Rima International Journal of Education (RIJE), Vol. 3 (No. 3): Nov 2024; P: 174-174 ISSN: 2756 - 6749

Service Learning in 21st Century: The Role of Emerging Technologies on Today's Preservice Teacher Education

HASSAN ALIYU & ALIYU GARBA

Department of of Science Education, Sokoto State University, Sokoto, Nigeria. Email: nagoronyo@gmail.com ; ORCID: 0000-0003-4929-3126

Abstract

This study explores the integration of emerging technologies in service learning within preservice teacher education, highlighting its significance in preparing future educators for the demands of 21st-century classrooms. Service learning, which combines academic learning with community engagement, is examined as a powerful pedagogical approach that fosters critical thinking, cultural competence, and social responsibility. The research identifies various emerging technologies, such as virtual reality, artificial intelligence, and collaborative online platforms that enhance the service-learning experience by facilitating access to resources, promoting communication, and enabling innovative pedagogical practices. However, the study also addresses challenges faced by preservice teachers, including inadequate institutional support, ethical concerns regarding data privacy, and the rapid evolution of technology. The study discusses the importance of a collaborative effort among educators, institutions, and technology developers to create a robust framework for service learning that influences technology effectively, thereby enriching teacher education and fostering a more equitable educational landscape for all students.

Keywords: Service Learning, Emerging Technologies, Preservice Teacher Education, Community Engagement, Pedagogical Practices

Introduction

In the 21st century, the evolving landscape of education necessitates innovative approaches to teacher preparation, particularly for preservice teachers. Service learning, a pedagogical approach that integrates community engagement with academic learning, has gained significant traction as a means of equipping future educators with practical skills, cultural competence, and a commitment to social responsibility (Billig, 2017). This blend of experiential learning and civic participation aligns seamlessly with the demands of modern education, where fostering critical thinking, adaptability, and empathy are paramount.

However, as the world becomes increasingly digital, the integration of emerging technologies into service learning has the potential to

redefine its scope and impact. Technological advancements—ranging from virtual reality (VR) and artificial intelligence (AI) to collaborative platforms and data analytics—offer unique opportunities to enhance the service-learning experience for preservice teachers. These technologies not only broaden the accessibility and inclusivity of such programs but also equip future educators with the digital literacy skills required to thrive in today's classrooms (Copur-Gencturk et al., 2023).

In today's fast-evolving educational settings, figuring out how to utilise new technologies to improve service learning is more than just an academic task; it's an essential pursuit. This research adds to the ongoing conversation about reforming teacher education, providing valuable insights into how technology-enhanced service learning can serve as a foundation for cultivating skilled, culturally sensitive, and future-ready educators.

Emerging Technologies for classroom Instruction in 21st Century

The rapid evolution of technology in recent decades has profoundly reshaped education, offering new opportunities for both teaching and learning (Gomez et al., 2021; Tunjera & Chigona, 2020). Emerging technologies are now at the forefront of transforming the traditional classroom into dynamic, interactive, and personalized learning environments. As we progress further into the 21st century, educators are increasingly integrating new tools that enhance student engagement, foster collaboration, and promote critical thinking skills.

Emerging technologies for education refer to innovative technological tools, systems, and platforms that are transforming the way teaching and learning occur in classrooms and other educational settings (Kerimbayev et al., 2023). These technologies are reshaping the traditional educational experience by enhancing access to learning, promoting engagement, fostering personalized education, and expanding new possibilities for students and educators alike. As educational institutions and learners increasingly embrace these advancements, emerging technologies are playing a key role in making education more interactive, accessible, and effective.

According to Gomez et al. (2021), the integration of emerging technologies into classroom instruction is profoundly reshaping the educational landscape in the 21st century. These technologies—ranging from Artificial Intelligence (AI) and Virtual Reality (VR) to

gamification and cloud computing—are transforming teaching methods and student learning experiences. One major implication is personalized learning, where AI systems analyze student data to tailor lessons, offering customized support for diverse learning needs. This can help close achievement gaps by addressing individual strengths and weaknesses.

Additionally, collaborative learning is enhanced through tools like cloud-based platforms and interactive technologies. Students can collaborate in real-time, share resources, and engage with peers globally, fostering teamwork and communication skills critical for the digital age (Kerimbayev et al., 2023). Immersive technologies like VR and AR bring abstract concepts to life, offering students experiential learning opportunities that deepen understanding and retention (Majewska & Vereen, 2023).

However, these advancements also raise challenges, such as the need for digital literacy among both educators and students, and concerns about equity in access to technology (Du & Meier, 2023). Teachers must adapt to new tools and integrate them effectively, which requires ongoing professional development. Despite these challenges, the potential of emerging technologies to enhance engagement, improve learning outcomes, and prepare students for future careers makes their role in modern classrooms essential. Some examples of emerging technologies in education include:

1. Artificial Intelligence (AI) and Machine Learning

Artificial intelligence (AI) is one of the most influential technologies in education today. According to (Kamalov & Gurrib, 2023), AI systems can personalize learning experiences for students by analyzing their performance and adapting content to suit individual needs. This is especially beneficial for creating differentiated learning environments, where students with varying learning speeds or styles can receive customized lessons.

For example, AI-powered tutoring systems can provide real-time feedback and help students work through problems in subjects like mathematics or language arts. AI can also assist teachers by automating administrative tasks such as grading, lesson planning, and identifying students who may need additional support. In this way, teachers are able to focus more on direct instruction and student interaction.

Machine learning, a subset of AI, enables systems to predict and recommend resources, exercises, and materials based on student behavior (Kamalov et al., 2023). This helps students engage with content that aligns with their interests or challenges, promoting a more individualized and interactive learning experience (Gligorea et al., 2023).

2. Virtual Reality (VR) and Augmented Reality (AR)

Virtual Reality (VR) and Augmented Reality (AR) are immersive technologies that are revolutionizing the way students experience learning (Ahmad et al., 2023), in the following manner:

- Virtual Reality (VR) creates entirely digital environments where students can engage in simulations that would be impossible or unsafe in the real world (Motejlek & Alpay, 2021). For example, VR can transport students to historical events, remote ecosystems, or the inside of a cell, offering a fully immersive experience that enhances learning retention. In subjects like science, history, and art, VR allows for experiential learning that is often more engaging and impactful than traditional methods.

- Augmented Reality (AR) overlays digital information onto the real world, enhancing students' interaction with physical objects (Cao & Yu, 2023). In classrooms, AR applications can bring static textbooks to life by displaying interactive 3D models, maps, or videos on the page when viewed through an AR-enabled device. For example, AR could be used to create interactive biology lessons where students can view and manipulate the internal structure of a plant or animal in 3D, making abstract concepts easier to grasp.

Both VR and AR provide opportunities for students to learn through discovery, exploration, and immersive engagement, fostering higher-order thinking skills like analysis, synthesis, and evaluation.

3. Gamification and Game-Based Learning

Gamification involves the application of game mechanics—such as points, levels, and rewards—into educational settings to enhance motivation and engagement (Zainuddin et al., 2020; Rahman et al., 2018). Game-based learning (GBL) goes further, integrating actual games into the learning process to teach content and develop skills (Demirbilek et al., 2022).

