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INNOVATIVE APPROACHES TO GEOGRAPHY LEARNING: A QUALITATIVE STUDY ON THE DEVELOPMENT OF GEO-CAPABILITIES

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ABSTRAK

Abstrak: Pendidikan geografi saat ini menghadapi berbagai tantangan, di antaranya keterbatasan akses terhadap teknologi, kurangnya pelatihan guru, serta dominasi metode pengajaran tradisional yang kurang mendukung pengembangan kemampuan geografi secara optimal. Penelitian ini bertujuan untuk mengidentifikasi tantangan sekaligus mengeksplorasi potensi pengembangan *geo-capabilities* di kalangan guru geografi di Jawa Timur dalam konteks keterbatasan tersebut. Penelitian ini menggunakan pendekatan kualitatif dengan jenis studi kasus, melibatkan 20 guru geografi dari berbagai sekolah sebagai partisipan. Data dikumpulkan melalui wawancara mendalam, observasi kelas, dan dokumentasi pembelajaran. Hasil penelitian menunjukkan bahwa *geo-capabilities* mencakup kemampuan mengintegrasikan pengetahuan geografi dengan teknologi digital, yang dapat meningkatkan keterampilan analisis data spasial, pemikiran kritis, dan pemecahan masalah. Faktor-faktor pendukung utama meliputi pelatihan profesional berkelanjutan, ketersediaan sumber daya digital, dukungan administrasi sekolah, serta jaringan kolaboratif antar guru. Meskipun dihadapkan pada sejumlah kendala, studi ini merekomendasikan pentingnya pelatihan teknis yang berkelanjutan, integrasi teknologi ke dalam kurikulum, dan penguatan kolaborasi guru untuk meningkatkan kualitas pembelajaran geografi dan menyiapkan siswa menghadapi tantangan abad ke-21.
Kata Kunci: *geo-capabilities, teknologi digital, GIS, pendidikan geografi, strategi pembelajaran inovatif*

Abstract: *Geography education currently faces various challenges, including limited access to technology, inadequate teacher training, and the dominance of traditional teaching methods that hinder the optimal development of geographical competencies. This study aims to identify the challenges and explore the potential for developing geo-capabilities among geography teachers in East Java under such limitations. A qualitative case study approach was employed, involving 20 geography teachers from different schools as participants. Data were collected through in-depth interviews, classroom observations, and document analysis. The findings reveal that geo-capabilities encompass the ability to integrate geographical knowledge with digital technologies, which enhances spatial data analysis, critical thinking, and problem-solving skills. Key supporting factors include continuous professional development, availability of digital resources, administrative support from schools, and collaborative teacher networks. Despite existing constraints, this study recommends the implementation of ongoing technical training, curriculum integration of digital tools, and strengthened teacher collaboration to improve geography learning outcomes and better prepare students to meet 21st-century challenges.*
Keywords: *Geo-capabilities, digital technology, GIS, geography education, innovative learning strategies*

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A. INTRODUCTION

In recent years, geography education has transformed significantly due to technological advancements and curriculum changes. The use of information technology in geography education enhances students' understanding of geospatial concepts (Wise, 2018). A study found that students using digital map-based applications showed significant improvement in mapping and spatial analysis skills compared to conventional methods. Integrating technology into geography education facilitates more interactive and participatory learning, increasing student interest and motivation (Felix, 2021).

Theoretically, the development of geo-capabilities involves students' ability to understand and apply geographical concepts in real-life contexts. Constructivist theory, which advocates for student-centered and active learning (Vygotsky & Cole, 1978), supports geography education approaches that emphasize critical and analytical skills through technological tools. Experiential learning theory, which highlights the importance of concrete experiences and active reflection (Kolb, 2014), is also relevant. Innovative approaches like project-based learning and geospatial simulations provide meaningful learning experiences for students.

Empirical evidence indicates that many schools have not fully utilized technology in geography education. Major barriers include limited access to technology and lack of teacher training (Artvinli, 2017). Many teachers rely on traditional methods, which are less effective in developing geo-capabilities (Ardiani & Mushoddik, 2024). Research shows that innovative approaches, such as project-based learning, can enhance collaborative and problem-solving skills (Kokotsaki et al., 2016), and geospatial simulations can improve understanding of complex geographical phenomena (Favier & van der Schee, 2014).

Several studies have emphasized the urgent need to bridge the gap between the availability of technological tools and their actual implementation in the classroom. For instance, Kerski et al. (2013a) revealed that although GIS and digital mapping technologies are increasingly accessible, their usage in schools remains limited due to a lack of pedagogical integration and teacher confidence. Similarly, Ertmer et al. (2006a) found that teachers' beliefs, school culture, and institutional support significantly influence the effective use of technology in teaching. These findings underscore the importance of exploring not only the technical aspects but also the instructional and contextual dimensions of geo-capabilities development. Given the evolving demands of 21st-century education, there is an urgent need to examine how geography teachers can be empowered to adopt innovative strategies that make learning more relevant, participatory, and skill-oriented. This study seeks to fill that gap by investigating how teachers in East Java navigate these challenges and what practical insights can be drawn to inform broader educational reforms.

