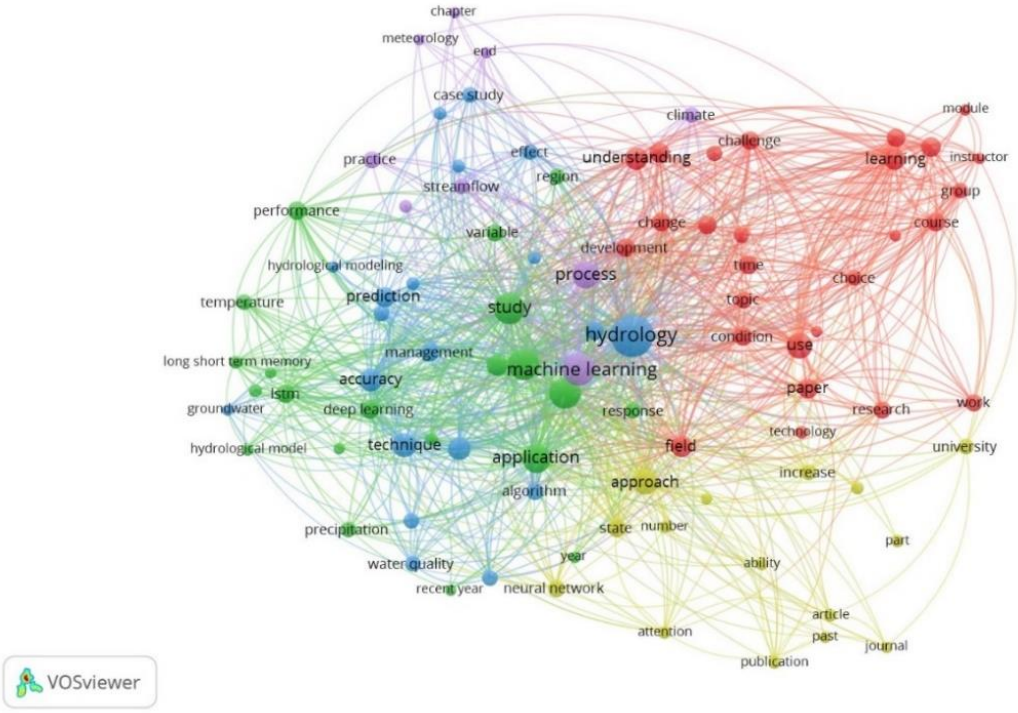

Figure 31. The results of the mapping of the research on VOSviewer.

4.3.1. Network visualization **Co-Word Map**

The results of the shared word map network visualization of hydrology research development are divided into 5 clusters, as shown in Figure 30 (Hamidah *et al*., 2020; Al Husaeni *et al*., 2023; Nandiyanto *et al*., 2021; Mulyawati & Ramadhan, 2021), namely:

(i) Cluster 1: The red color consists of 19 items, including field, technology, research, work, paper, use, condition, topic, time, development, change, understanding, challenge, learning, module, instructor, group, course, and choice.
(ii) Cluster 2: Green color consists of 15 items including year, recent year, precipitation, application, hydrological, deep learning model, system, long short time memory, temperature, performance, variable, study, region, machine, and response.
(iii) Cluster 3: The blue color consists of 9 items, namely Water quality, algorithm, technique, accuracy, management, prediction, hydrological modeling, case study, and hydrology.
(iv) Cluster 4: The yellow color consists of 13 items: neural network, attention, publication, article, past, journal, ability, state, number, approach, increase, part, and university.
(v) Cluster 5: The purple color consists of 8 items: machine learning, process, stream flow, practice, meteorology, chapter, end, and climate.