According to Sharmin et al. (2023), games, whether digital or physical, encourage students to solve problems, make decisions, and collaborate with peers in a fun, low-risk environment. For example, educational platforms like Kahoot! and Quizizz use quizzes and games to reinforce concepts in subjects like math, science, and history. Likewise, Minecraft Education Edition allows students to build and explore virtual worlds while learning everything from architecture and engineering to history and coding. Moreover, Silva et al. (2017), assert that the intrinsic motivation generated by these games can help students develop persistence, teamwork, and problem-solving skills, all while making learning enjoyable. Teachers can create more engaging, interactive, and dynamic classrooms by integrating gamification and game-based learning.

4. Cloud Computing and Collaborative Tools

Cloud computing has become indispensable for modern education, providing access to a wide range of tools, platforms, and resources that facilitate learning anywhere, anytime. Through cloud-based platforms like Google Classroom, Microsoft Teams, and Edmodo, students and teachers can collaborate seamlessly on assignments, share resources, and access learning materials from any device with an internet connection (Monika et al., 2023; Sari et al., 2021).

Cloud computing also enables real-time feedback, document sharing, and collaboration on projects, which fosters a cooperative learning environment (Wu, 2019; Çakıroğlu & Erdemir, 2018). Collaborative tools such as Google Docs, Padlet, and Trello help students work together on group assignments, enhancing communication skills, teamwork, and accountability. Moreover, cloud computing enables the storage and sharing of vast amounts of educational content, such as lesson plans, instructional videos, and interactive simulations, creating an easily accessible, centralized hub for learning materials (Al-Samarraie & Saeed, 2018).

5. Learning Analytics and Data-Driven Instruction

Learning analytics refers to the collection and analysis of data from student interactions with learning platforms, assignments, and assessments to gain insights into their progress, behavior, and engagement (Caspari-Sadeghi, 2022). If data could be utilized effectively, teachers can identify patterns and trends, allowing them to make informed decisions about instruction, intervention, and curriculum development.

Emerging technologies in the classroom are reshaping education in the 21st century, allowing for more personalized, engaging, and interactive learning experiences. With AI-driven adaptive learning systems, immersive VR environments, and collaborative cloud platforms, these innovations are improving how students learn and how teachers instruct. As these technologies advance, they promise to further transform education, making it more accessible, inclusive, and dynamic than ever, particularly in the training of preservice teachers.

6. Internet of Things (IoT) and Smart Classrooms

The Internet of Things (IoT) refers to the network of interconnected devices that communicate and share data (Altwoyan & Alsukayti, 2022; Qi-chao, 2022). In education, IoT is transforming classrooms into smart environments that enhance learning and teaching. For example, IoT-enabled devices can track student attendance, monitor classroom temperature and lighting, and provide real-time data on classroom engagement through smart whiteboards and interactive displays. Sensors and smart devices can also assist in creating a more inclusive classroom by supporting students with disabilities through adaptive technology (e.g., voice recognition software, smart hearing aids, or tactile learning devices). The integration of IoT in classrooms provides a seamless learning environment where teachers can manage classroom logistics and tailor learning experiences to individual student needs more efficiently.

Emerging technologies in the classroom are reshaping education in the 21st century, allowing for more personalized, engaging, and interactive learning experiences. With AI-driven adaptive learning systems, immersive VR environments, and collaborative cloud platforms, these innovations are improving how students learn and how teachers instruct. As these technologies advance, they promise to further transform education, making it more accessible, inclusive, and dynamic than ever, particularly in the training of preservice teachers.

Preservice Teachers' Experience in Traditional Settings

Preservice undergraduate teachers are embarking on a pivotal journey towards becoming educators who will shape the minds and futures of countless students. This stage of their professional development is marked by rigorous coursework, hands-on experiences, and a plethora of opportunities for growth and reflection (Low, 2023; Yuan & Yang, 2020). As they delve into educational theories, pedagogy, and the diverse needs of learners, these future teachers are not just absorbing

information; they are also developing critical thinking skills and a framework for effective teaching practices (Benedicto & Andrade, 2022).

According to Ludwikowska (2019), collaboration plays a crucial role in their training, whether through peer group projects, mentoring relationships, or field placements in real classrooms. These interactions expose preservice teachers to various teaching styles and classroom management techniques, allowing them to curate their own approach to education. It is within this vibrant community that they learn the value of feedback, adaptability, and resilience—essential traits for any successful educator. Additionally, technology integration has become an indispensable facet of modern teaching, and preservice teachers are encouraged to harness innovative tools and resources (Cao et al., 2023). If teachers focus on exploring digital strategies and blended learning environments, they are better equipped to engage the digital-native generation of students, fostering an inclusive learning atmosphere that responds to varied interests and learning modalities.

Generally, the preparation of preservice undergraduate teachers is about more than mastering content; it is about shaping their identities as reflective practitioners and advocates for equity in education. Their experience is one of constant evolution, a blend of theory and practice that empowers them to approach the profession with passion, creativity, and an unwavering commitment to fostering a love of learning in their future classrooms (Becton et al., 2020).

Service-Learning Experiences for Preservice Undergraduate Teachers

Service learning is an educational approach that combines learning objectives with community service to provide a pragmatic, real-world experience (Lavery et al., 2017). It involves students engaging in projects or activities that address real-world issues while applying what they are learning in the classroom to those issues. Service learning is typically structured around the idea that students can achieve academic, personal, and civic growth by participating in service to their communities. The concept emphasizes a reciprocal relationship where students apply academic knowledge to address community needs, while also reflecting on the service experience to deepen their understanding of course content (Rochford, 2013). This pedagogical strategy not only enhances students' academic learning but also fosters a sense of civic responsibility and social awareness (Bringle & Clayton, 2021). Service learning is often structured in a

way that encourages students to actively engage with the community, participate in meaningful projects, and gain a deeper appreciation for diverse perspectives (Griffith & Zhang, 2013).

According to (Said et al., 2015), key feature of service learning is its focus on reflection. Students are typically required to reflect on their service experiences, both individually and in group discussions, to analyze how the service connects to their academic studies and personal growth. Reflection helps students internalize the lessons learned from their engagement, encouraging them to consider how their academic knowledge can be used to address real-world issues (Rogers et al., 2019). This process also aids in developing critical thinking, problem-solving, and communication skills, which are valuable both in academic and professional settings.

Beyond academic benefits, service learning also promotes community engagement and social responsibility (Schelbe et al., 2014). When working directly with community members, students contribute to positive social change, often in areas such as education, healthcare, environmental sustainability, or social justice. This fosters a sense of empathy and encourages students to be active participants in society (Wu et al., 2022). In turn, communities benefit from the support of students who bring fresh perspectives and enthusiasm to local projects. Ultimately, service learning creates a mutually beneficial relationship between students and the communities they serve, enhancing both individual and collective growth.