Geography education is crucial for raising environmental awareness and social responsibility among students. It helps students understand global issues like climate change, sustainability, and social inequality, aligning with 21st-century education goals. Students with well-developed geo-capabilities are better equipped to address environmental and social problems. This research aims to explore innovative approaches in geography education to develop students' geo-

capabilities and provide insights for teachers and policymakers to design effective teaching strategies.

B. METHODS

This study employs a qualitative approach to explore the impact of innovative teaching strategies on the development of geo-capabilities among geography teachers. A qualitative approach allows researchers to gain a deep understanding of the teachers' experiences and perceptions in real-world contexts (Creswell, 2014). The type of research used is a case study, focusing on geography teachers in East Java as the subjects. Case studies provide in-depth insights into the phenomena being investigated and allow for detailed analysis of the factors influencing the development of geo-capabilities.

The subjects of this study are 20 geography teachers selected from various schools in East Java. These teachers were chosen based on their experience of using digital tools and innovative teaching strategies in their geography teaching for at least one year. The research setting includes the school environments where these teachers teach, as well as the teaching and learning activities involving digital tools and innovative strategies. This setting allows the researcher to directly observe the implementation of these strategies and their impact on the development of geo-capabilities.

Data collection techniques include in-depth interviews, classroom observations, and documentation. In-depth interviews are conducted using a semi-structured format, allowing for an in-depth exploration of the teachers' experiences and perceptions. Classroom observations are carried out to directly observe the implementation of digital tools and innovative teaching strategies. Additionally, documentation such as lesson plans, teaching materials, and student products are collected for further analysis. This multi-method approach ensures comprehensive data collection.

Data analysis uses thematic analysis based on the approach by (Miles & Huberman, 1994). The steps of data analysis include transcribing the interviews, initial coding to identify key themes, and grouping themes to find related patterns. Data are interpreted within the context of existing theory and literature to provide deeper insights into the impact of innovative teaching strategies on geo-capabilities. The validity of the data is ensured through data triangulation, member checking, and audit trails, ensuring that the research findings are trustworthy and reliable.

C. RESULT AND DISCUSSION

1. Results

1.1 Definition of Geo-Capabilities in Geography Education

Based on the analysis of interview data, 85% of respondents defined geo-capabilities as the ability to integrate geographical knowledge with digital technology. These capabilities are not viewed merely as a set of technical skills, but rather as a holistic integration of conceptual understanding, critical analysis, and digital literacy. The majority of respondents emphasized that geo-capabilities enable students to analyze spatial data, understand geographical phenomena, and connect theoretical knowledge with practical, real-world applications. This integrated competence is considered essential for equipping students to interpret complex spatial relationships and make informed decisions in a dynamic and interconnected global context.

In addition, several teachers elaborated that geo-capabilities encompass attitudes and competencies that empower educators to effectively facilitate geography learning. These include cognitive abilities such as reasoning and analysis, affective traits like curiosity and environmental responsibility, and psychomotor skills related to the use of digital tools such as GIS applications. One teacher emphasized that the use of digital tools in classroom practice is not a complement but a central feature of effective geography instruction, especially in helping students visualize abstract concepts and apply them in authentic settings. This underscores a growing consensus among educators that fostering geo-capabilities is critical to preparing students with 21st-century competencies.

1.2 Experiences Using Digital Tools in Geography Teaching

Respondents described various experiences in using digital tools such as GIS (Geographic Information System) and mapping applications in geography teaching. One teacher shared how they used GIS for environmental mapping projects, enabling students to collect and analyze data related to local environmental conditions. Through these projects, students not only applied geographical concepts but also developed critical thinking and spatial reasoning skills. Another teacher reported utilizing digital mapping tools to teach about population dynamics, migration patterns, and urban growth, allowing students to explore demographic data across different regions interactively.

13 out of 20 respondents (65%) reported implementing digital tools for more advanced instructional purposes. These included activities such as climate data analysis, land-use classification, and the creation of interactive maps for case-based learning scenarios. Rather than merely functioning as delivery tools for geographic content, these technologies were strategically used to foster inquiry-based learning, facilitate geographical simulations, and enable comparative analyses between regions. According to the respondents, the adaptability and instructional depth offered by these tools also enhanced the effectiveness of differentiated instruction, making abstract geographical processes more accessible and concrete for diverse student needs.

1.3 The Impact of Digital Tools

The findings of this study unequivocally demonstrate that digital tools have profoundly transformed the landscape of geography education, influencing both teaching methodologies and student learning experiences. One of the most notable impacts is the enhanced engagement and interaction of students in the classroom. Digital tools such as Geographic Information Systems (GIS), remote sensing platforms, and interactive mapping applications allow students to visualize complex spatial data in ways that traditional static maps or textbooks cannot provide. These technologies enable dynamic exploration of geographic phenomena such as climate patterns, land use changes, and population density variations, making abstract concepts more concrete and relatable.

Moreover, digital tools have shifted the role of students from passive recipients of information to active participants in the learning process. Through the use of simulations, virtual field trips, and data-driven geographic inquiries, students are encouraged to investigate problems, interpret data, and construct solutions collaboratively. This active engagement fosters not only cognitive skills such as critical thinking and spatial reasoning but also soft skills like communication and teamwork. Teachers in this study reported that students showed increased motivation and confidence when working with digital platforms, particularly in project-based tasks and real-world applications. In this way, the

integration of digital tools contributes not only to the enrichment of geography education but also to the cultivation of independent, digitally literate learners prepared to navigate and address contemporary global challenges.

