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Digital Learning Tools in Geography Education: A Systematic Literature Review

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Abstract: Digital learning tools not only enable the integration of technology in geography learning, but also bring a number of significant benefits to teaching methods and student understanding. However, it is difficult to find research that looks comprehensively and systematically at the use of digital learning tools in geography education. Therefore, this research aims to comprehensively examine the use of digital learning tools in Geography education. This research uses Systematic Literature Review (SLR) analysis which focuses on the types, impacts and obstacles in the use of digital learning tools in geography education. The data source in this research is the Scopus Database. This study analyzed13 articles from a total of 74 documents published in 2018–2023 which were screened by applying inclusion and exclusion criteria in three different rounds. This research shows that there are various types of digital learning tools used in geography education. In addition, the use of digital learning tools in geography education has had a positive impact. However, there were still a number of obstacles in implementing digital learning tools, such as limited technical resources, lack of additional training for teachers, as well as limited time, infrastructure and access, which need to be addressed immediately. The implication of these findings is the need to increase teacher training, improve educational technology infrastructure, and develop relevant curricula. In addition, the further research involving long-term evaluation and in-depth analysis of the impact of using digital learning tools will enrich understanding of the benefits of using technology in geography education.

Keywords: Digital learning tools, Geography education, Systematic literature review

Introduction

The rapidly developing digital era has brought significant changes. This can be characterized by the presence of digital technology which has changed many aspects of life, including the way of learning and teaching (Guillén-Gámez et al., 2023). In recent years, teaching tools have also changed due to developments in IT information technology (Choleva et al., 2022). These changes also provide new challenges and opportunities for the world of education (Farias-Gaytan et al., 2023). Learning is required to be more interactive, affordable and relevant to the demands of the times. The presence of technology in learning is expected to play a role in providing creative and innovative skills (Leavy et al., 2023). Therefore, learning outcomes and learning quality can be improved.

The presence of technology in education requires teachers to be able to adapt and adopt it to provide quality learning. Teachers need to align skills with the demands brought by technological advances in education (Camilleri & Calleja, 2023). The implementation of educational technology can be reflected in the use of digital learning tools. However, not all learning fields use digital learning tools optimally. Usually, this is due to various obstacles such as a lack of knowledge about the importance of digital learning tools in supporting

successful learning, limited knowledge in their application, and limitations in accessing, obtaining or using digital learning tool (Fergencs et al., 2020; Kibirige, 2023). In fact, the use of digital learning tools has great potential in improving the quality of learning (Cavalcanti et al., 2021).

In the context of geography education, the use of digital learning tools has become very important. One of the main challenges in geography education is how to describe and explain various geographical aspects which are often abstract or complex. This then emphasizes the importance of visual representation in geography learning, one of which can be obtained from digital learning tools. One study shows that the use of digital learning tools can create better understanding and stronger analysis (Lin et al., 2013).

Digital learning tools not only enable the integration of technology in geography learning, but also bring a number of significant benefits to teaching methods and student understanding. The utilization of these tools allows for more interactive geography learning, visualizing complex concepts, providing access to real-time geographic data, and giving students a more engaged and in-depth learning experience. The use of digital learning tools in geography education can also have the potential to provide more interesting and interactive learning experiences, increase students' understanding of geographic concepts, and prepare them for the challenges of an increasingly connected world (Strobl, 2007).

The previous explanation has shown that innovation in geography learning, especially through the use of digital learning tools, has great significance. Although some research in recent years has begun to examine the role of digital learning tools in geography education, the scope is still limited. Based on observations, these studies tend to focus on one particular digital learning tool and on specific geographic topics, while others lean more towards specific pedagogical aspects, and seek to assess their impact on student achievement. In addition, it is difficult to find research that looks comprehensively and systematically at the use of digital learning tools in geography education.