Consequently, according to (Norman, 2018), service learning offers significant implications for the experiences of preservice undergraduate students—those who are preparing to become future educators. When integrating community service with academic coursework, service learning provides a unique opportunity for these students to deepen their understanding of teaching, develop professional skills, and engage with the broader community. Thus, some of the crucial implications of service learning on preservice undergraduate students' experience include:

1. Development of Teaching Skills

Service learning allows preservice teachers to apply the theoretical knowledge they acquire in the classroom to real-world teaching situations (Lavery et al., 2017; Said et al., 2015). This hands-on experience enhances their teaching abilities, helping them understand how to manage diverse classrooms, communicate effectively with

students, and adapt to different learning needs. Working directly with students, especially in underserved or diverse communities, enables preservice teachers to experiment with various teaching strategies and gain confidence in their ability to teach (Cavendish et al., 2020; Sanger, 2020).

For instance, preservice teachers might work in after-school programs, tutoring students, or helping to develop educational activities. These experiences provide opportunities to observe classroom dynamics, engage in lesson planning, and implement instructional strategies in real-life settings, all of which are crucial for their professional development.

2. Improved Reflection and Critical Thinking

Service learning encourages students to reflect on their experiences, helping them connect academic knowledge with practical application (Lin, 2021). For preservice teachers, this reflective practice is particularly valuable because it fosters critical thinking about teaching methods, the challenges they face in the classroom, and the effectiveness of their interactions with students.

According to (Brown et al., 2020), at the time of reflecting on their community service experiences, preservice teachers develop a deeper understanding of the social and emotional needs of their future students. This reflection also allows them to evaluate their personal growth and teaching strategies, which can lead to more intentional and thoughtful decision-making in their future careers.

3. Increased Cultural Competence

As disclosed by (Borgerding & Caniglia, 2017), one of the most important benefits of service learning for preservice teachers is the opportunity to engage with diverse communities. Whether working in urban, rural, or economically disadvantaged areas, students have the chance to interact with individuals from different cultural, socioeconomic, and linguistic backgrounds. This experience helps preservice teachers build cultural competence, which is critical in today's increasingly diverse classrooms.

Moreover, Afifah & Wirza (2021), also believe that when working in these communities, preservice teachers gain firsthand insight into the challenges that students from different backgrounds face. They learn to appreciate the importance of culturally responsive teaching, which

can lead to more inclusive and equitable teaching practices. Additionally, they become better equipped to recognize and address issues related to diversity, equity, and inclusion in their future classrooms (Darling-Hammond et al., 2024).

4. Enhanced Professionalism and Work Ethic

As suggested by Andrews & Richmond (2019), engaging in service learning helps preservice students develop a strong sense of professionalism, responsibility, and work ethic. Through their service activities, students learn the importance of punctuality, commitment, teamwork, and communication, all of which are key qualities for future educators (Norman, 2018). These professional habits are reinforced by real-world expectations in the service setting, where preservice teachers may need to collaborate with other educators, parents, and community members, often under challenging conditions. This hands-on experience also cultivates leadership skills as preservice teachers take initiative, problem-solve, and make decisions about how best to meet the needs of the students or community members they are serving.

5. Strengthened Commitment to Social Justice and Civic Responsibility

According to Reames et al. (2020), service learning encourages preservice teachers to recognize their role as active citizens who can contribute to social change. It exposes them to social issues such as poverty, inequality, and educational disparities, and fosters a sense of civic responsibility and a commitment to social justice. In this case, Yuan (2017), observed that when directly addressing community needs, preservice teachers develop an understanding of the broader social context in which education operates. This experience often deepens their passion for teaching and motivates them to advocate for underrepresented or marginalized groups. Many preservice teachers come to see their future work not just as an educational endeavor but as part of a broader movement to improve social conditions through education.

6. Building Stronger Community Connections

Service learning fosters a strong sense of connection between preservice students and the communities they serve (Dirksen, 2020). Some authors like Hildenbrand & Schultz (2015) believed that by actively participating in community development or educational

outreach projects, preservice teachers gain a sense of belonging and social responsibility. This builds bridges between the academic world and the communities where students will eventually work as professionals. These experiences often result in long-term collaborations between schools and community groups, which continues to benefit both students and the areas they help. Preservice teachers also build valuable support networks that can boost their careers down the road.

7. Improved Career Readiness and Employability

According to Weatherby-Fell et al. (2019), service learning helps preservice teachers develop a range of practical skills that increase their employability. It enhances their resumes by demonstrating initiative, leadership, and real-world experience. Employers in education value candidates who have experience working with diverse groups of students and have demonstrated the ability to solve problems, collaborate with colleagues, and engage in reflective practice. Additionally, service learning provides opportunities for preservice teachers to build professional relationships and gain mentoring from experienced educators, which can lead to future job opportunities or references (Lavery et al., 2017).

The Role of Emerging Technologies in Service-Learning Experiences

Service learning, which combines academic education with community service, has been acknowledged for its effectiveness in promoting critical thinking, civic responsibility, and practical skills among students (Gibson & Sandifer, 2020). According to Haines & McClure (2020), emerging technologies have become increasingly important in changing the service-learning experience, particularly for preservice teachers. These technologies, including digital platforms, social media, virtual classrooms, and artificial intelligence, are altering the ways students interact with their learning, work with communities, and reflect on their experiences (García-Martínez et al., 2023).

1. Enhancing Access to Resources and Learning Materials

Emerging technologies allow students to access a broader range of educational resources, bridging the divide between traditional classroom learning and real-world experiences (Koehler & Vilarinho-Pereira, 2021). For preservice teachers, having access to digital

libraries, educational apps, and online databases significantly improves their ability to research and plan their service learning projects. These tools also familiarise them with a variety of pedagogical strategies and best practices that they can apply in real teaching environments, making them more innovative and resourceful (Figuccio, 2020; Ngai et al., 2023).

Preservice teachers can utilise online platforms such as Google Classroom or various learning management systems (LMS) to share teaching resources, participate in discussions with mentors, and obtain feedback on their community projects. This approach allows them to handle their service learning more effectively, even in remote or varied environments, ensuring that students can engage in meaningful ways regardless of geographical or infrastructural challenges (Weitl-Harms, 2024).

2. Facilitating Collaboration and Communication

Emerging technologies, particularly social media and collaborative tools like Slack, Zoom, or Microsoft Teams, are central to fostering communication and collaboration in service-learning projects (Regmi, 2024). These tools let future teachers link up with classmates, advisors, and community members, building a support network that goes beyond the actual classroom. Online meetings and shared work spaces help students exchange thoughts, solve problems, and think about their experiences as they happen (Trust et al., 2016).

Furthermore, people in the community who live far away or can't get to in-person meetings can still take part in service-learning projects using technology. This leads to community involvement that includes more people from different backgrounds. For example, teachers-in-training might use social media to push educational campaigns, work together on digital storytelling projects, or connect with local communities through online workshops or webinars.