1.4 Innovative Teaching Strategies

Geography teachers in East Java have embraced a diverse array of innovative teaching strategies to enhance the effectiveness of their instruction. These strategies encompass project-based learning with digital tools, collaborative learning using technology, and problem-based learning with real-world cases. Other strategies include gamification, simulations, digital fieldwork-based learning, flipped classroom implementation, and multimedia integration.

Project-based learning, often combined with tools such as GIS and digital mapping software, allows students to conduct investigations on environmental and urban issues in their local contexts. This not only deepens conceptual understanding but also encourages the application of knowledge in solving real-life problems. Teachers noted that collaborative learning using cloud-based platforms and shared data sets promotes teamwork, communication skills, and shared responsibility among students. Problem-based learning, on the other hand, provides opportunities for students to engage with authentic geographical issues—such as disaster management or land-use conflicts—through guided inquiry and research.

Gamification strategies were implemented through the use of digital quizzes, interactive challenges, and point-based reward systems, which increased student motivation and classroom participation. Simulations such as natural disaster scenarios or climate modeling offered students experiential learning environments where they could explore complex processes safely and realistically. In addition, the integration of multimedia—including videos, animations, and infographics—enabled teachers to accommodate different learning styles. The flipped classroom model was also frequently cited, wherein students reviewed instructional content at home and used classroom time for discussions, group tasks, and practical applications. Collectively, these innovative strategies have created more dynamic, student-centered geography learning environments that foster deeper understanding and skill development.

1.5 Problem-Based Learning (PBL)

Problem-based learning (PBL) has gained widespread traction among geography teachers in East Java as a pedagogical method to illuminate intricate geographical concepts. Teachers reported that PBL empowers students to actively engage in solving real-world problems, which in turn fosters the development of critical thinking, analytical reasoning, and collaborative problem-solving skills. One teacher cited the use of real-time climate change data to guide student investigations into the impacts of global warming across various regions. This approach encouraged students to synthesize information, draw comparisons, and propose viable solutions, thereby enhancing their understanding of environmental geography.

Furthermore, several teachers implemented PBL through field-based projects, such as mapping urban development impacts using GIS tools and conducting water pollution studies in local rivers. These activities required students to collect, process, and analyze geographic data, applying their classroom knowledge in meaningful, context-rich environments. In addition to improving academic competencies, PBL was also credited with increasing student motivation and environmental awareness. By confronting authentic challenges, students

developed a deeper appreciation for geography's relevance to society and the environment, aligning with the broader goals of 21st-century education.

1.6 Collaborative Learning in Geography Education

Geography teachers across East Java have embraced collaborative learning strategies to promote cooperation and interaction among students in the learning process. These include group discussions, collaborative projects, team-based learning, community partnerships, and school-to-school collaborations.

Teachers reported that group discussions encouraged students to exchange ideas and perspectives on complex geographical issues, promoting critical thinking and deeper understanding through dialogue. Collaborative projects, often facilitated by digital tools such as shared documents and mapping software, allowed students to work together in solving real-world problems, such as urban planning or disaster mitigation. Team-based learning approaches provided a structured framework for students to take responsibility for specific roles, enhancing leadership and organizational skills while reinforcing content mastery through peer support.

Moreover, community partnerships—such as working with local environmental agencies or neighborhood associations—enabled students to engage directly with societal challenges, applying their geographical knowledge to contribute to real-world solutions. Collaborations between schools also broadened students' exposure to different perspectives and fostered inter-school networks of learning.

2. Discussion

2.1 Definition of Geo-Capabilities: Theoretical and Empirical Anchors

The concept of geo-capabilities, as revealed in this study, aligns with theoretical frameworks that view geography education as a multidimensional process encompassing technical, cognitive, and affective domains. Lambert & Morgan (2010) argue that a solid conceptual foundation in geography is essential for students to apply geographic knowledge effectively in practical settings. This is supported by Lee & Bednarz (2009), who highlights the role of Geographic Information Systems (GIS) in enhancing spatial reasoning, and Baker & White (2003), who emphasize how digital tools can foster critical thinking. Lemmens (2011) further supports the notion that technology integration boosts student motivation and engagement, adding an affective dimension to geo-capabilities.

Empirical data from this study corroborate these theoretical assertions. Teachers frequently described geo-capabilities not only as digital proficiency but also as an integrated competency involving analytical thinking, environmental awareness, and the use of digital platforms like GIS in real-life teaching scenarios. One respondent noted that applying GIS tools enabled students to contextualize geographical phenomena more vividly, while another emphasized the cognitive shift in students toward data-driven decision-making. These empirical observations confirm that geo-capabilities are more than a technical skillset; they represent a pedagogical paradigm that blends theoretical understanding with practical relevance in the geography classroom. The findings from the field affirm that geo-capabilities are a multi-dimensional construct involving not only technical proficiency with digital tools but also conceptual and affective components. This aligns with . Lambert & Morgan (2010), who emphasize that strong conceptual foundations are critical for effective geography education. Egiebor & Foster (2019)

shows that using GIS fosters spatial awareness, while Baker & White (2003) found that technology improves students' critical thinking. Lemmens (2011) also supports the idea that technology enhances student motivation. These perspectives collectively validate the respondents' understanding of geo-capabilities as complex, holistic competencies.

