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Bibliometric Computational Mapping Analysis of Trend Virtual Reality in Education Using VOS Viewer

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ABSTRACT
This study aims to present a bibliometric analysis of the topic of trend virtual reality in education published in the Google Scholar database. The data used in this study totalled 986 published articles from 2013 to 2023. This study used reference management software, namely Publish or Perish for data collection, Microsoft Excel for data analysis, and VOSviewer for data visualization. The results show that virtual reality in education research has increased from 2013 to 2023. In 2023 the number of virtual reality in education studies has decreased by 78 publications from the previous year 2021 The results of bibliometric data mapping found 81 relevant items based on co-words and 6 items based on co-authorship. Each item is divided into 5 clusters (based on co-words) and 2 clusters (based on co-authorship). International Journal of virtual reality in education is a journal that publishes many publications on keywords. It is hoped that the findings of this study can become a reference and provide direction for future researchers with similar themes, for example, the link between virtual reality in education and digitalization in education.

Keywords: *Virtual Reality, Bibliometric, Education.*

1. INTRODUCTION

Online learning (in networks) is still an essential alternative for teachers carrying out teaching assignments during the Covid-19 pandemic [1]-[2]. Distance Learning has become a priority agenda since the government implemented the Learning from Home program [3]-[4]. Teachers, students, and parents must adapt to the new policy and continue working together so that students can continue their study routines despite limitations. Of course, this is not easy, and it takes a long time to learn how to ensure that distance learning runs smoothly [5].

Implementing practicum in practical courses requires lecturers to be able to carry out learning according to the demands of learning outcomes and learning outcomes [6]. Practicum is part of teaching and learning where students can develop skills. During everyday learning, patisserie practicum is carried out in laboratories on campus [7]. Covid-19 constraints make lecturers design virtual-based learning, including how to design virtual practicum learning [8].

The virtual laboratory has a vital role in implementing practicum activities [9]. Virtual laboratories are used for demonstrations before the actual practicum occurs in the laboratory [10]. This virtual laboratory can also meet the needs of students, such as giving freedom to students to conduct or carry out practicums anywhere and anytime without having to be guided by a lecturer [11].

Computer simulations provide opportunities for students to carry out patisserie dynamically and interactively [12]. Simulation in the form of interactive multimedia-based computer software, which is operated by a computer and can simulate activities in the laboratory as if the user were in a natural laboratory, is called a virtual laboratory. Virtual laboratory is a laboratory with observational or experimental activities using software run by a computer; all the equipment needed by a laboratory is included in the software [13]. Virtual laboratories provide students with tools, materials, and laboratory equipment on computers to perform subjective experiments anywhere and anytime [14].

Virtual reality is a technology that replaces sensory input derived from the real world with sensory input created by computer simulation [15]. It provides interactivity by responding to movements and the natural behaviours of humas in the real world. Virtual reality may prove to be a powerful resource that can help in teaching by providing an environment that allows the

student to experience scenarios and situations rather than imagining them [16].

Virtual reality allows a user to interact with a computer-generated three-dimensional model or virtual environment [17]-[18]. Virtual reality is broadly applicable and has been applied to many different areas of education including the science, archaeology, history and architecture [19]. The advantage of virtual reality over conventional methods of description is that the student is given the opportunity to experience subject matter that would be different if not impossible to illustrate or describe with conventional method [20].

This research aims to determine the trend of virtual reality in learning through literature review and bibliometric analysis. We also explain the overview of virtual reality in education. We used VOS viewer mapping to analyse the data. Key words were obtained from the relationship "virtual reality in education" to search for data from 2013 to 2023. Every year research on the relationship between virtual reality in education increases. This shows the importance of virtual reality bibliometric analysis in education in the hope that it can help and become a reference for determining research topics. The novelty of this research is on the topic of virtual reality in education.

2. METHOD

Bibliometric methods are increasingly being used by science mapping to measure research performance of institutions and researchers [21]. The article literature data is used in this study is based on searched from journal publication on Google Scholar. We chose Google Scholar because Google Scholar is an open source of data. A reference application is used to collect research data namely Publish or Perish. Publish or Perish software was used to conduct a literature review on our chosen topic.