3. Personalizing and Enhancing Learning Experiences

According to Regmi (2024), technologies like adaptive learning platforms and artificial intelligence (AI) have the potential to personalise the learning experience for preservice teachers engaged in service learning. These tools can provide tailored feedback based on students' progress and needs, helping them refine their teaching strategies and approaches. AI-powered tutoring systems, for example, can help preservice teachers simulate classroom scenarios, practice

lesson delivery, or receive instant feedback on teaching performance (Maity & Deroy, 2024).

However, technologies such as virtual reality (VR) and augmented reality (AR) provide immersive learning experiences that replicate real-world classroom settings or community environments. Preservice teachers can practice their teaching skills in virtual classrooms before interacting with actual students or face the challenges of working in underserved communities without stepping off campus. These immersive tools foster empathy, improve problem-solving abilities, and enrich students' comprehension of various learning environments (Ng, 2021).

4. Promoting Reflection and Critical Thinking

Emerging technologies significantly contribute to fostering reflection and critical thinking, essential elements of the service-learning process (Ng, 2021). Digital platforms like blogs, podcasts, and video journals enable preservice teachers to capture their experiences, contemplate challenges, and evaluate their personal development. These tools not only create a venue for self-expression but also present chances for valuable feedback from peers and instructors.

The opportunity to revisit and refine reflections through digital media enables preservice teachers to gain a deeper understanding of their teaching methods and how to enhance their interactions with students and communities. Moreover, these reflective practices are vital for cultivating a lifelong learning mindset, which is essential in the ever-evolving field of education. New technologies are transforming the service learning landscape by creating fresh opportunities for engagement, collaboration, and reflection (Bringle et al., 2022). For preservice teachers, these tools provide significant advantages to enrich their learning experiences, develop crucial skills, and equip them for the varied challenges present in today's classrooms and communities.

Challenges Preservice Teachers May Face When Using Emerging Technologies for Service Learning and How to Overcome the Challenge

Incorporating emerging technologies into service learning provides many opportunities for preservice teachers, but it also brings several challenges that can affect their effectiveness and engagement (Luan et al., 2020). These challenges arise from technical, pedagogical, and

systemic issues that need to be tackled to fully realize the advantages of technology-enhanced service learning.

1. Lack of Digital Literacy

Preservice teachers often vary in their familiarity with emerging technologies such as virtual reality (VR), augmented reality (AR), and artificial intelligence (AI)-powered tools. While some may be adept at using basic educational software, others may struggle to use advanced technologies effectively. This disparity can lead to frustration, reduced confidence, and a lack of engagement in service learning projects. For example, a preservice teacher using AR for community history lessons might struggle to create immersive experiences due to limited technical know-how. These problems can be solved by coming up with structured training programs that focus on building foundational digital literacy and providing hands-on experience with specific tools (Tınmaz et al., 2022).

2. Technical Barriers

Emerging technologies typically depend on dependable hardware, software, and internet access. Unfortunately, many service-learning environments, particularly in underserved communities, do not have the necessary infrastructure to support these technologies. Preservice teachers may encounter obstacles like software compatibility problems, hardware malfunctions, or insufficient bandwidth. For instance, a VR tool designed for virtual classroom simulations might not operate effectively because of outdated hardware in the service-learning setting. This issue can be addressed by promoting the use of low-tech alternatives and ensuring access to mobile-compatible tools that can work in resource-limited environments (Gallegos et al., 2022).

3. Limited Time and Resources

Preservice teachers frequently find it challenging to juggle their coursework, fieldwork, and the learning curve associated with new technologies. Service learning requires a considerable amount of effort to plan and implement community-based projects, and incorporating emerging technologies can further heighten the stress of their workload. For example, a preservice teacher may face difficulties in integrating AI-based assessment tools while also handling their teaching duties. To address this challenge, educators should focus on streamlining the integration process by choosing user-friendly

technologies and offering continuous support throughout the service-learning program (Gligorea et al., 2023).

4. Resistance to Change

Some preservice teachers may be reluctant to embrace new technologies due to fears of failure or a preference for conventional teaching methods. This resistance can arise from a lack of confidence in their ability to adapt to new tools or skepticism about the role of technology in enhancing meaningful learning experiences. For example, a preservice teacher might favor traditional group discussions over digital collaborative tools, thinking that technology undermines personal interaction. To overcome this challenge, educators should focus on demonstrating the effectiveness of these tools through success stories, mentorship, and peer collaboration to build trust and acceptance (Regmi, 2024).

5. Pedagogical Misalignment

Emerging technologies hold great potential, but their success hinges on their alignment with educational goals. Preservice teachers often find it challenging to incorporate these tools effectively into their service-learning projects, resulting in technology use that may seem disconnected or superficial. For instance, implementing gamification in a community literacy program could divert attention from the primary learning objectives if not properly aligned. This challenge can be tackled by offering clear guidelines and examples that demonstrate how to use technologies in ways that support pedagogical aims and boost engagement (Crow & Henning, 2021).

6. Challenges in creating an environment where everyone feels valued and included

Service-learning environments typically include a variety of learners, each with unique needs. However, emerging technologies can sometimes unintentionally leave out certain groups, like individuals with disabilities or those who do not have access to devices. Preservice teachers must address these equity issues while making sure that technology is used in an inclusive manner. For example, a digital storytelling tool may not be usable for students with visual impairments in a community learning program. It is essential for teachers to select technologies that come with accessibility features and to modify activities to accommodate the diverse needs of their learners (Yiğit, 2020).

7. Inadequate support from the Institution

Preservice teachers rely heavily on guidance and resources from their institutions. Inadequate institutional support, such as limited access to training, mentorship, or funding for emerging technology tools, can hinder their ability to effectively integrate these technologies into service-learning projects. For instance, a lack of training on how to use collaborative tools like Google Classroom might leave preservice teachers unprepared for tech-based service learning. Institutions can provide professional development opportunities, access to resources, and partnerships with technology providers to facilitate better preparation (Henukh & Astra, 2021).

8. Ethical and Privacy Concerns

Using emerging technologies frequently entails the collection and management of data, which brings up ethical issues related to privacy and consent. Preservice teachers may find themselves ill-equipped to manage sensitive information in a responsible manner, particularly in community-based service-learning environments. For instance, a teacher utilizing AI-driven platforms for community assessments could encounter difficulties in guaranteeing that the data of participants is handled ethically. This challenge can be mitigated through training focused on data privacy laws, ethical standards, and the responsible use of technology.

9. Technocentrism

A common pitfall when integrating emerging technologies is placing too much emphasis on the tools instead of the learning outcomes. Preservice teachers might concentrate excessively on mastering the technology, which can overshadow the creation of meaningful, reflective service-learning experiences. For instance, if too much time is spent on setting up VR simulations, it may take away from building deeper connections within the community. This issue can be mitigated by promoting a balanced approach where technology acts as a facilitator rather than the main focus of the service-learning activity.

10. Accelerating technological evolution

Emerging technologies change rapidly, and preservice teachers often find it difficult to stay updated with the latest tools and updates. This challenge is made even more complex by the necessity to adjust their teaching methods to effectively integrate these new technologies. For

example, a preservice teacher may dedicate time to mastering a particular tool, only to find it has become outdated or has been succeeded by a newer version. To tackle this issue, it's important to encourage adaptability and offer continuous training opportunities to remain informed about technological advancements.