2.2 Use of Digital Tools in Practice

Field data from this study illustrate the practical integration of digital tools by geography teachers across East Java. Teachers reported using tools such as Geographic Information Systems (GIS), mapping applications, and climate data platforms to facilitate student engagement with real-world geographic problems. Applications ranged from urban growth analysis and population studies to environmental mapping projects. These tools enabled students to collect, visualize, and interpret spatial data, promoting inquiry-based learning and deeper conceptual understanding. Notably, 65% of respondents indicated that they used digital tools not only to deliver content but also to guide students through exploratory and problem-solving activities within authentic geographic contexts.

These classroom practices resonate with findings in existing literature that highlight the pedagogical benefits of digital tools in geography education. According to Kerski et al. (2013), GIS provides a powerful platform for experiential learning and spatial thinking. Chen (2021) confirmed that using GIS enhances students' analytical and critical thinking abilities, while Hallinger & Wang (2020) emphasized the motivational impact of simulations in geography instruction. These studies support the argument that the use of digital tools fosters active learning, improves academic performance, and equips students with essential 21st-century skills. Thus, the experiences of teachers in East Java not only reflect a commitment to innovative instruction but also affirm broader global trends in digital geography education. The experiences shared by teachers reflect the potential of digital tools to enrich geography instruction. The use of GIS for fieldwork, mapping applications for demographic studies, and climate data analysis demonstrates their adaptability and practical value. These practices reflect constructivist learning theory, emphasizing hands-on, contextualized learning. GIS improves students' critical thinking, and demonstrate the motivational benefits of simulation-based instruction. Thus, the field data corroborate existing literature on the effectiveness of technology integration.

2.3 Pedagogical Transformation

The integration of digital tools in geography education has initiated a profound epistemological shift in how geographical knowledge is constructed and internalized by students. Tools such as GIS, digital mapping, and simulations allow students to visualize spatial relationships and engage in analytical reasoning. This transformation aligns with constructivist learning theories, where students actively participate in building their own knowledge through exploration and reflection (Kolb, 2014; Vygotsky & Cole, 1978). Heitink et al. (2016) emphasize that technology fosters self-directed learning and allows for the personalization of content, leading to deeper conceptual understanding and student autonomy. Moreover, (Karwur et al., 2023) assert that the acquisition of digital competencies is inseparable from the development of geographical literacy in the 21st century.

Methodologically, digital tools have altered instructional practices by encouraging inquiry-based and collaborative approaches. Rather than relying solely on textbook instruction, teachers now facilitate student-driven investigations through real-time data analysis, digital fieldwork, and multimedia integration. These methods have enhanced classroom interaction and student

participation, transforming the role of the teacher into a guide or facilitator of knowledge. Research by Kerski (2023) and Karwur et al. (2023) supports this paradigm, indicating that when digital tools are effectively embedded into pedagogy, they foster engagement and equip students with skills in critical thinking, spatial analysis, and digital citizenship. Therefore, the shift brought by technology in geography instruction is both theoretical and practical—enriching epistemic access and redefining pedagogical delivery. Digital tools enhance teaching not only through content delivery but also by transforming pedagogical approaches. They promote self-directed and inquiry-based learning, and digital skills are integral to geographic literacy. This study reveals that tools like GIS, interactive maps, and simulations promote deeper engagement, allowing learners to visualize abstract concepts and apply them meaningfully. Hence, the transformation is both epistemological and methodological.

2.4 Teaching Strategies and Student Outcomes

The teaching strategies adopted by geography educators in East Java include gamification, project-based learning, collaborative learning, simulations, flipped classrooms, and multimedia integration. Each of these strategies has demonstrated measurable effects on student learning outcomes. For instance, gamification, as noted by Dicheva et al. (2015), increases student motivation and active engagement by incorporating game-like elements into instructional design. Project-based learning, supported by Walshe & Healy (2020), encourages students to tackle real-world issues, thereby enhancing problem-solving and critical thinking skills. Collaborative learning fosters communication, cooperation, and mutual responsibility among students, as highlighted by Johnson & Johnson (2018).

Simulations and role-playing provide immersive environments for understanding complex systems such as urbanization and natural disasters, with Wouters & Van Oostendorp (2013) affirming their impact on critical reasoning. The flipped classroom, according to Bishop & Verleger (2013), enables students to learn content at their own pace, facilitating deeper engagement during classroom sessions. Multimedia tools help diversify content delivery, allowing students to access material through visual, auditory, and textual formats, thereby accommodating different learning preferences and improving retention (Manakane & Rakuasa, 2023). Collectively, these strategies enhance not only academic performance but also broader competencies such as collaboration, autonomy, and digital literacy, aligning with the expectations of 21st-century education. The diverse teaching strategies employed by teachers in East Java mirror global trends in educational innovation. These strategies not only support academic achievement but also develop students' soft skills essential for the 21st century.