Cluster views refer to items with the same markings as the visible items. An item's current density determines its color, suggesting that the dot's color remains fixed based on its connections to other items. The Co-Word Density Map is useful for an overview of a bibliometric map's general structure by showing which items are essential to analyze (Donthu *et al*., 2021). The results show the most frequently used keywords in publications displaying hydrological research maps from 2014 to 2024, as shown in Figure 31. According to the map, the smaller the color with the larger diameter of the circle, the denser the keyword, which means the more frequently it appears, and if the part is small, then with any color background, the less regularly it seems. Bibliometrics is a method of quantitatively analyzing scientific literature. In VOSviewer data, bibliometrics is used to identify research trends, foster collaboration between researchers, and map the structure of scientific knowledge (Escoffery

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et al., 2014). They highlighted the importance of journals with the highest number of publications as a basis for research. In addition, Rong and Bahaudin, in their study, found that an effective strategy for sustainable development is to conduct research on vernacular architecture in response to urbanization as well as environmental and climate change challenges, using bibliometric baseline data to find research gaps. As a result, bibliometric results based on VOSviewer data can provide valuable insights into research trends, international collaborations, and the contributions of researchers, countries, and institutions in various fields, such as medicine, computer science, and sustainability.

4.3.2. Scatter Analysis of Hydrology Research

Data is essential in research and science. Developing knowledge, making decisions, and understanding phenomena are aided by data. Scientific journals are a valuable source of data in this situation. They contain research findings, analyses, and results from researchers from various disciplines. In data analysis, frequency is an essential component. We can identify trends, measure popularity, and evaluate relevance by looking at how often a topic or concept appears in journals. In addition, the results help us understand a particular research focus. In the following, we will discuss how to criterion the distribution of articles based on journal name, country, author, content, and output type.

a. Article distribution by journal name

Analyzing the distribution of articles by journal name is very important in the academic world. Scientific journals are where researchers publish their research findings. We can identify research trends and disciplinary focus and track knowledge contributions from different sources by looking at journal names. In addition, the number of articles published in a particular journal gives an idea of the relevance and popularity of the topics covered.

Based on **Table 4**, it is found that the distribution of hydrology articles based on publishers is divided into: Journal of Hydrology (8), Frontiers in Education (3), Frontiers in Water (2), Springer Climate (2), Water Resources Research (2), Water Switzerland (2), Acta Geophysica (1), Advances in Intelligent Systems and Computing (1), Advances in Water Resources (1), Archives of Computational Methods in Engineering (1), E3s Web of Conferences (1), Geophysical Research Letters (1), Hydrology and Earth System Sciences (1), Hydrology and Earth System Sciences Discussions (1), IEEE Access (1), Journal of Geography in Higher Education (1), Journal of the American Water Resources Association (1), Journal of Water and Climate Change (1), Proceedings of the ACM SIGKDD International Conference on Knowledge Discovery and Data Mining (1), Knowledge Discovery and Data Mining (1), Scientific Data (1), Soil and Water Research (1), Sustainability Switzerland (1), Vadose Zone Journal (1), and Water Science and Technology (1).

Table 4 shows that the Journal of Hydrology is the scientific journal that publishes the most articles on hydrology. It contains many articles on hydrological elements such as hydrometeorology, hydrogeology, watershed management, surface hydrology, and water quality. However, only some articles have been published on research related to hydrology education. This is due to 1) Primary Focus: The Journal of Hydrology may focus primarily on scientific research that relates directly to the technical and scientific aspects of the field of hydrology (Shen & Lawson, 2021; Zounemat-Kermani *et al*., 2021). Research on hydrology education may be more frequently published in journals focusing on education and learning. 2) Space Limitations: Scientific journals need more space for articles. Research more related to the technical and applicative elements of hydrology may be prioritized. 3) Target Audience: The Journal of Hydrology may be more geared towards hydrological scientists, researchers,

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and practitioners interested in research and technical aspects. Hydrology education may be more relevant to teachers, students, and practitioners. 4) Availability of Alternatives: Studies on hydrology education may be more frequently published in journals specifically specializing in science education, environmental education, or geoscience education (Habib *et al*., 2016; Sahraei *et al*., 2021). However, remember that these are only hypotheses based on logical thinking. The editorial policies and preferences of authors contributing to the Journal of Hydrology may need further scrutinization to gain a better understanding.

Table 4. Distribution of articles by journal name.