The difficulties that preservice teachers encounter when trying to incorporate new technologies into service learning are complex and involve various aspects, including technical skills, teaching methods, and systemic issues. Tackling these challenges calls for a well-rounded strategy that includes specialized training, support from institutions, and an emphasis on inclusivity and ethical considerations. Preservice teachers can fully harness the power of technology to improve their service-learning experiences and better equip themselves for the evolving needs of 21st-century classrooms by addressing these obstacles.

Conclusion

The study highlights the transformative potential of integrating emerging technologies into preservice teacher education. As the educational landscape evolves, the incorporation of innovative tools such as virtual reality, artificial intelligence, and collaborative online platforms not only enhances the service-learning experience but also prepares future educators to navigate the complexities of modern classrooms. These technologies facilitate immersive learning experiences, allowing preservice teachers to engage with diverse communities and develop essential skills in real-world contexts. Moreover, the study highlights the critical role of service learning in fostering cultural competence and social responsibility among preservice teachers. This experiential learning approach not only enriches their pedagogical practices but also empowers them to become advocates for equity and inclusion in education. Finally, the study calls for a collaborative effort among educators, policymakers, and technology developers to create a robust framework for service learning that embraces innovation.

Recommendation

I. Future studies should emphasize the pedagogical strategies that accompany the use of emerging technologies in service learning.

II. It is essential to create comprehensive ethical guidelines and training for preservice teachers regarding data privacy and

responsible technology use in service learning. Future research should address these ethical considerations more thoroughly, ensuring that educators are well-prepared to handle sensitive information responsibly.

Reference

Abidin, Z. Z., Budayasa, I. K., & Khabibah, S. (2021). Reflective Practice of Pre-Service Mathematics Teacher on Online Learning. *Journal of Physics Conference Series* (Vol. 1957, Issue 1, p. 12004). IOP Publishing. https://doi.org/10.1088/1742-6596/1957/1/012004

Afifah, D. N., & Wirza, Y. (2021). An Investigation into Foreign Pre-Service Teacher's Intelligibility in an International Teaching Program. Education and Humanities Research/Advances in social science, education and humanities research. https://doi.org/10.2991/assehr.k.210427.021

Ahmad, S., Umirzakova, S., Mujtaba, G., Amin, M., & Whangbo, T. K. (2023). Education 5.0. https://export.arxiv.org/pdf/2307.15846v1.pdf

Al-Samarraie, H., & Saeed, N. (2018). A systematic review of cloud computing tools for collaborative learning: Opportunities and challenges to the blended-learning environment [Review of A systematic review of cloud computing tools for collaborative learning: Opportunities and challenges to the blended-learning environment]. Computers & Education, 124, 77. Elsevier BV. https://doi.org/10.1016/j.compedu.2018.05.016

Altwoyan, W., & Alsukayti, I. S. (2022). A Novel IoT Architecture for Seamless IoT Integration into University Systems. *International Journal of Advanced Computer Science and Applications* (Vol. 13, Issue 4). Science and Information Organization. https://doi.org/10.14569/ijacsa.2022.0130413

Andrews, D. J. C., & Richmond, G. (2019). Professional Development for Equity: What Constitutes Powerful Professional Learning? *Journal of Teacher Education* (Vol. 70, Issue 5, p. 408). SAGE Publishing. https://doi.org/10.1177/0022487119875098

Becton, Y. J., Bogiages, C., D'Amico, L. K., Lilly, T., Currin, E., Jeffries, R., & Tamim, S. R. (2020). An Emerging Framework for the EdD Activist. *Impacting Education Journal on Transforming Professional Practice* (Vol. 5, Issue 2, p. 43). University Library System, University of Pittsburgh. https://doi.org/10.5195/ie.2020.131

Benedicto, P. N., & Andrade, R. (2022). Problem-Based Learning Strategies and Critical Thinking Skills Among Pre-Service Teachers. *International Journal of Science Technology*

Engineering and Mathematics (Vol. 2, Issue 2, p. 1). https://doi.org/10.53378/352885

Borgerding, L. A., & Caniglia, J. (2017). Service Learning Within a Secondary Math and Science Teacher Education Program: Preservice MAT Teachers' Perspectives. *School Science and Mathematics* (Vol. 117, Issue 1, p. 63). Wiley. https://doi.org/10.1111/ssm.12210

Bringle, R. G., & Clayton, P. H. (2021). Civic Learning: A Sine Qua Non of Service Learning. *Frontiers in Education* (Vol. 6). Frontiers Media. https://doi.org/10.3389/feduc.2021.606443

Brown, C. P., Barry, D. P., Ku, D. H., & Puckett, K. (2020). Teach as I Say, Not as I Do: How Preservice Teachers Made Sense of the Mismatch between How They Were Expected to Teach and How They Were Taught in Their Professional Training Program. *The Teacher Educator* (Vol. 56, Issue 3, p. 250). Taylor & Francis. https://doi.org/10.1080/08878730.2020.1847225

Çakıroğlu, Ü., & Erdemir, T. (2018). Online project based learning via cloud computing: exploring roles of instructor and students. *Interactive Learning Environments* (Vol. 27, Issue 4, p. 547). Taylor & Francis. https://doi.org/10.1080/10494820.2018.1489855

Cao, J., Bhuvaneswari, G., Arumugam, T., & Aravind, B. R. (2023). The digital edge: examining the relationship between digital competency and language learning outcomes. *Frontiers in Psychology* (Vol. 14). Frontiers Media. https://doi.org/10.3389/fpsyg.2023.1187909

Cao, W., & Yu, Z. (2023). The impact of augmented reality on student attitudes, motivation, and learning achievements—a meta-analysis (2016–2023). *Humanities and Social Sciences Communications* (Vol. 10, Issue 1). Palgrave Macmillan. https://doi.org/10.1057/s41599-023-01852-2

Caspari-Sadeghi, S. (2022). Learning assessment in the age of big data: Learning analytics in higher education. *Cogent Education* (Vol. 10, Issue 1). Taylor & Francis. https://doi.org/10.1080/2331186x.2022.2162697

Cavendish, W., Perez, X., & Mahotiere, M. (2020). Pre-Service Teacher Supports in Urban Schools. *Action in Teacher Education* (Vol. 43, Issue 1, p. 54). Taylor & Francis. https://doi.org/10.1080/01626620.2020.1776175

Cook, H., Apps, T., Beckman, K., & Bennett, S. (2023). Digital competence for emergency remote teaching in higher education: understanding the present and anticipating the future. *Educational Technology Research and Development*

(Vol. 71, Issue 1, p. 7). Springer Science+Business Media. https://doi.org/10.1007/s11423-023-10194-4

Darling-Hammond, L., Alexander, M. D., & Hernández, L. E. (2024). Redesigning High Schools: 10 Features for Success. https://doi.org/10.54300/533.285

Demirbilek, M., Talan, T., & Alzouebi, K. (2022). An Examination of the Factors and Challenges to Adopting Gamification in English Foreign Language Teaching. *International Journal of Technology in Education* (Vol. 5, Issue 4, p. 654). https://doi.org/10.46328/ijte.358