The search for article data in Publish or Perish is used to filter publications to use the keyword “virtual reality” and “education” based on the need for publication titles. The research was published between 2013-2023. All data were collected in May 2023 and 986 articles were found indexed by Google Scholar. The articles that had been collected and matched for studying analysis were the converted into two data types: research information system (*.ris) and comma separated value format (*.csv). The *.ris format is used as the format for data mapping in the VOS viewer application, while the *.csv is used as the format for data analysis in Ms. Excel.

Microsoft Excel is used to analyse development data every year and sort articles based on the highest number of citations. VOS viewer is used to visualize and evaluate trends using bibliometric maps. The article data from the source database is mapped. VOS viewer is used to generate three variations of mapping publications, namely network visualization, density visualization, and overlay visualization based on the relationship between items.

The research was conducted through several stages: (1) collection of publication data using the Publish or Perish application; (2) process bibliometric data for articles that have been collected by using Microsoft Excel application; (3) analysis of computational mapping of bibliometric published data using VOS viewer application; (4) analysis of computational mapping results.

3. RESULT AND DISCUSSION

3.1 Mapping Analysis of Trend Virtual Reality in Education

We use the VOS viewer application to map article data that is relevant. There are three variations of mapping publications, namely network visualization, density visualization, and overlay visualization based on the relationship between [22]-[23]. Seven cluster were identified that grouped related keywords, forming groups that were heterogeneous with each other and internally homogeneous. The most common keyword leading to the main cluster is: “virtual reality”.

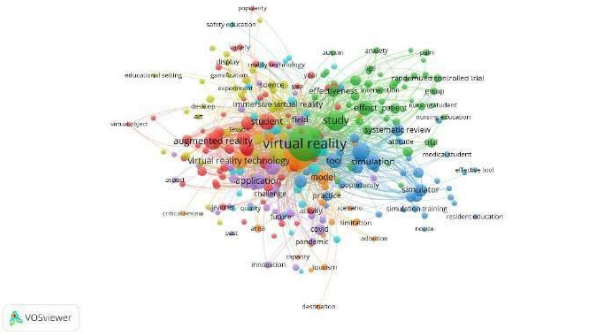

Figure 1. Network visualization

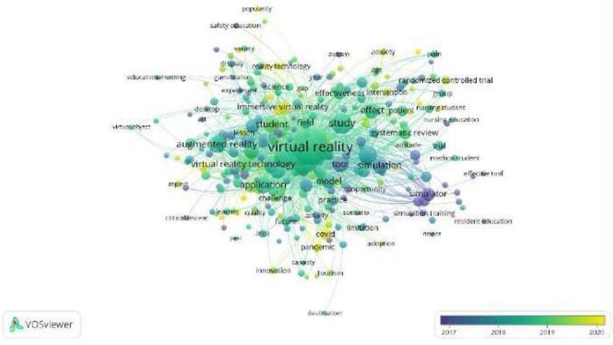

Figure 2. Overlay visualization

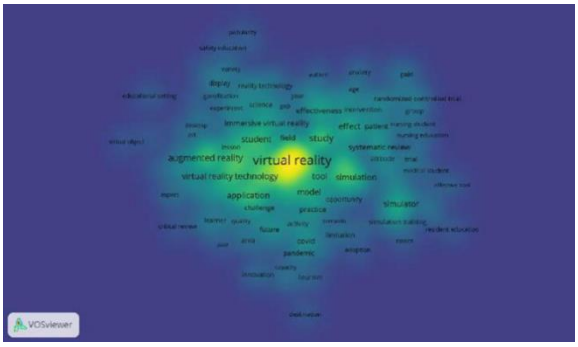

Figure 3. Density visualization

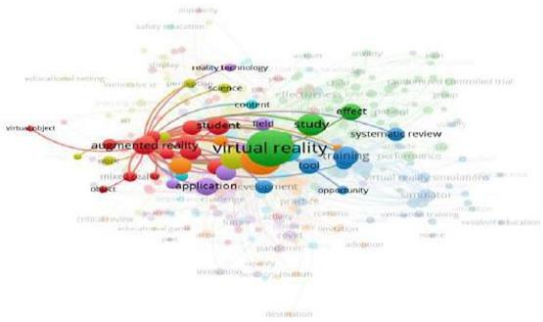

Figure 4. Network visualization of the term virtual reality in education (cluster 1)

