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Using Digital Technologies in the Geography Lesson

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Abstract

Rapid advances in technology have profoundly transformed daily life and all spheres of human activity, including education. In this context, one of the central responsibilities of geography teachers is the development of students' geographical information competence, or geographical literacy, which is inseparable from digital and media literacy. The integration of digital technologies in geography lessons facilitates the presentation of educational material in diverse forms and formats, thereby enhancing the effectiveness of the learning process and optimizing student engagement. The multimedia nature of digital resources makes it possible to visualize geographical phenomena, processes, objects, and locations, effectively creating virtual journeys to various regions, countries, cities, or villages. Such technologies thus provide powerful learning environments that enrich students' educational experiences. Given that smartphones, computers, social media, and the Internet are already integral to students' daily lives, leveraging these tools provides access to a wide range of geographic information sources and strengthens geographical competence and literacy. A variety of digital resources are commonly employed in geography teaching, including multimedia products, digital educational platforms, websites of scientific and educational institutions, electronic interactive maps, online calculators, digital simulations, and educational computer games. In recent years, the integration of artificial intelligence (AI) into education has become increasingly widespread, offering unique opportunities to improve learning quality, foster engagement, and support personalized education. Within geography education, AI not only expands the pedagogical toolkit available to teachers but also enables students to acquire deeper and more interactive knowledge. Personalized learning pathways, interactive and virtual environments, data-driven analysis, and audiovisual resources all contribute to richer and more engaging learning experiences. The application of AI in geography lessons significantly enhances teaching effectiveness and student motivation. With the assistance of AI-based tools, students can explore diverse geographical objects and their characteristics, examine the scale and dynamics of geographical processes and events, generate forecasts, and apply acquired information to conduct geographical research. Moreover, the use of digital technologies supports teachers in assessing students' knowledge and skills, organizing and consolidating learning outcomes, managing classroom time more efficiently, and presenting instructional content in a vivid and engaging manner.

Keywords: teaching geography, digital technologies, artificial intelligence, education

Introduction

As Lambert notes, "*Geography in education has a reputation for being an early adopter of technologies – after all, it is an information-rich subject with an intrinsic interest in a rapidly changing world, and information is now instantly available at the touch of a button; indeed, we are soaked in information*" (Walshe & Healy, 2020).

Rapid technological advances have transformed virtually every aspect of modern life, including education (Selwyn, 2017). Digital technologies have reshaped pedagogical practices, creating new opportunities for interaction, collaboration, and information sharing (Redecker, 2017). Within this evolving educational landscape, geography education has increasingly embraced digital tools to foster geographical literacy—a competency that encompasses the ability to acquire, evaluate, and apply geographic information (Lambert, 2019). Geographical literacy today is inseparable from digital and media literacy, as these skills enable students to navigate, interpret, and critically assess digital information sources (Hobbs, 2017; Buckingham, 2013).

The integration of digital technologies in geography lessons has been shown to enhance teaching effectiveness by presenting educational content in diverse formats and enabling richer learning experiences (Jenkins et al., 2009; Goodchild, 2010). Multimedia resources, including interactive maps, virtual simulations, and audiovisual materials, allow students to visualize complex geographical phenomena and processes, effectively creating virtual journeys to different regions, countries, or environments (Demirci et al., 2013). Such approaches foster engagement and support deeper conceptual understanding by providing immersive and experiential learning opportunities.

Given the centrality of smartphones, computers, social media, and the Internet in students' daily lives, geography teachers are increasingly encouraged to leverage these tools as authentic learning resources (Selwyn, 2016; Warschauer & Grimes, 2007). Digital platforms and resources—such as educational websites, online calculators, GIS applications, and interactive simulations—offer rich opportunities for accessing geographic data and fostering critical thinking skills (Voogt & Roblin, 2012).

In recent years, the integration of artificial intelligence (AI) in education has emerged as a transformative trend. AI provides personalized learning pathways, adaptive feedback, and advanced data analysis capabilities, thereby enhancing both teaching and learning processes (Luckin et al., 2016; Holmes et al., 2019). Within geography education, AI-powered tools such as spatial data analysis software, immersive VR platforms, and intelligent tutoring systems enable students to explore geographic objects, analyse spatial processes, and model geographic phenomena at unprecedented levels of depth (Batty, 2018; Goodchild, 2010). These capabilities not only enrich students' engagement but also strengthen their geographical competence by facilitating the integration of real-world data into learning activities.