SLR (Systematic Literature Review) analysis is a research method used to identify, evaluate, and synthesize existing literature on a particular topic. This involves a systematic and rigorous process of searching for relevant studies, screening them based on predetermined inclusion criteria, and analyzing their findings. The goal of the SLR is to provide a comprehensive and unbiased summary of the available evidence regarding a particular research question (D. Davies et al., 2013). SLR helps in understanding the breadth and depth of existing research and identifies gaps for further research. Second, SLR makes it possible to organize, analyze, and synthesize groups of related literature to test specific hypotheses and/or develop new theories. Third, SLR can be used to evaluate the validity and quality of existing research (Xiao & Watson, 2019). SLR studies regarding the use of digital learning tools are still very limited. Only a few of them were found regarding the use of digital courseware used in teaching and learning in geography subjects for secondary school students (Ghafar et al., 2023). Apart from that, there is also research related to the evaluation of digital technology, such as GIS, which can be a relevant tool in teaching and learning geography (Konstantakatos & Galani, 2023). Based on these observations, no SLR analysis studies related to the use of digital learning tools in geography education have been found that are more comprehensive and systematic. Therefore, this SLR research wants to thoroughly examine the use of digital learning tools in geography education with systematic procedures according to SLR analysis. In this regard, there are several research question, namely (RQ1) What types of digital learning tools are used in geography education? (RQ2) What impact does the use of digital learning tools have in geography education? (RQ3) What obstacles are faced in using digital learning tools in geography education?

The use of digital learning tools is very important in the current and future educational context, because this not only reflects adaptation to technological advances, but is also an effort to improve the quality of learning through the use of innovative technology. This research is important because it will provide insight into the types of digital learning tools that are effective in geography education, help evaluate the impact of using digital learning tools in geography learning, and identify barriers to the use of digital learning tools in geography education. Ultimately, it is hoped that this will help educators and learning tool developers make better decisions about which learning tools to use to improve the effectiveness of teaching and learning

Method

This study follows the SLR methodology adopted from EPPI-Centre y (EPPI-Centre, 2007) and Acquah & Katz (Acquah & Katz, 2020), with relevant adjustments made to align with the research objectives. The stages in this SLR research were as follows:

1. Scoping the review
2. Searching for studies
3. Determining inclusion criteria and exclusion criteria
4. Study selection
5. Data analysis
6. Conclusions/recommendations

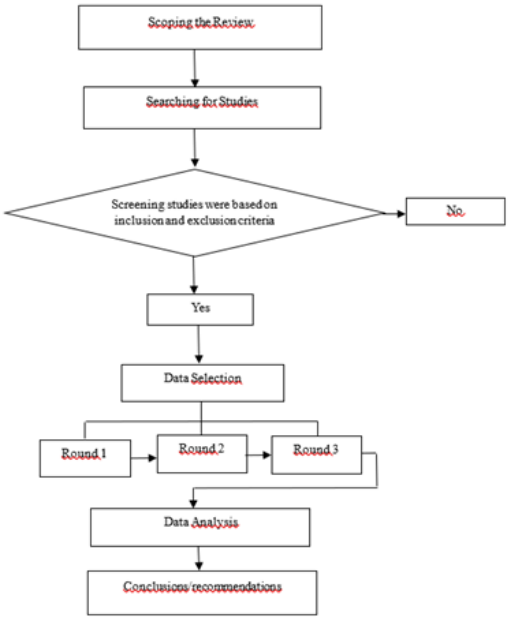

Figure 1. Flow chart illustrating systematic review process

Scoping the Review

At this stage, the research topic is clearly identified. Then proceed with formulating research questions, as explained in the introduction. This involves identifying the relevant type of study, the time period of the study, the language, and the specific topics or issues to be included in the analysis. This stage helps ensure that the research focuses on clear and relevant research questions, allowing for a more targeted and accurate literature search in line with the research objectives.

Searching for Studies

This section involves selecting a database and determining keywords used to search for literature according to the research topic. The data source in this research is the Scopus Database. The reason for choosing the Scopus Database is because Scopus is one of the largest curated abstract and citation databases, with extensive global and regional coverage of scientific journals, conference proceedings and books, while ensuring only high-quality data is indexed through rigorous content selection and re-evaluation by Independent Selection and Content Advisory Board (Baas et al., 2020).

In searching the literature, the author identified several things, namely (1) it must be related to digital learning tools or types of digital learning tools as part of technology in the world of education (2) Terms related to geography education should be included because the context of this research leads to use of digital learning tools in geography learning. Based on these considerations, the keywords used in the search are "Digital AND Learning AND Tools AND Geography AND Education".