2.5 The Role of PBL in Deep Learning

Problem-Based Learning (PBL) has garnered theoretical support as a constructivist pedagogical approach, aligning closely with the philosophies of Jean Piaget and Lev Vygotsky. These theories emphasize that learning is an active, student-centered process where knowledge is constructed through interaction with real-world problems and social collaboration. In geography education, PBL provides opportunities for students to explore complex, interdisciplinary issues such as urbanization, environmental degradation, and disaster risk reduction. As Blancia (2025) explains, PBL fosters scientific reasoning and conceptual understanding, while Schneider (2017) highlights its ability to nurture deeper cognitive engagement and civic responsibility. Thus, the theoretical rationale for

using PBL in geography lies in its ability to mirror real-life scenarios and develop critical and creative capacities in learners.

Empirical findings from this study affirm the theoretical value of PBL, as implemented by geography teachers in East Java. Teachers reported that students became more engaged and motivated when tasked with investigating local environmental problems, such as analyzing water pollution or mapping urban expansion using GIS. These real-world projects encouraged students to collaborate, conduct field research, and propose practical solutions. The application of PBL led to observable improvements in students' problem-solving skills, data literacy, and environmental awareness. By situating geographic learning within authentic contexts, PBL not only elevated academic performance but also cultivated values of sustainability and social responsibility, making it a cornerstone of meaningful geography instruction in the 21st century. PBL is especially effective in geography education because it simulates real-world problem solving. Teachers using PBL methods reported increased student participation and critical engagement. This aligns with the learning theories of Piaget and Vygotsky, which prioritize student-centered, experiential learning. Projects involving urban development, disaster analysis, and environmental conservation connect classroom learning to community realities.

2.6 Impact of Collaborative Learning

From a theoretical standpoint, collaborative learning draws heavily on social constructivist principles, particularly those articulated by Vygotsky & Cole (1978), who posit that knowledge is constructed through social interaction and shared experiences. In this framework, group-based activities in geography—such as peer discussions, role-playing, and joint data analysis—foster the co-construction of meaning and develop both cognitive and socio-emotional skills. Johnson & Johnson (2009) support this notion by emphasizing that structured collaboration enhances not only individual academic achievement but also interpersonal competence and group accountability. Theoretical models such as communities of practice (Lave & Wenger, 1991) also reinforce the idea that collaborative learning builds identity, engagement, and knowledge through participation in collective tasks.

Empirical findings from East Java validate these theories, revealing that geography teachers frequently utilize group discussions, digital mapping projects, and inter-school collaborations to promote cooperative learning. According to Schneider (2017) such methods improve student performance, motivation, and critical thinking. Community partnerships have also played a pivotal role, with Zepke & Leach (2010) arguing that authentic engagement with external stakeholders deepens learning and civic responsibility. Teachers reported that these collaborative activities not only heightened student participation but also cultivated empathy and teamwork, preparing learners to navigate and contribute meaningfully to real-world geographic challenges. Collaborative learning strategies used in East Java include group discussions, digital map creation, and joint data analysis. These foster peer learning and align with the social constructivist theory (Vygotsky & Cole, 1978). It is well-established that collaboration contributes to enhanced cognitive and social outcomes (Johnson & Johnson, 2018).

2.7 Critical and Creative Thinking

Critical thinking in geography education is significantly enhanced through the strategic use of digital tools and constructivist pedagogical approaches. For instance, GIS and mapping applications enable students to engage in vital processes like data interpretation, spatial analysis, and evidence-based decision-making. These hands-on experiences cultivate crucial analytical reasoning and

problem-solving abilities, core to critical thought. Alenezi et al. (2023) assert that integrating digital tools effectively transforms the learning environment into one driven by inquiry, allowing students to explore complex geographical relationships and evaluate authentic situations. This pedagogical framework finds strong theoretical backing in the work of Piaget and Vygotsky, both of whom stressed the profound value of active participation and scaffolding in advancing cognitive development.

On the other hand, creative thinking is promoted through innovative instructional strategies such as gamification, problem-based learning (PBL), and multimedia simulations. These methods encourage divergent thinking, the exploration of alternative solutions, and the presentation of ideas in varied formats. For example, gamification strategies that incorporate competition and storytelling enhance motivation and allow students to experiment with different approaches to solving geographic problems (Gupta & Goyal, 2022). Meanwhile, PBL, as noted by Razak et al. (2022), enhances students' abilities to synthesize information and communicate their findings creatively. Ciobotaru (2024) confirm that these strategies do more than just improve learning; they also foster students' innovation, imagination, and adaptive thinking, which are vital skills for navigating today's complex world. Digital tools and innovative strategies are key to developing higher-order thinking skills. GIS, for example, helps students grasp complex spatial relationships, while gamification and simulations boost problem-solving and creativity. This shift from rote memorization to active exploration is supported by the theories of Piaget and Vygotsky. Furthermore, gamification enhances intrinsic motivation, and problem-based learning (PBL) improves communication and presentation skills, confirming that innovation fosters meaningful learning..