Dirksen, C. (2020). Community Engagement for Student Faith Development: Service-Learning in the Pentecostal Tradition. In C. Dirksen, Christian Higher Education (Vol. 19, Issue 1, p. 78). Taylor & Francis. https://doi.org/10.1080/15363759.2019.1689198

Darling-Hammond, L. (2017). Teacher education around the world: What can we learn from international practice? *European Journal of Teacher Education*, 40(3), 291–309. https://doi.org/10.1080/02619768.2017.1315399

Du, X., & Meier, E. (2023). Innovating Pedagogical Practices through Professional Development in Computer Science Education. In X. Du & E. Meier, *Journal of Computer Science Research* (Vol. 5, Issue 3, p. 46). https://doi.org/10.30564/jcsr.v5i3.5757

Dumont, H., & Ready, D. D. (2023). On the promise of personalized learning for educational equity [Review of On the promise of personalized learning for educational equity]. Npj Science of Learning, 8(1). Nature Portfolio. https://doi.org/10.1038/s41539-023-00174-x

Duong, Q. P., & Pham, T. N. (2021). Moving beyond four walls and forming a learning community for speaking practice under the auspices of Facebook. *E-Learning and Digital Media* (Vol. 19, Issue 1, p. 1). SAGE Publishing. https://doi.org/10.1177/20427530211028067

Figuccio, M. J. (2020). Examining the Efficacy of E-Service-Learning. In M. J. Figuccio, Frontiers in Education (Vol. 5). *Frontiers Media*. https://doi.org/10.3389/feduc.2020.606451

Figueroa, R. B., Gil, F. A. P., Taniguchi, H., & Esguerra, J. R. (2023). Virtual Reality Photo-based Tours for Teaching Filipino Vocabulary in an Online Class in Japan: Transitioning into the New Normal. arXiv (Cornell University). Cornell University. https://doi.org/10.48550/arXiv.2301.

Gligorea, I., Cioca, M., Oancea, R., Gorski, A.-T., Gorski, H., & Tudorache, P. (2023). Adaptive Learning Using Artificial Intelligence in e-Learning: A Literature Review [Review of Adaptive Learning Using Artificial Intelligence in e-Learning: A

Literature Review]. *Education Sciences*, 13(12), 1216. Multidisciplinary Digital Publishing Institute. https://doi.org/10.3390/educsci13121216

Gomez, F. C., Trespalacios, J., Hsu, Y., & Yang, D. (2021). Exploring Teachers' Technology Integration Self-Efficacy through the 2017 ISTE Standards. *TechTrends* (Vol. 66, Issue 2, p. 159). Springer Science+Business Media. https://doi.org/10.1007/s11528-021-00639-z

González-Cabañes, E., García, T., Chase, C. C., & Pérez, J. C. N. (2023). PROTOCOL: Problem solving before instruction (PS-I) to promote learning and motivation in child and adult students. *Campbell Systematic Reviews* (Vol. 19, Issue 3). The Campbell Collaboration. https://doi.org/10.1002/cl2.1337

Griffith, R., & Zhang, G. (2013). Service Learning in Teacher Preparation: Returns on the Investment. *The Educational Forum* (Vol. 77, Issue 3, p. 256). Taylor & Francis. https://doi.org/10.1080/00131725.2013.792908

Guillén, G., Sawin, T., & Avineri, N. (2020). Zooming out of the crisis: Language and human collaboration. *Foreign Language Annals* (Vol. 53, Issue 2, p. 320). Wiley. https://doi.org/10.1111/flan.12459

Hildenbrand, S., & Schultz, S. M. (2015). Implementing Service Learning in Pre-Service Teacher Coursework. In S. Hildenbrand & S. M. Schultz, *Journal of Experiential Education* (Vol. 38, Issue 3, p. 262). SAGE Publishing. https://doi.org/10.1177/1053825915571748

Iberahim, A., Yunus, M. M., & Sulaiman, N. A. (2023). A Review on Technology Enhanced Language Learning (TELL) [Review of A Review on Technology Enhanced Language Learning (TELL)]. *International Journal of Academic Research in Business and Social Sciences*, 13(2). https://doi.org/10.6007/ijarbss/v13-i2/16496

Kamalov, F., & Gurrib, I. (2023). A New Era of Artificial Intelligence in Education. https://export.arxiv.org/pdf/2305.18303v1.pdf

Kamalov, F., Calonge, D. S., & Gurrib, I. (2023). New Era of Artificial Intelligence in Education: Towards a Sustainable Multifaceted Revolution. *Sustainability* (Vol. 15, Issue 16, p. 12451). Multidisciplinary Digital Publishing Institute. https://doi.org/10.3390/su151612451

Kerimbayev, N., Umirzakova, Z., Shadiev, R., & Jotsov, V. (2023). A student-centered approach using modern technologies in distance learning: a systematic review of the literature [Review of A student-centered approach using modern technologies in distance learning: a systematic review of the literature]. Smart

Learning Environments, 10(1). Springer Nature. https://doi.org/10.1186/s40561-023-00280-8

Kilgo, C. A., Ezell Sheets, J. K., & Pascarella, E. T. (2015). The link between high-impact practices and student learning: Some longitudinal evidence. Higher Education, 69(4), 509–525. https://doi.org/10.1007/s10734-014-9788-z

Lavery, S. D., Coffey, A., & Sandri, S. (2017). The Value of Service-Learning in a Pre-Service Secondary Teacher Qualification. *International perspectives on inclusive education* (p. 241). Emerald Publishing Limited. https://doi.org/10.1108/s1479-363620170000012015

Lin, T.-H. (2021). Service-Learning Project: Different Stages of Reflection and Learning (By T.-H. Lin; Vol. 30, p. 214). https://doi.org/10.1109/iceit51700.2021.9375570

Low, E. L. (2023). Rethinking teacher education in pandemic times and beyond. In E. L. Low, Educational Research for Policy and Practice. Springer Science+Business Media. https://doi.org/10.1007/s10671-023-09337-4

Ludwikowska, K. (2019). Teacher competence inventory. In K. Ludwikowska, Education + Training (Vol. 61, Issue 9, p. 1123). Emerald Publishing Limited. https://doi.org/10.1108/et-12-2018-0266

Majewska, A. A., & Vereen, E. (2023). Using Immersive Virtual Reality in an Online Biology Course. In A. A. Majewska & E. Vereen, Journal for STEM Education Research (Vol. 6, Issue 3, p. 480). Springer Science+Business Media. https://doi.org/10.1007/s41979-023-00095-9

Monika, M., Bala, J., & Berden, S. (2023). Scope and Challenges of Multimedia in Education Sector. *International Journal for Multidisciplinary Research* (Vol. 5, Issue 3). https://doi.org/10.36948/ijfmr.2023.v05i03.3868

Motejlek, J., & Alpay, E. (2021). Taxonomy of Virtual and Augmented Reality Applications in Education. *IEEE Transactions on Learning Technologies* (Vol. 14, Issue 3, p. 415). Institute of Electrical and Electronics Engineers. https://doi.org/10.1109/tlt.2021.3092964