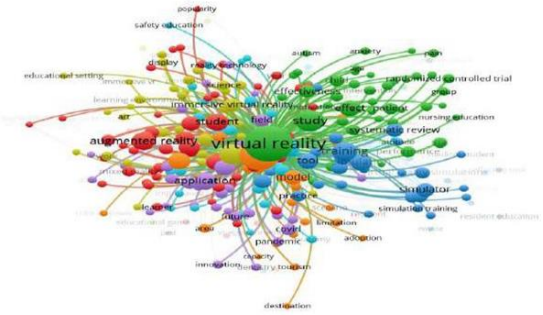

Figure 5. Network visualization of the term virtual reality in education (cluster 2)

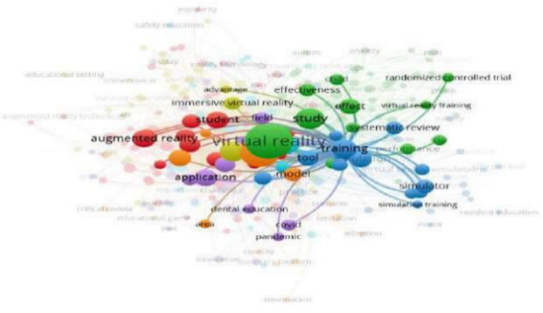

Figure 6. Network visualization of the term virtual reality in education (cluster 3)

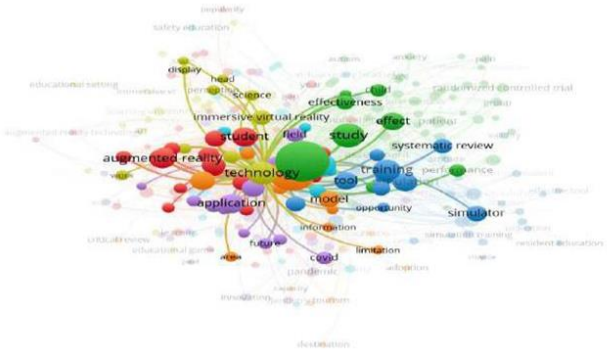

Figure 7. Network visualization of the term virtual reality in education (cluster 4)

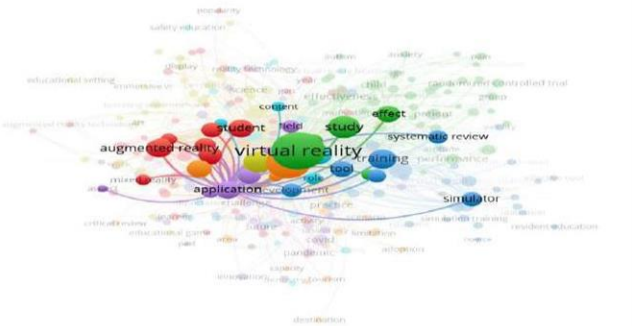

Figure 8. Network visualization of the term virtual reality in education (cluster 5)

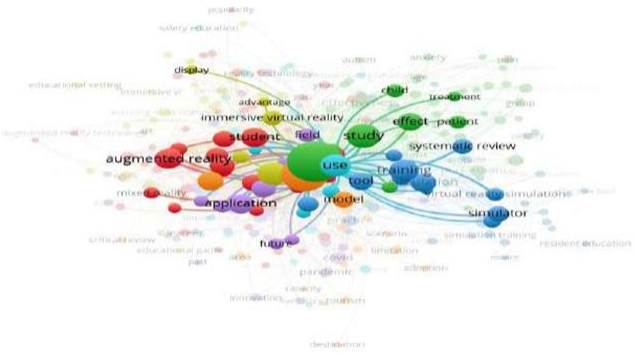

Figure 9. Network visualization of the term virtual reality in education (cluster 6)

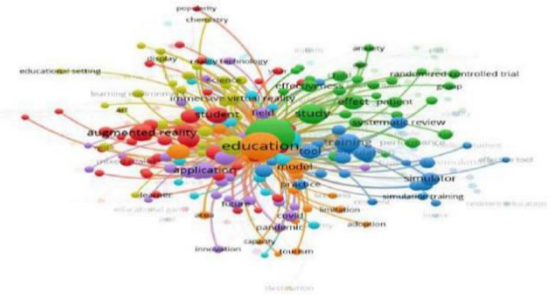

Figure 10. Network visualization of the term virtual reality in education (cluster 7)

Image descriptions are outlined in table 1. Figure 5 and 10 shows term related to the topic, namely virtual reality education. Based on figure 5, the term of virtual reality is in cluster 2. “Virtual reality” is connected to 51 other terms with a total link strength of 4268 and an accurancy of 702. While based on figure 10, the term of education is in cluster 7. “Education” is connected to 29 other terms with a total link strength 268 and an accurancy of 433.