No	Journal	Frequency
1	Journal Of Hydrology	8
2	Frontiers In Education	3
3	Frontiers In Water	2
4	Springer Climate	2
5	Water Resources Research	2
6	Water Switzerland	2
7	Acta Geophysica	1
8	Advances In Intelligent Systems and Computing	1
9	Advances In Water Resources	1
10	Archives Of Computational Methods in Engineering	1
11	E3s Web of Conferences	1
12	Geophysical Research Letters	1
13	Hydrology And Earth System Sciences	1
14	Hydrology And Earth System Sciences Discussions	1
15	IEEE Access	1
16	Journal of Geography in Higher Education	1
17	Journal of the American Water Resources Association	1
18	Journal of Water and Climate Change	1
19	Proceedings of the ACM SIGKDD International Conference on Knowledge Discovery and Data Mining	1
20	Scientific Data	1
21	Soil And Water Research	1
22	Sustainability Switzerland	1
23	Vadose Zone Journal	1
24	Water Science and Technology	1

b. Distribution of articles by author

In the academic world, writing scientific articles requires an organized and systematic structure. The article's introduction serves as a crucial component, offering a concise summary of the topics the article will cover. **Table 5** displays the distribution of authors contributing the most to hydrology articles. The data are Shen, C. (4), Chen, X. (2), Gallagher, M.A. (2), Habib, E. (2), Lawson, K. (2), Merwade, V. (2), Ndehedehe, C. (2), Ruddell, B.L. (2), Sanchez, C.A. (2), Schiesser, R. (2), Zhu, S. (2), and Zounemat-Kermani, M. (2).

Individual study is required to provide suggestions for policy improvements. Researchers need to master essential methods for combining research results and organizing them into actionable messages. Combining research results through a systematic review approach can present applicable messages based on the available evidence (Siswanto, 2010). In the academic world, research is fundamental. Research aims to find solutions to problems, increase understanding, generate evidence based on data, and develop skills (Zounemat-Kermani *et al*., 2021). Research allows us to broaden our knowledge, find solutions to problems, and contribute to advancing science and society.

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Table 5. Distribution of Hydrology research by Author.

No	Author	Frequency
1	Shen, C.	4
2	Chen, X.	2
3	Gallagher, M.A.	2
4	Habib, E.	2
5	Lawson, K.	2
6	Merwade, V.	2
7	Ndehedehe, C.	2
8	Ruddell, B.L.	2
9	Sanchez, C.A.	2
10	Schiesser, R.	2
11	Zhu, S.	2
12	Zounemat-Kermani, M.	2

c. Distribution of articles based on country of origin

Analyzing the distribution of articles by country of origin is very important in the academic world. Scientific journals are places where researchers publish their research findings. Considering an article's country of origin, we can identify research trends and disciplinary focus and track knowledge contributions from different sources. In addition, the number of articles published in journals from various countries indicates how popular and relevant the topic is. For example, do certain countries produce more health research? Are researchers from other countries more likely to cover environmental issues? This article will look at articles written in different countries and find perspectives to help further understanding. Based on **Table 6**, the top 10 countries writing articles on hydrology are the United States (18), China (8), Australia (5), Germany (4), India (4), Iran (4), Belgium (2), Canada (2), Bosnia and Herzegovina (2), and Croatia (1).

Several factors can influence the difference in the amount of literature on hydrology between countries. First, location and climate are essential. Countries with an environment rich in water resources, such as large rivers or lakes, tend to concentrate more on hydrological research (Zhu *et al*., 2020). Second, national priorities and needs influence the allocation of resources for research. Countries facing significant water problems, such as droughts or floods, may be more active in hydrological research (Tjia *et al*., 2020). Last but not least, countries that have strong universities and research institutions in this field will further encourage hydrological research (Lin *et al*., 2023). These factors interact with each other and shape the different patterns of hydrological research contributions in various countries.

Tabel 6. Distribution of Hydrology research based on the country.

No	Country	frequency
1	United States	18
2	China	8
3	Australia	5
4	Germany	4
5	India	4
6	Iran	4
7	Belgium	2
8	Canada	2
9	Bosnia and Herzegovina	2
10	Croatia	1

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d. Distribution of articles by Publication Type and Content

Analyzing the distribution of articles by field of study is very important in the academic world. Scientific journals are places where researchers publish their research findings. We can identify research trends and disciplinary focus and track knowledge contributions from different sources by examining an article's field of study. In addition, the number of articles that appear in a particular field of study gives an idea of the popularity and relevance of the topics covered. For example, at the center of more industrial research in the engineering field? Do environmental science researchers cover ecological issues more often? To answer these questions, this study will examine various articles written in the field of research and explore new perspectives. Knowing how researchers contribute to different disciplines broadens our view and expands the scope of study. **Table 7**: Distribution of Hydrology Research Based on Publication Type. The distribution is shown in Table 6, namely: Article (22), Book Chapter (6), Conference Paper (6), Review (5), Editorial (2), Erratum (2), Conference Review (1), and Data Paper (1).