Norman, Z. D. (2018). Understanding the Effect of Service Learning on Students' Servant Leadership Development. In Z. D. Norman, SSRN Electronic Journal. RELX Group (Netherlands). https://doi.org/10.2139/ssrn.3152036

Qi-chao, H. (2022). Strategy Analysis of Wireless Internet of Things Technology in College English Teaching. In H. Qi-chao, Wireless Communications and Mobile Computing (Vol. 2022, p. 1). Wiley. https://doi.org/10.1155/2022/1516378

Rahman, M. H. A., Panessai, I. Y., Noor, N. A. Z. M., & Salleh, N. S. M. (2018). Gamification Elements and Their Impacts on Teaching and Learning – A Review [Review of Gamification Elements And Their Impacts On Teaching And Learning – A Review]. *The International Journal of Multimedia & Its Applications*, 10(6), 37. https://doi.org/10.5121/ijma.2018.10604

Reames, T. G., Blackmar, J. M., & Pierce, J. C. (2020). Teaching the Three E's of Sustainability through Service-Learning in a Professional Program. In T. G. Reames, J. M. Blackmar, & J. C. Pierce, New Directions for Teaching and Learning (Vol. 2020, Issue 161, p. 73). Wiley. https://doi.org/10.1002/tl.20374

Rochford, R. A. (2013). Service-Learning for Remedial Reading and Writing Students. In R. A. Rochford, *Community College Journal of Research and Practice* (Vol. 37, Issue 5, p. 345). Taylor & Francis. https://doi.org/10.1080/10668926.2010.532463

Ruggiero, D., & J. Mong, C. (2015). The Teacher Technology Integration Experience: Practice and Reflection in the Classroom. *Journal of Information Technology Education: Research*, 14, 161–178. https://doi.org/10.28945/2227

Rogers, J., Peecksen, S., Douglas, M. E., & Simmons, M. (2019). Validation of a reflection rubric for higher education. In J. Rogers, S. Peecksen, M. E. Douglas, & M. Simmons, Reflective Practice (Vol. 20, Issue 6, p. 761). Taylor & Francis. https://doi.org/10.1080/14623943.2019.1676712

Said, H., Ahmad, I., Hassan, Z., & Awang, Z. (2015). Service Learning as Critical Pedagogy: Implications for Student Community Awareness and Citizenship Development. *Mediterranean Journal of Social Sciences*. Mediterranean Center of Social and Educational Research. https://doi.org/10.5901/mjss.2015.v6n2p471

Sanger, C. S. (2020). Inclusive Pedagogy and Universal Design Approaches for Diverse Learning Environments. In C. S. Sanger, Springer eBooks (p. 31). Springer Nature. https://doi.org/10.1007/978-981-15-1628-3_2

Sari, N. W. W., Wulansari, T. T., Yanuartha, W., Sipayung, M. S., & Pribadi, A. S. (2021). Factors Which Influence The Success of Google Classroom Based on Age. *Journal of Physics Conference Series* Vol. 1807, Issue 1, p. 12016. IOP Publishing. https://doi.org/10.1088/1742-6596/1807/1/012016

Schelbe, L., Petracchi, H. E., & Weaver, A. (2014). Benefits and Challenges of Service-Learning in Baccalaureate Social Work Programs. In L. Schelbe, H. E. Petracchi, & A. Weaver, Journal

of Teaching in Social Work (Vol. 34, Issue 5, p. 480). Taylor & Francis. https://doi.org/10.1080/08841233.2014.954689

Sharmin, S., Bhattacharjee, A., Sadik, R., Patre, P. R., Koiler, R., Getchell, N., & Barmaki, R. (2023). Insights into Cognitive Engagement: Comparing the Effectiveness of Game-Based and Video-Based Learning. In S. Sharmin, A. Bhattacharjee, R. Sadik, P. R. Patre, R. Koiler, N. Getchell, & R. Barmaki, arXiv (Cornell University). Cornell University. https://doi.org/10.48550/arXiv.2307.

Silva, T. de S., Marinho, E. C. R., Cabral, G., & Gama, K. (2017). Motivational Impact of Virtual Reality on Game-Based Learning: Comparative Study of Immersive and Non-Immersive Approaches (p. 155). https://doi.org/10.1109/svr.2017.28

Stefaniak, J. E. (2020). A Systems View of Supporting the Transfer of Learning through E-Service-Learning Experiences in Real-World Contexts. In J. E. Stefaniak, TechTrends (Vol. 64, Issue 4, p. 561). Springer Science+Business Media. https://doi.org/10.1007/s11528-020-00487-3

Tawalbeh, T. I. (2020). Mentoring Experience at University Level: EFL Mentees' Perceptions and Suggestions. In T. I. Tawalbeh, International Journal of Higher Education (Vol. 10, Issue 1, p. 41). Sciedu Press. https://doi.org/10.5430/ijhe.v10n1p41

Tunjera, N., & Chigona, A. (2020). Assisting teacher educators with constructive technology integration into curriculum delivery in the 21st Century (By N. Tunjera & A. Chigona; Vol. 10, p. 12). https://doi.org/10.1145/3410886.3410900

Wang, R. E., Ribeiro, A. M., Robinson, C. D., Loeb, S., & Demszky, D. (2024). Tutor CoPilot: A Human-AI Approach for Scaling Real-Time Expertise. arXiv (Cornell University). Cornell University. https://doi.org/10.48550/arxiv.2410.03017

Weatherby-Fell, N., Duchesne, S., & Neilsen-Hewett, C. (2019). Preparing and supporting early childhood pre-service teachers in their professional journey. *The Australian Educational Researcher* (Vol. 46, Issue 4, p. 621). Springer Nature. https://doi.org/10.1007/s13384-019-00340-4

Wu, C., Cheng, S., Zhang, Y., Yan, J., He, C., Sa, Z., Wu, J., Lin, Y., Heng, C., Su, X., & Lang, H. (2022). Social responsibility and subjective well-being of volunteers for COVID-19: The mediating role of job involvement. *Frontiers in Psychology* (Vol. 13). Frontiers Media. https://doi.org/10.3389/fpsyg.2022.985728

Wu, Z.-Y. (2019). A Secure and Efficient Digital-Data-Sharing System for Cloud Environments. *Sensors* (Vol. 19, Issue 12, p. 2817). Multidisciplinary Digital Publishing Institute. https://doi.org/10.3390/s19122817

Yuan, H. (2017). Preparing Teachers for Diversity: A Literature Review and Implications from Community-Based Teacher Education [Review of Preparing Teachers for Diversity: A Literature Review and Implications from Community-Based Teacher Education]. *Higher Education Studies*, 8(1), 9. Canadian Center of Science and Education. https://doi.org/10.5539/hes.v8n1p9

Yuan, R., & Yang, M. (2020). Understanding university-based teacher educators' boundary crossing experiences: voices from Hong Kong. *Teachers and Teaching* (Vol. 26, Issue 2, p. 193). Taylor & Francis. https://doi.org/10.1080/13540602.2020.1777961