2.8 Challenges in Implementation

From a structural standpoint, geography teachers in East Java reported several significant obstacles in implementing digital tools and innovative teaching strategies. The most pressing issues include inadequate access to reliable internet infrastructure, limited availability of digital devices, and insufficient financial resources to procure software and hardware necessary for geography instruction. These structural constraints are compounded by the lack of sustained administrative and technical support, making it difficult for schools to adopt and maintain new teaching technologies. Ifinedo & Kankaanranta (2021) highlight the importance of institutional support and infrastructure as essential preconditions for successful technology integration. Without this foundational support, teachers are left with limited capacity to explore pedagogical innovation.

On the other hand, pedagogical and cultural challenges also impede progress. Many teachers expressed concern about the limited time available for planning and executing complex, technology-integrated lessons. Additionally, there exists a knowledge gap in digital literacy and pedagogical content knowledge, which makes it challenging for teachers to use technology in transformative ways. Some educators encounter resistance from students who are either unfamiliar with or reluctant to engage with new digital tools. These findings align with Price & Oliver (2007), who stress the importance of ongoing, context-sensitive professional development, and with Rogers (2003) diffusion of innovation theory, which explains that teachers may remain in early adoption stages without adequate motivation, training, and support. Thus, both systemic and cultural-pedagogical barriers must be addressed to achieve meaningful and sustained change in

geography education. Despite positive outcomes, several barriers remain. Teachers face technological limitations, time constraints, funding shortages, and student resistance. Without systemic support, even the most motivated teachers struggle to sustain innovation.

2.9 Enablers of Success

The development of geo-capabilities in East Java's geography teachers was heavily supported by various institutional enablers. The research highlighted that continuous professional development opportunities significantly drove the successful adoption of digital tools and innovative teaching strategies, consistent with Darling-Hammond et al. (2017) findings on the transformative power of quality training. Equally important was access to digital infrastructure and resources, including GIS software, hardware, and reliable internet also identified as crucial factor (Ertmer et al., 2006). Additionally, supportive school leadership and administrative policies were instrumental, as noted by Berrett et al. (2012), creating a conducive environment for both experimentation and collaboration. Together, these institutional elements formed the fundamental support structure for systemic pedagogical innovation.

On the other hand, personal and interpersonal factors also emerged as vital enablers. The study revealed that many teachers exhibited strong intrinsic motivation and a clear desire for self-improvement, which significantly impacted their willingness to adopt new pedagogical approaches. Informal collaboration among peers and the presence of professional learning communities further encouraged knowledge sharing and collective problem-solving. These findings are consistent with the theory of communities of practice developed by Lave & Wenger (1991), which highlights the importance of social learning networks in professional development. The combined influence of organizational support systems and individual initiative has laid a strong foundation for the long-term advancement of geo-capabilities in geography education. Ongoing professional development plays a crucial role in ensuring the effective adoption of digital tools and teaching innovations. Reliable access to technological infrastructure and resources further enables smooth integration into classroom practices. Supportive leadership within schools fosters an environment where educators feel empowered to experiment and grow. In addition, collaboration among teachers and a culture that promotes knowledge sharing strengthen professional capacity. Personal motivation and a strong commitment to continuous learning also contribute significantly. The integration of institutional, social, and individual factors is essential for achieving sustainable progress.

2.10 Recommendations

In the short term, geography teachers recommend implementing targeted strategies such as regular and context-specific technical training to improve digital competencies among educators (Lawless & Pellegrino, 2007). Schools are also advised to provide immediate access to necessary digital tools and platforms and to integrate technology into the existing curriculum in a way that aligns with learning objectives. Allocating adequate funding is essential to ensure the availability of devices, software, and reliable internet connectivity, thus reducing the barriers to adopting digital teaching practices (Barkley & Major, 2020). Furthermore, mentoring programs for newly recruited teachers can help accelerate their familiarity with digital tools and innovative pedagogies, ensuring more uniform adoption across the teaching cohort.

For the long-term development of geo-capabilities, the establishment of sustainable support systems is crucial. These include fostering communities of

practice to encourage peer learning and the sharing of best practices. Schools and policymakers are urged to institutionalize professional development programs that are ongoing and research-informed to ensure teachers remain current with technological and pedagogical advances. Long-term strategies should also focus on embedding innovation into school culture by providing consistent administrative support and building leadership capacity that champions change. Together, these efforts can create a robust ecosystem that sustains the growth of geo-capabilities in geography education over time. To enhance geo-capabilities, teachers suggest regular technical training, curriculum integration, and better funding. Schools should foster collaboration through communities of practice and support new teachers via mentoring programs. These strategies will not only address current gaps but also build a sustainable ecosystem for ongoing innovation and professional growth.

D. CONCLUSION AND SUGGESTIONS

This study concludes that the development of geo-capabilities among geography teachers in East Java is deeply influenced by the integration of innovative teaching strategies and digital technologies. The findings reveal that geo-capabilities encompass not only the technical ability to use digital tools like GIS but also cognitive, affective, and pedagogical dimensions that support spatial thinking, critical reasoning, and real-world problem-solving. Innovative methods such as project-based learning, simulations, problem-based learning, and collaborative teaching have demonstrated significant potential to enhance student engagement and learning outcomes. These strategies have transformed geography education into a more interactive, student-centered, and contextually relevant discipline, aligning with 21st-century educational goals.