Criteria for Inclusion and Exclusion

In this stage, inclusion and exclusion criteria are applied to select articles that are appropriate to the research topic. Titles and abstracts were reviewed to assess their relevance to the established research questions. In this research, research may only be included if it meets the criteria, namely (1) research in the form of scientific

journals; (2) studies published in the last 5 years, starting from 2018-2023; (3) Written in English, and (4) Research is available in full text form. Articles that do not meet these criteria will be removed from the list. In addition, publications were also filtered by excluding (1) Publications that did not discuss the use of digital learning tools in geography education; (2) Research that does not discuss the impact of using digital learning tools in geography education; (3) Research that does not discuss obstacles in using digital learning tools in geography education/learning.

Study Selection

In this data analysis, a search was carried out on the Scopus database in September 2023 with the keywords "Digital AND Learning AND Tools AND Geography AND Education". The search results were 74 documents which were then filtered in 3 rounds as follows:

1. Round 1 = The selected documents are documents originating from various countries, published in the period 2018-2023, only scientific articles, and written in English. The selection results can be seen in Table 1.
2. Round 2: Selecting titles and abstracts without paying attention to the quality of each document. The type of document chosen discusses the use of digital learning tools and geography education. The selection results can be seen in Table 1.
3. Round 3: A more detailed study is carried out, including the title, abstract, keywords and contents of the document to decide whether the document in question is worthy of further study or not. The learning results are digital and can be accessed in full text

Table 1: Data Selection Results

Data Sources	Keywords	Result Based on Keywords	Round 1		Round 2		Round 3	
			In	Ex	In	Ex	In	Ex
Scopus	Digital AND Learning AND Tools AND Geography AND Education	74	29	45	24	50	13	61

Results and Discussion

Based on the Systematic Literature Review method explained in the methodology section, 13 studies that met the criteria were identified and systematically reviewed to answer the research questions that had been formulated. The results of the study can be seen in Table. 2

Based on the table above, the analysis results show various types of digital learning tools used in geography education, including Digital Story Mapping, Web GIS, Geobrowsers and VR Platforms, GIS-based map archive system, GPS-enabled portable air pollution sensor, Geographic Information Systems (GIS), Web GIS Platform, Digital Atlas WebGIS Application, VR Oculus Rift headset, Instagram, OSM (OpenStreetMap), Google Maps, and ESRI applications, geo-editors, and geotag photos. This type of digital learning tool has been used to enhance the geography learning experience and create an interactive learning environment.

The use of digital learning tools in geography education has had a positive impact. These impacts include increasing ICT skills, increasing multi-literacy skills, active and student-centered learning, increasing geographical thinking skills, increasing understanding of spatial concepts, increasing digital competence, improving learning outcomes, increasing student motivation and engagement, and developing geographic skills and understanding of sustainability issues. These digital learning tools have also improved students' understanding of local air quality and spatio-temporal variations in air pollution concentrations through real-world experiences.

The use of digital learning tools in geography education is also faced with various obstacles. These obstacles include limited technical resources, lack of additional training for teachers, limited access and infrastructure, lack of skills and training for teachers and students, dependence on technology, lack of relevant content, digital divide, limited devices available, limited internet connection , platform complexity, limited knowledge and information, as well as limitations in data collection and interaction with the system.