Zainuddin, Z., Chu, S. K. W., Shujahat, M., & Perera, C. J. (2020). The impact of gamification on learning and instruction: A systematic review of empirical evidence [Review of The impact of gamification on learning and instruction: A systematic review of empirical evidence]. Educational Research Review, 30, 100326. Elsevier BV. https://doi.org/10.1016/j.edurev.2020.100326

Zaragoza-García, I., Ortuño-Soriano, I., Posada-Moreno, P., Sánchez-Gómez, R., & Raurell-Torredà, M. (2021). Virtual Simulation for Last-Year Nursing Graduate Students in Times of Covid-19: A Quasi-Experimental Study. *Clinical Simulation in Nursing* (Vol. 60, p. 32). Elsevier BV. https://doi.org/10.1016/j.ecns.2021.07.003

Billig, S. H. (2017). Implementing Service-Learning in Elementary Schools to Enhance Inclusion. In S. H. Billig, International perspectives on inclusive education (p. 75). Emerald Publishing Limited. https://doi.org/10.1108/s1479-363620170000012006

Bringle, R. G., Rego, M. A. S., & Regueiro, B. (2022). Editorial: Service Learning, Educational Innovation and Social Transformation. *Frontiers in Education* (Vol. 6). Frontiers Media. https://doi.org/10.3389/feduc.2021.818660

Copur-Gencturk, Y., Li, J., Cohen, A. S., & Orrill, C. H. (2023). The impact of an interactive, personalized computer-based teacher professional development program on student performance: A randomized controlled trial. *Computers & Education* (Vol. 210, p. 104963). Elsevier BV. https://doi.org/10.1016/j.compedu.2023.104963

Crow, S. R., & Henning, J. A. (2021). Designing Lessons and Programs that Motivate Students. In S. R. Crow & J. A. Henning, School Libraries Worldwide (p. 1). International Association of School Librarianship. https://doi.org/10.29173/slw8257

Figuccio, M. J. (2020). Examining the Efficacy of E-Service-Learning. In M. J. Figuccio, *Frontiers in Education* (Vol. 5). Frontiers Media. https://doi.org/10.3389/feduc.2020.606451

Gallegos, B., Dieker, L., Smith, R., & Ralston, N. C. (2022). Serving Students with Disabilities who are Culturally and Linguistically Diverse in Rural Communities: Technology Access is Essential. *Northwest Journal of Teacher Education* (Vol. 17, Issue 1). Communications in Information Literacy. https://doi.org/10.15760/nwjte.2022.17.1.1

García-Martínez, I., Batanero, J. M. F., Cerero, J. F., & León, S. P. (2023). Analysing the Impact of Artificial Intelligence and Computational Sciences on Student Performance: Systematic Review and Meta-analysis. *Journal of New Approaches in Educational Research* (Vol. 12, Issue 1, p. 171). University of Alicante. https://doi.org/10.7821/naer.2023.1.1240

Gibson, E. M., & Sandifer, M. C. (2020). It Takes a Village: Service Learning as Our Social Responsibility in Higher Education. Innovations in higher education teaching and learning (p. 93). Emerald Publishing Limited. https://doi.org/10.1108/s2055-364120200000021008

Gligorea, I., Cioca, M., Oancea, R., Gorski, A.-T., Gorski, H., & Tudorache, P. (2023). Adaptive Learning Using Artificial Intelligence in e-Learning: A Literature Review [Review of Adaptive Learning Using Artificial Intelligence in e-Learning: A Literature Review]. *Education Sciences*, 13(12), 1216. Multidisciplinary Digital Publishing Institute. https://doi.org/10.3390/educsci13121216

Haines, S., & McClure, C. (2020). Out in the Field: Experiential Learning through University–Community Partnerships. Innovations in higher education teaching and learning (p. 121). Emerald Publishing Limited. https://doi.org/10.1108/s2055-364120200000023009

Henukh, A., & Astra, I. M. (2021). The use of Google classroom as ICT literacy to improve physics students' collaboration skill in industrial revolution 4.0. *AIP conference proceedings* (Vol. 2331, p. 30002). American Institute of Physics. https://doi.org/10.1063/5.0041660

Koehler, A. A., & Vilarinho-Pereira, D. R. (2021). Using social media affordances to support Ill-structured problem-solving skills: considering possibilities and challenges. *Educational Technology Research and Development* (Vol. 71, Issue 2, p. 199). Springer Science+Business Media. https://doi.org/10.1007/s11423-021-10060-1

Luan, H., Géczy, P., Lai, H., Gobert, J. D., Yang, S. J. H., Ogata, H., Baltes, J., Guerra, R. da S., Li, P., & Tsai, C. (2020).

Challenges and Future Directions of Big Data and Artificial Intelligence in Education [Review of Challenges and Future Directions of Big Data and Artificial Intelligence in Education]. *Frontiers in Psychology*, 11. Frontiers Media. https://doi.org/10.3389/fpsyg.2020.580820

Maity, S., & Deroy, A. (2024). Generative AI and Its Impact on Personalized Intelligent Tutoring Systems. https://doi.org/10.35542/osf.io/kawr5

Ng, C. F. (2021). The Physical Learning Environment of Online Distance Learners in Higher Education – A Conceptual Model [Review of the Physical Learning Environment of Online Distance Learners in Higher Education – A Conceptual Model]. Frontiers in Psychology, 12. Frontiers Media. https://doi.org/10.3389/fpsyg.2021.635117

Ngai, G., Lau, K. H., & Kwan, K. (2023). A Large-Scale Study of Students' E-Service-Learning Experiences and Outcomes During the Pandemic. *Journal of Experiential Education* (Vol. 47, Issue 1, p. 29). SAGE Publishing. https://doi.org/10.1177/10538259231171852

Regmi, K. D. (2024). The rise of learning technology in an unequal world: potentials and limitations in enhancing lifelong learning. *International Review of Education* (Vol. 70, Issue 3, p. 433). Springer Science+Business Media. https://doi.org/10.1007/s11159-023-10058-2

Tınmaz, H., LEE, Y.-T., Fanea-Ivanovici, M., & Baber, H. (2022). A systematic review on digital literacy [Review of A systematic review on digital literacy]. Smart Learning Environments, 9(1). Springer Nature. https://doi.org/10.1186/s40561-022-00204-y

Trust, T., Krutka, D. G., & Carpenter, J. P. (2016). "Together we are better": Professional learning networks for teachers. *Computers & Education* (Vol. 102, p. 15). Elsevier BV. https://doi.org/10.1016/j.compedu.2016.06.007

Weitl-Harms, S. (2024). Iterative Service-Learning: A Computing-Based Case-study Applied to Small Rural Organizations. arXiv (Cornell University). Cornell University. https://doi.org/10.48550/arXiv.2406.

Yiğit, E. Ö. (2020). Digital Storytelling Experiences of Social Studies Pre-Service Teachers. *International Journal of Technology in Education* (Vol. 3, Issue 2, p. 70). https://doi.org/10.46328/ijte.v3i2.25