Furthermore, digital and AI-based technologies support teachers in planning, assessing, and delivering geography lessons more effectively. They offer tools for monitoring student progress, organising learning materials, and optimising classroom time (Redecker, 2017; Jisc, 2019). Interactive digital environments, simulations, and data visualisations allow for more vivid and meaningful presentations of geographic content, thereby fostering deeper learning and critical inquiry (Demirci et al., 2013).

Thus, the growing body of research underscores that the effective integration of digital and AI technologies into geography education not only enhances instructional quality but also equips students with the knowledge, skills, and critical capacities necessary to navigate the complexities of a digitally mediated and interconnected world (Lambert, 2019).

Within this context, one of the central responsibilities of geography teachers is the development of students' geographical information competence—or, more broadly, geographical literacy (Bliadze, 2015; Bliadze, 2020a; Bliadze, 2020b). This competence encompasses the ability to independently locate, select, analyze, process, and apply geographic information, as well as to communicate findings effectively through oral, written, and digital means.

Methods and Materials

The development of geographical literacy in contemporary education is inseparable from digital and media literacy, which encompasses not only knowledge and skills but also attitudes. When guided by legal and ethical principles, this literacy enables the effective and purposeful use of digital technologies through the acquisition, organization, evaluation, and creation of information.

In the modern classroom, the global information network is a shared space for both teachers and students. Consequently, teachers are expected to possess not only adequate computer literacy but also

a solid grounding in pedagogy and child psychology. Professional experience in schools serves as a filter that allows teachers to select, adapt, and integrate information effectively. Combined with tailored teaching materials, the internet thus provides valuable opportunities to design engaging and innovative geography lessons. Rather than prescribing a fixed set of methods, digital resources contribute to more flexible and creative instructional practices, supporting the development of meaningful learning activities.

The integration of digital technologies allows educational content to be presented in multiple formats, thereby improving the efficiency of the learning process and optimizing students' participation. Digital resources can make geographical phenomena, processes, and locations more visible, offering students the opportunity to virtually "travel" across regions, countries, cities, and villages. As smartphones, computers, social media, and the internet are already central to students' daily lives, leveraging these tools in the classroom provides access to diverse geographic information sources while simultaneously strengthening both geographical competence and literacy.

Digital resources also support personalized and individualized learning, enabling teachers to design flexible learning pathways that encourage innovation and creativity. In geography lessons, technologies are employed with two primary aims: (1) to enhance the effectiveness of teaching through technical means and (2) to provide students with opportunities to adapt learning content and create digital products of their own. Depending on the topic and objectives of a lesson, geography teachers may utilize a wide range of digital tools, including hardware (cameras, recorders, scanners, printers), software (office applications, media editors, GIS programs, associative mapping tools), and online resources for searching, publishing, and sharing materials. Sequencing these tools strategically ensures novelty and sustained engagement; for instance, students might begin by creating tables or graphs, progress to using digital mapping software, and ultimately produce presentations, interactive maps, or multimedia projects. Such activities encourage students to compile original outputs that synthesize knowledge around specific topics.

Digital technologies further allow for the rapid manipulation of maps, graphs, and data at varying scales, which greatly enhances students' analytical skills. Applications such as Google Earth, *Worldmapper*, and *Gapminder* provide interactive opportunities to reframe perspectives on global and regional issues, fostering critical engagement with spatial information. Unlike static printed maps, electronic tools not only present material more dynamically but also empowers students to become active creators of learning resources. They are equally valuable in project-based learning, especially in the preparation of final presentations. Platforms such as Adobe Spark, Canva, and Microsoft PowerPoint allow the integration of maps, images, videos, and text into coherent, visually engaging outputs. Collaborative tools such as Google My Maps and ArcGIS StoryMaps further enable students to co-create digital maps, annotate content, and share results in real time, reinforcing teamwork and digital collaboration skills.

- ✓ A wide array of resources can be employed in teaching geography, including:
- ✓ Multimedia products (documentaries, films, animations, audio recordings).
- ✓ Educational websites (e.g., National Geographic, Khan Academy).
- ✓ Websites of academic and research institutions (e.g., *World Resources Institute, GEBCO, Vakhushti Bagrationi Institute of Geography, Ivane Javakhishvili Tbilisi State University*).
- ✓ Interactive maps (e.g., *Google Earth, National Geographic MapMaker, Earthquakes & Volcanoes, UN SDG* dashboards).
- ✓ Online calculators (e.g., *CO_2 footprint calculators, water use calculators*).
- ✓ Digital simulations (e.g., *PhET, Our World in Data*).
- ✓ Official databases (e.g., *Census Bureau, Geostat, DataLab*).
- ✓ Websites of international organizations (e.g., *World Economic Forum, UNICEF, NATO/EU Information Center, National Environmental Agency of Georgia*).
- ✓ Blogs and specialized geography portals (e.g., *Geography.ge*).
- ✓ Educational computer games (e.g., *World Geography Games, Geojigsaw, PurposeGames*).