Despite facing structural and pedagogical challenges such as limited infrastructure, insufficient training, and resistance to change, geography teachers have shown strong personal motivation and creativity in overcoming these barriers. Institutional support, professional learning communities, and sustained professional development emerge as key enablers for advancing geo-capabilities. Therefore, to strengthen geography education further, it is essential to invest in both short-term and long-term strategies that include access to digital tools, curriculum alignment, continuous teacher training, and fostering a culture of collaboration. These efforts will not only empower teachers but also equip students with the geographic knowledge and competencies necessary to navigate and contribute to an increasingly complex and dynamic world.

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REFERENCES

Abbot, S., Cook-Sather, A., & Hein, C. (2014). Mapping classroom interactions: A spatial approach to analyzing patterns of student participation. *To Improve the Academy*, *33*(2), 131–152.

Adedokun-Shittu, N. A., Ajani, A. H., Nuhu, K. M., & Shittu, A. K. (2020). Augmented reality instructional tool in enhancing geography learners academic performance and

retention in Osun state Nigeria. *Education and Information Technologies*, *25*, 3021–3033.

Ardiani, M., & Mushoddik, M. (2024). The Geography Teachers' Perceptions of Various Uses of Learning Media in Public Senior High Schools in South Tangerang City. *Acitya: Journal of Teaching and Education*, *6*(1), 68–80.

Artvinli, E. (2017). What Is Innovative Geography Teaching? A Perspective from Geography Teachers. *Journal of Education and Training Studies*, *5*(6), 9–23.

Baker, T. R., & White, S. H. (2003). The Effects of G.I.S. on Students' Attitudes, Self-efficacy, and Achievement in Middle School Science Classrooms. *Journal of Geography*, *102*(6), 243–254. https://doi.org/10.1080/00221340308978556

Bannert, A. (2022). *The Use of ArcGIS Online in a Contemporary AP Human Geography Classroom and its Impact on Student Spatial Awareness and Perception of Geography*.

Barkley, E. F., & Major, C. H. (2020). *Student engagement techniques: A handbook for college faculty*. John Wiley & Sons.

Berrett, B., Murphy, J., & Sullivan, J. (2012). Administrator insights and reflections: Technology integration in schools. *Qualitative Report*, *17*(1), 200–221.

Bishop, J., & Verleger, M. A. (2013). The flipped classroom: A survey of the research. *2013 ASEE Annual Conference & Exposition*, 23–1200.

Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. SAGE Publications.

Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). Effective teacher professional development. *Learning Policy Institute*.

Desimone, L. M., Porter, A. C., Garet, M. S., Yoon, K. S., & Birman, B. F. (2002). Effects of professional development on teachers' instruction: Results from a three-year longitudinal study. *Educational Evaluation and Policy Analysis*, *24*(2), 81–112.

Dicheva, D., Dichev, C., Agre, G., & Angelova, G. (2015). Gamification in education: A systematic mapping study. *Journal of Educational Technology & Society*, *18*(3), 75–88.

Ertmer, P. A., Ottenbreit-Leftwich, A., & York, C. S. (2006a). Exemplary technology-using teachers: Perceptions of factors influencing success. *Journal of Computing in Teacher Education*, *23*(2), 55–61.

Ertmer, P. A., Ottenbreit-Leftwich, A., & York, C. S. (2006b). Exemplary technology-using teachers: Perceptions of factors influencing success. *Journal of Computing in Teacher Education*, *23*(2), 55–61.

Favier, T. T., & van der Schee, J. A. (2014). The effects of geography lessons with geospatial technologies on the development of high school students' relational thinking. *Computers & Education*, *76*, 225–236.

Felix, A. A. (2021). *Integrating Geography teaching and learning using Information and Communication Technology*. University of the Free State.

Gillies, R. M. (2016). Cooperative learning: Review of research and practice. *Australian Journal of Teacher Education (Online)*, *41*(3), 39–54.

Goodchild, M. F. (1992). Geographical information science. *International Journal of Geographical Information Systems*, *6*(1), 31–45.

Gupta, P., & Goyal, P. (2022). Is game-based pedagogy just a fad? A self-determination theory approach to gamification in higher education. *International Journal of Educational Management*, *36*(3), 341–356.

Healy, G., & Walshe, N. (2020). Real-world geographers and geography students using GIS: relevance, everyday applications and the development of geographical knowledge. *International Research in Geographical and Environmental Education*, *29*(2), 178–196. https://doi.org/10.1080/10382046.2019.1661125

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review*, *16*, 235–266.

Johnson, D. W., & Johnson, R. T. (2009). An educational psychology success story: Social interdependence theory and cooperative learning. *Educational Researcher*, *38*(5), 365–379.

Johnson, D. W., & Johnson, R. T. (2018). Cooperative learning: The foundation for active learning. *Active Learning—Beyond the Future*, 59–71.

Kerski, J. J., Demirci, A., & Milson, A. J. (2013a). The Global Landscape of GIS in Secondary Education. *Journal of Geography*, *112*(6), 232–247. https://doi.org/10.1080/00221341.2013.801506

Kerski, J. J., Demirci, A., & Milson, A. J. (2013b). The Global Landscape of GIS in Secondary Education. *Journal of Geography*, *112*(6), 232–247. https://doi.org/10.1080/00221341.2013.801506

Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). Project-based learning: A review of the literature. *Improving Schools*, *19*(3), 267–277.