Table 7. Distribution of Hydrology research by Publisher Kind

No	Publisher Kind	frequency
1	Article	22
2	Book Chapter	6
3	Conference Paper	6
4	Review	5
5	Editorial	2
6	Erratum	2
7	Conference Review	1
8	Data Paper	1

Several reasons can be explained why the state produces more scientific articles on hydrology than other media. First, the topic and purpose of communication differ for scientific and other media articles. Different media (such as news or blogs) focus on popularity, accessibility, and writing style. (Tortajada *et al*., 2018). Instead, scientific articles are written to accurately and rigorously communicate scientific research and findings (McWha *et al*., 2018). Secondly, the target audience is also essential: scientific articles are aimed at practitioners, scientists, and scholars who need in-depth information, while other media reach the general public who want more concise and easily digestible information (Huey *et al*., 2018). Finally, academic traditions and publishing policies are also influential (Wohlwend, 2020). Scientific papers are valued in the academic world and are often required to obtain a degree or research funding, so researchers tend to choose to write them.

Furthermore, it is critical to analyze the distribution of articles based on the type of publication content. Scientific journals provide a platform for researchers to publish their research findings. By paying attention to an article's publication type, we can identify research trends, focus on specific disciplines, and track knowledge contributions from various sources, as shown in **Table 8**. Based on **Table 8**, the distributions of articles according to content distribution are Environmental Science (24), Computer Science (10), Earth and Planetary Sciences (10), Social Sciences (8), Engineering (6), Agricultural and Biological Sciences (4), Energy (3), Mathematics (3), Biochemistry, Genetics, and Molecular Biology (2), Decision Sciences (2), Materials Science (1), Physics, and Astronomy (1). Authors can increase the visibility and impact of each work by repurposing content into other formats, such as YouTube videos or sharing graphics on social media (Bakombo *et al*., 2023; Yang *et al*., 2022). In this

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study, we examined the distribution of articles based on publication type and content. Our findings demonstrate interesting variations in author preferences and publishing trends.

Table 8. Distribution of Hydrology Research by Subject Area

No	Subject Area	Document
1	Environmental Science	24
2	Computer Science	10
3	Earth and Planetary Sciences	10
4	Social Sciences	8
5	Engineering	6
6	Agricultural and Biological Sciences	4
7	Energy	3
8	Mathematics	3
9	Biochemistry, Genetics and Molecular Biology	2
10	Decision Sciences	2
11	Materials Science	1
12	Physics and Astronomy	1

Several reasons can be explained why a country writes more about environmental hydrology than education. First, research on hydrology is vital because ecological issues such as water management, pollution, and climate change directly impact the survival of humans and ecosystems. (Lin *et al*., 2023; Siswanto, 2010). Second, despite its importance, education is often perceived as a long-term investment (Van Loon, 2019). Countries may be more interested in solving their current significant problems, such as addressing the water crisis, than prioritizing education, which takes longer to achieve tangible results. Finally, research allocation is also influenced by government policy priorities and resources (Habib *et al*., 2016; Shen *et al*., 2021; Verjans & Robel, 2024). Because of their importance and immediate impact, environmental issues often receive greater attention than education.

5. CONCLUSION

Based on the above results and discussion, ResearchRabbit, when integrated with VOSviewer, can serve as a database for mapping hydrological research. The environmental field still dominates the distribution of research in hydrological studies, with a total of 24 documents. America is the country that has done the most hydrology research. The author who has studied this field the most is dominated by the annual Journal of Hydrology, which has eight documents. Thus, it is concluded that researchers worldwide have yet to study hydrological content research for the education sector widely. This point makes it ironic because teaching hydrological concepts is very important.

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7. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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