Together, these tools enrich geography education by fostering creativity, critical thinking, and digital competence, while also broadening students' spatial awareness and global perspective.

Results

In recent years, the use of artificial intelligence (AI) in education has gained considerable popularity. AI offers unique opportunities to enhance learning quality, foster student engagement, and support personalized instruction.

The integration of AI into geography education provides substantial benefits for both teachers and students. In geography lessons, AI not only expands the range of teaching tools available but also enables students to acquire deeper and more interactive knowledge. Personalized learning pathways, immersive virtual environments, advanced data analysis, and the incorporation of audiovisual resources contribute to richer and more engaging educational experiences. As a result, the integration of AI into geography lessons significantly improves teaching effectiveness and strengthens student motivation.

Through modern technologies and instruments, AI can collect, process, and analyze vast amounts of geographic data, allowing students to explore diverse aspects of geography—from the geological structure of mountains and climate dynamics to demographic trends, cultural traditions, and settlement patterns. This capacity enables a comprehensive and multi-layered understanding of both natural and human processes.

Opportunities of AI in Geography Education

Personalized learning: AI-powered systems such as intelligent tutors, adaptive platforms, and individualized study plans provide tailored support aligned with students' prior knowledge, learning pace, and needs. For instance, systems like IBM Watson can generate personalized curricula that adjust dynamically to students' progress.

Interactive and virtual environments: The combination of AI and virtual reality (VR) creates unique opportunities for experiential learning. Tools such as Google Earth VR and National Geographic VR allow students to virtually explore different regions, observe climate change impacts, and gain first-hand insights into natural processes.

Data analysis and visualization: AI tools facilitate big data analysis and visualization, which are crucial for geographical research. Platforms such as Tableau and Power BI enable students and teachers to examine trends in climate change, population dynamics, and resource distribution.

Audiovisual resources: AI applications in speech and image recognition, such as Google Voice and Amazon Rekognition, can enrich lectures, webinars, and digital teaching materials, making them more interactive and accessible.

Interactive maps: AI-powered mapping tools such as ESRI ArcGIS enable students to analyze real-time geographic data, track environmental and demographic changes, and engage in spatial problem-solving.

Geographic simulations: Simulation platforms, such as those developed by UNIGIS, allow students to model and explore natural and human processes, thereby deepening their understanding of environmental and social interactions at both global and local scales.

Challenges of AI Integration

The implementation of AI in geography education is not without challenges. Successful integration requires careful curriculum planning, comprehensive teacher training, and equitable access to technology. In Georgia, particularly in rural areas, many public schools remain inadequately equipped with technical resources. Limited internet access further restricts the use of digital and AI-based tools. Additionally, not all students have access to personal computers or laptops at home, creating disparities in opportunities for digital learning.

Language barriers present another significant obstacle. Geographic information resources in the Georgian language remain limited, while a large proportion of teachers and students lack proficiency in English or other languages, restricting their access to high-quality international materials.

The Role of Technology in Geography Education

Despite these challenges, technology plays a crucial role in supporting teachers. It assists with assessing students' knowledge and skills, organizing and consolidating learning outcomes, optimizing lesson time, and presenting content in a vivid and dynamic manner. However, the integration of educational technologies should not replace traditional teaching methods. Rather, digital tools should complement established pedagogical approaches as part of a balanced methodology.

When planning the use of AI and other technologies, teachers must consider three key factors: (1) students' level of digital competence, (2) the availability of technical infrastructure, and (3) the specific objectives of the lesson. While the preparation and effective use of technology-based resources can be time-consuming—requiring teachers to identify, adapt, and evaluate online materials—the benefits in terms of student engagement and learning outcomes make this investment worthwhile.

Ultimately, AI and digital technologies, when used thoughtfully and inclusively, have the potential to transform geography education into a more interactive, personalized, and meaningful learning experience, equipping students with the skills and knowledge necessary to understand and navigate the complexities of the modern world.

Conclusion

Therefore, incorporating technology into geography lessons enables teachers to create dynamic, interactive learning experiences that enhance student engagement while deepening their geographical competence and understanding of the world's diverse environments.

Competing interests

The authors declare that they have no competing interests.

Authors' contribution

M.B. and M. S. conceived of the presented idea. All authors provided critical feedback and helped shape the research, analysis and manuscript.

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