Table 2: Literature identification results

Study	Year	Types of digital learning tools	The impact of digital learning tools	Obstacles to using digital learning tools
(Anunti, 2023)	2023	Digital Story Mapping	Improved ICT Skills, Improved Multi-literacy Skills, Active and Student-Centered Learning, Improved Geographical Thinking Abilities	Limited Technical Resources, Lack of Additional Training for Teachers, Time Limitations
(Puertas-Aguilar, 2023)	2023	Web GIS	Increase Understanding of Spatial Concepts, Improve Digital Competence, Improve Learning Outcomes, Increase Motivation and EngagementIncrease Motivation and Engagement	Limited Access and Infrastructure, Lack of Training and Skills, Lack of Training and Skills, Dependence on Technology, Lack of Relevant Content, and Digital Divide
(Daniele, 2022)	2022	Geobrowsers and VR Platforms	Improve geographic skills, Encourage understanding of sustainability issues, Increase student engagement, and Enrich learning experiences	Limited devices available, Limited internet connection, Lack of training, Platform complexity, Time limitations
(Bedair, 2022)	2022	GIS-based map archive system	Improves the learning process, increases student interaction with maps, and provides necessary learning tools. In addition, the use of digital technology in geography learning can create an interactive and efficient learning environment. With digital learning tools, students can more easily understand the material and develop their geography skills.	Limited Knowledge and Information, Skills in Changing Paper Maps to Digital, Suitability of Open Source Platforms, Teacher and Student Readiness
(Park, 2021)	2021	GPS-enabled portable air pollution sensor	Increase students' understanding of local air quality and spatial-temporal variations in air pollution concentrations through real-world experiences, as well as strengthen skills and knowledge gained in the classroom.	GPS Attachment Limitations, Sensor Data Limitations, Cost and Time Limitations, Privacy Limitations
(Labianca, 2021)	2021	Geographic Information Systems (GIS)	Development of critical thinking and greater awareness of continuous learning. Apart from that, the use of GIS has also encouraged the development of personal skills, critical thinking abilities, and active participation in society.	There is a need to have a "toolbox", there is limited time available and a lack of basic knowledge of students, the end user has a role that is not neutral and reflects the observer's point of view
(Csachová, 2020)	2020	Web GIS Platform	Increase student engagement, understanding and skills, spatial thinking, and relationships between subjects.	Limited digital skills of teachers, limited availability of digital technology equipment in schools, and lack of teacher training in the use of geospatial technology
(González, 2020)	2020	Digital Atlas WebGIS Application	Increased Spatial Thinking Ability, Increased Geographic Knowledge, Formation of Responsible and Active Spatial Citizenship, Instructional Effectiveness, Confirmation for	Lack of Teacher Involvement in Secondary Schools, Lack of Resources, Limited Research Samples, Level of Resistance to Technology:

			Geospatial Technology Integration	
(Detyna, 2020)	2020	VR Oculus Rift headset	Increases student engagement, helps them achieve learning goals, and provides an immersive visual experience	Confusion using hardware, differences in quantitative data between geography students in experiment 1 and experiment 2
(T. Davies, 2019)	2019	Instagram	First, it enables students and teachers to record, manipulate, and interpret a higher quantity and quality of visual data compared to previous technologies. Second, Instagram enables real-time student feedback and engagement, facilitating critical thinking and problem solving online. Additionally, incorporating Instagram into teaching practices helps connect students' familiarity with social media and encourages student-directed learning. Lastly, Instagram provides a platform for students to explore and interpret the world around them,	Understanding technology, dependence on technology, financial limitations, limitations in using Instagram, and obstacles in using Instagram in the field
(Huyer, 2019)	2019	OSM (OpenStreetMap), Google Maps, and ESRI applications, geo-editor" and "geotag photos	Increase students' understanding of digital maps, digital data analysis, and their implications, and enable students to explore and get to know more deeply the structure of the city or area around their school.	The need for ready access to use smartphones and computers as the main platform for learning
(Reynard, 2018)	2018	InterGEO: Moodle e-learning platform and videoconferencing technology	Dissemination of Knowledge, Expanding Access, Collaboration between Universities, Complementing Conventional Lectures, Student Involvement	Content that does not conform to partner universities' teaching plans, Future evolution of the platform, Student engagement and successful learning, Copyright issues, Language
(Pingel, 2018)	2018	JavaScript based web-map	First, this tool increases student interest and involvement in learning by providing an experience similar to playing games. Second, this tool helps students build global cognitive maps in a more structured and coherent way. Third, this tool provides additional insight into how students construct their understanding of spatial relationships in the world.	Limitations of Data Collection, Limitations of Interaction with the System, Limitations of the Tool Itself

Apart from that, there are also obstacles such as limited GPS devices, limited sensor data, limited costs and time, privacy, lack of teacher digital skills, limited digital technology devices in schools, lack of teacher training in the use of geospatial technology, insufficient teacher involvement in secondary schools, lack of resources, limited research samples, and level of resistance to technology. There are still obstacles such as confusion in using hardware, understanding of technology, dependence on technology, financial limitations, limitations in using Instagram, as well as obstacles in using Instagram in the field.