Table 1. Clusters based on the results of the keyword visualization.

Cluster	Figure	Items
1	Figure 4	Acceptance, activity, addition, augmented reality, augmented reality application, augmented reality technology, benefit, case, case study, computer, concept, context, educational application, educational technology, educator, engineering education, environment, gap, immersion, impact, influence, integration, interest, learner, learning, learning process, mixed reality, mobile augmented reality, mobile virtual reality, motivation, object, online learning, overview, paper, pilot study, platform, popularity, real world, reality, researcher, school, student, system, teaching, term, usage, user, variety, virtual environment, virtual laboratory, virtual learning environment, virtual object, virtual reality device, web, year.
2	Figure 5	Adolescent, age, anxiety, author, autism, change, child, children, control group, current study, difference, education level, educational environment, educational tool, effect, effectiveness, efficacy, empathy, evaluation, feasibility, group, implementation, intervention, knowledge, level, meta-analysis, nursing education, nursing student, older adult, outcome, pain, participant, patient, performance, problem, program, project, promise, randomized controlled trial, randomized controlled trial, self-efficacy, study, treatment, trial, understanding, virtual reality, virtual reality experience, virtual reality exposure, virtual reality training, VR education, VRS.
3	Figure 6	Assessment, attitude, combination, development, educational value, effective tool, evidence, improvement, incorporation, medical education, medical student, need, novice, opportunity, potential, practice, resident, resident education, resource, simulation, simulation training, simulator, skill, surgeon, surgical education, surgical simulation, surgical training, survey, systematic review, tool, training, utilization, validation, validity, virtual reality simulation, virtual reality simulation training, virtual reality simulator.
4	Figure 7	Advantage, art, chemistry, comparison, design education, desktop, display, educational game, educational setting, experiment, game, gratification, head, immersive virtual reality, immersive VR, internet, IVR, learning environment, lesson, literature review, medium, multimedium, oculus rift, perception, science, science education, serious game, software, state, strategy, subject, systematic literature review, technology, type, virtual world, work.
5	Figure 8	Affordance, analysis, application, article, artificial intelligence, aspect, challenge, classroom, covid, dental education, dentistry, educational institution, educational process, field, future, health, individual, innovation, language learning, literature, metaverse, pandemic, part, past, perspective, possibility, reality technology, research, review, time, trend, university, value, virtual reality application, virtual reality system, world.
6	Figure 9	Access, anatomy, ASD, autism spectrum disorder, content, device, education system, educational purpose, experiential learning, framework, hardware, importance, interaction, medicine, person, quality, recent year, role, safety education, teacher, teacher education, technique, use, virtual, virtual reality environment, virtual reality headset, virtual reality tool, VR application, VR environment, way.
7	Figure 10	Ability, achievement, adoption, area, attention, capacity, construction, critical review, destination, education, engagement, entertainment, example, experience, higher education, implication, information, life, limitation, model, order, presence, relevance, scenario, sense, tourism, video, virtual reality technology, VR technology.

Virtual reality is a trending research topic in education, and virtual reality is a medium that provides convenience and innovation in education [24]. The study results show that virtual reality has a good influence and impact on educational development. education can more easily reach various groups, not limited by space and time. Research regarding virtual reality in education continues to increase from year to year. This shows that virtual reality continues to be developed and integrated into education [25]. This has a significant impact on virtual reality, which will occur on a large scale and influence the application of education. this research may provide additional information to understand research trends using bibliometric analysis, as reported in previous reports.

5. CONCLUSION

This study aims to discuss virtual reality in education from literature review and bibliometric analysis. The VOS viewer capture method analyses virtual reality in education bibliometric data. Data was taken from 2013 to 2023. The results showed that the highest virtual reality in education research was in 2021. From the results,

research analysis of virtual reality in education has a significant influence. This can be seen from the data presented in VOS viewer. The results of this study are expected to be a consideration for scientists and other researchers to examine more deeply research related to virtual reality in education.

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