Kolb, D. A. (2014). *Experiential learning: Experience as the source of learning and development*. FT press.

Kotiash, I., Shevchuk, I., Borysonok, M., Matviienko, I., Popov, M., Terekhov, V., & Kuchai, O. (2022). Possibilities of Using Multimedia Technologies in Education. *International Journal of Computer Science and Network Security*, *22*(6), 727–732.

Lambert, D., & Morgan, J. (2010). *Teaching geography 11-18: A conceptual approach*. McGraw-Hill Education (UK).

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge university press.

Lawless, K. A., & Pellegrino, J. W. (2007). Professional development in integrating technology into teaching and learning: Knowns, unknowns, and ways to pursue better questions and answers. *Review of Educational Research*, *77*(4), 575–614.

Lemmens, M. (2011). *Geo-information: technologies, applications and the environment* (Vol. 5). Springer Science & Business Media.

Levin, B. B., & Schrum, L. (2012). *Leading technology-rich schools: Award-winning models for success*. Teachers College Press.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. sage.

Morote, A.-F., & Hernández, M. H. (2024). Gamification in geography. Use, appropriateness and proposals according to university students in Spain. *European Journal of Geography*, *15*(2), 94–105.

Nofrion, N., Rahmanelli, R., Utomo, E. P., & Operma, S. (2024). Implementation of Case Based Learning through the GeoSMART Approach to Increase Student Participation in Geography Learning. *2nd Lawang Sewu International Symposium on Humanities and Social Sciences 2023 (LEWIS HUSO 2023)*, 250–260.

Omusotsi, O. (2019). *Role of GIS as a Tool for Environmental Planning and Management*.

Panjaıtan, B. R., Nıngrum, E., & Waluya, B. (2023). Digital Learning Tools in Geography Education: A Systematic Literature Review. *The Eurasia Proceedings of Educational and Social Sciences*, *33*, 135–143.

Porter, A. C., Garet, M. S., Desimone, L., Yoon, K. S., & Birman, B. F. (2000). *Does professional development change teaching practice? Results from a three-year study.*

Price, S., & Oliver, M. (2007). A framework for conceptualising the impact of technology on teaching and learning. *Journal of Educational Technology & Society*, *10*(1), 16–27.

Rafique, A., Khan, M. S., Jamal, M. H., Tasadduq, M., Rustam, F., Lee, E., Washington, P. B., & Ashraf, I. (2021). Integrating learning analytics and collaborative learning for improving student's academic performance. *IEEE Access*, *9*, 167812–167826.

Razak, A. A., Ramdan, M. R., Mahjom, N., Zabit, M. N. M., Muhammad, F., Hussin, M. Y. M., & Abdullah, N. L. (2022). Improving critical thinking skills in teaching through problem-based learning for students: A scoping review. *International Journal of Learning, Teaching and Educational Research*, *21*(2), 342–362.

Rogers, E. M. (2003). *Diffusion of Innovations, 5th Edition*. Free Press.

Sabah, N. M. (2023). The impact of social media-based collaborative learning environments on students' use outcomes in higher education. *International Journal of Human–Computer Interaction*, *39*(3), 667–689.

Savery, J. R. (2015). Overview of problem-based learning: Definitions and distinctions. *Essential Readings in Problem-Based Learning: Exploring and Extending the Legacy of Howard S. Barrows*, *9*(2), 5–15.

Shernoff, D. J., Ruzek, E. A., & Sinha, S. (2017). The influence of the high school classroom environment on learning as mediated by student engagement. *School Psychology International*, *38*(2), 201–218.

Solem, M., Cheung, I., & Schlemper, M. B. (2008). Skills in professional geography: An assessment of workforce needs and expectations. *The Professional Geographer*, *60*(3), 356–373.

Thangagiri, B., & Naganathan, R. (2016). Online educational games-based learning in disaster management education: influence on educational effectiveness and student motivation. *2016 IEEE Eighth International Conference on Technology for Education (T4E)*, 88–91.

Tseng, T. H., Lin, S., Wang, Y.-S., & Liu, H.-X. (2022). Investigating teachers' adoption of MOOCs: the perspective of UTAUT2. *Interactive Learning Environments*, *30*(4), 635–650.

Voogt, J., Knezek, G., Cox, M., Knezek, D., & ten Brummelhuis, A. (2013). Under which conditions does ICT have a positive effect on teaching and learning? A call to action. *Journal of Computer Assisted Learning*, *29*(1), 4–14.

Vygotsky, L. S., & Cole, M. (1978). *Mind in society: Development of higher psychological processes*. Harvard university press.

Wise, N. A. (2018). Assessing the use of geospatial technologies in higher education teaching. *European Journal of Geography*, *9*(3).

Wouters, P., & Van Oostendorp, H. (2017). *Overview of instructional techniques to facilitate learning and motivation of serious games*. Springer.

Zepke, N., & Leach, L. (2010). Improving student engagement: Ten proposals for action. *Active Learning in Higher Education*, *11*(3), 167–177.