The level of need for easy access using smartphones and computers as the main platform for learning is also an obstacle. There are also obstacles related to content that does not match the teaching plan, future evolution of the platform, student engagement and learning success, copyright issues, and language. Finally, there are obstacles related to interaction with the system, and limitations of the tool itself.

The results of this analysis provide a comprehensive picture of the types of digital learning tools used in geography education, the impacts obtained from their use, and the obstacles faced by educators and students in adopting this technology. This knowledge can be the basis for developing more effective strategies for integrating digital learning tools in geography education..

This research reveals valuable findings related to the use of digital learning tools in geography education. There are three main aspects that need to be considered in the context of this discussion: diversification of digital learning tools, positive impact on student learning outcomes and skills, and challenges in implementation.

First, the diversification of digital learning tools is one of the most striking aspects of these findings. The types of digital learning tools that have been identified, such as Digital Story Mapping, Web GIS, and VR Platforms, show great potential in enriching the geography learning experience (Daniele, 2022; Huyer, 2019). This diversification gives educators the opportunity to present material in interesting and varied ways (Bedair, 2022), increasing student engagement (Csachová, 2020; Daniele, 2022; Detyna, 2020; Pingel, 2018) and accommodating various learning styles.

Second, the use of digital learning tools in geography education appears to have a significant positive impact on student learning outcomes and skills (Park, 2021; Puertas-Aguilar, 2023). Improved ICT skills, multi-literacy skills, and geographical thinking abilities emphasize the importance of integrating these digital tools in the learning process (Anunti, 2023; Daniele, 2022). The results of this study also noted increased student motivation and engagement, which can promote more effective and student-centered learning (Anunti, 2023; Davies, 2019; Puertas-Aguilar, 2023).

Third, the challenges in implementing digital learning tools are an aspect that cannot be ignored. Obstacles such as limited technical resources (Anunti, 2023; González, 2020), lack of additional training for teachers (Anunti, 2023; Csachová, 2020; Daniele, 2022; Puertas-Aguilar, 2023), as well as limited time (Anunti, 2023; Daniele, 2022; Labianca, 2021), infrastructure and access (Puertas-Aguilar, 2023), need to be overcome immediately. Issues such as platform complexity, lack of relevant content (Daniele, 2022; Puertas-Aguilar, 2023; Reynard, 2018), and the digital divide require serious attention in order to ensure maximum utilization of these digital tools in the context of geography education (Puertas-Aguilar, 2023).

Conclusion

This study provides valuable insight into the use of digital learning tools in geography education. The findings show that the use of digital learning tools has great potential to enrich geography education in the digital era, with the important note that the challenges in implementation need to be given serious attention so that the benefits can be realized. Diversifying digital learning tools can produce more interesting and varied learning experiences, as well as improve students' understanding of geography concepts. Positive impacts are also seen in improving students' ICT skills, multi-literacy skills, and geographical thinking abilities, which makes the integration of digital tools a valuable asset in achieving educational goals. However, challenges in implementation, including limited resources and teacher training, as well as gaps in access and infrastructure, need to be addressed so that the benefits of digital learning tools can be felt equally. The implication of these findings is the need to increase teacher training, improve educational technology infrastructure, and develop relevant curricula. In addition, further research involving long-term evaluation and in-depth analysis of the impact of using digital learning tools will enrich understanding of the benefits of using technology in geography education. This will help in developing best practices and ensuring that technology is used effectively to improve student learning outcomes and skills. By taking these steps, geography education can keep up with the times and ensure that students are ready to face the demands of an increasingly digital world.

Recommendations

Based on the results of research regarding the use of digital learning tools in geography education, recommendations that can be taken are to improve teacher training in terms of use, handling and maintenance of

digital devices and software. Schools and educational institutions need to invest in adequate technological infrastructure, including stable internet access and the latest hardware. The development of a geography curriculum that includes relevant digital learning tools should also be prioritized. It is important to continue to carry out in-depth evaluations of the effectiveness of using technology in geography learning and overcome technical barriers such as limited resources. Collaboration between teachers and educational institutions in the exchange of experiences will also enrich the implementation of technology in geography teaching.

Scientific Ethics Declaration

Budi Rahmah Panjaitan., Epon Ningrum., and Bagja Waluya declare that the scientific ethical and legal responsibility of this article published in EPESS journal belongs to the authors.

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