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EMERGING TECHNOLOGIES AS CATALYSTS IN THE EXPERIENTIAL LEARNING OF STUDENT TEACHERS

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Abstract

The rapid evolution of emerging technologies, such as virtual reality (VR), augmented reality (AR), artificial intelligence (AI), the metaverse, and immersive simulations, has a significant impact on experiential learning. Learners interact with dynamic and interactive environments that go beyond the boundaries of traditional classrooms. While VR bridges the physical and digital realms by creating simulated experiences, AI technologies personalize the learning process and offer new tools for developing the 4Cs competences - creativity, collaboration, critical thinking and communication - adapting and differentiating individual learning paths. Emerging technologies facilitate the design of didactic scenarios including virtual classrooms, adaptive feedback systems, and online interactions as a few of the tools that student teachers can use to implement teaching strategies and reflect on their outcomes. The paper proposes a reconfiguration of the experiential learning cycle which integrates in its stages - concrete experience, reflective observation, abstract conceptualization, and active experimentation - emerging technologies as tools that facilitate practical activities, stimulate collaboration within the triad formed by university coordinator, student teacher and mentor teacher, and consequently deepen the didactic competencies of all the three members. By reviewing existing literature, a conceptual framework for technology-enhanced pedagogical practice within the experiential learning cycle is proposed, in which innovative learning ecosystems can be created. By bridging theory and practice, emerging technologies serve as catalysts for experiential learning, preparing future educators to design and implement innovative didactic strategies developing the technology-enhanced learning environment.

Keywords: emerging technologies; experiential learning; student teachers; competences; didactic strategy;

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Introduction

Based on the idea that skills are consolidated and deepened through direct experience and reflection, experiential learning emphasizes active involvement, problem solving, and the implementation of concepts in authentic contexts. The student-centered approach shifts the focus from passive reception of information to active participation, in which student teachers engage in testing ideas, adapting teaching strategies, and internalizing learning through cycles of action, reflection, and application. They are prepared to play an active role in various dimensions of their education, including in the digital space. The European OECD 2030 DeSeCo project focuses on clearly defining and selecting the skills needed to train innovative, aware, and responsible adults (OECD, 2018). Developing the skills needed to handle the complexity of the real world is one of the main challenges for education systems (Ramírez-Montoya et al., 2025). The enhancement of didactic competencies requires practical experience, with experiential learning (EL) becoming a cornerstone in the teacher training. The central hub of this type of learning is the triad, which brings together the university coordinator, the student teacher, and the mentor teacher to create a structured and supportive framework for actual and future didactic careers.

Experiential Learning Cycle

Kolb (2015, pp. 18, 25) defines EL as "a particular form of learning from life experience" and its theory as "a useful framework for learning-centered educational innovation, including instructional design, curriculum development, and lifelong learning". The author proposes a conceptualized model consisting of four interconnected stages, namely concrete experience, reflective observation, abstract conceptualization, and active experimentation, distributed in a cycle in which competencies are formed and developed through the transformation of experience (Kolb, 2015). Learners acquire knowledge that is accumulated through direct engagement on *concrete experiences* around a central task which is divided subsequently into meaningful components, within a deductive approach, in the framework of *abstract conceptualization*. Learning through experiential experiences allows ST to reflect, analyze, and conceptualize their observations and test what they have learned in new and different contexts (Riches & Kaleva, 2025). The transformation occurs through *reflective observation* of the acquired experience, exploring it from different insights, and is completed by encouraging the learner to interact with the environment through *active experimentation* (Gordon, 2022; Mughal & Zafar, 2011). Gordon (2022) defines learning as a combination of styles created by combining the four stages of EL. The author presents an extensive list of learning styles, which includes: (i) experimentation, highlighted by concrete experience, (ii) imagination, emphasized by reflective observation and concrete experience, (iii) reflection, focused on reflective observation, (iv) analysis, emphasized by abstract

conceptualization and reflective observation, (v) thinking, reinforced by abstract conceptualization, (vi) decision-making, focused on active experimentation and abstract conceptualization, (vii) action, centered on active experimentation, (viii) initiation, reinforced by active experimentation and concrete experimentation, and (ix) balancing, a combination of all four EL stages (Gordon, 2022). The cycle process described above can be observed in Figure 1.

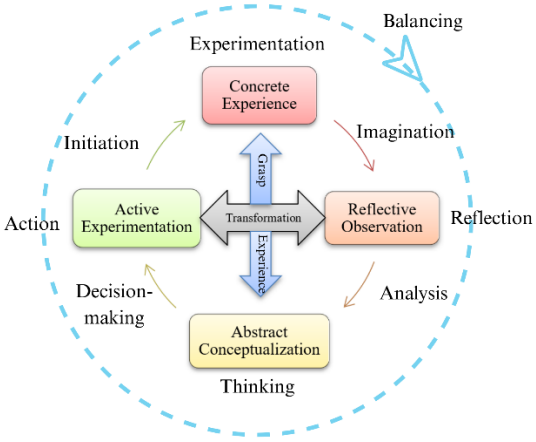

Figure 1. Experiential Learning Cycle (adapted from Egan et al., 2023; Gordon, 2022; Kolb, 1984; Nagel et al., 2024)

The model portrays learning as a continuous process that has the potential to motivate learners to improve their current skills or knowledge. The model can be used by applying the circular model described above, starting with updating previous knowledge that, for example, student teachers have assimilated in the disciplines they have followed to learning through experience and to transforming this learning beyond short-term experience. The overall goal is about learning to be seen as a continuous and long-term process and the training program to be one structured, focused, and dynamic episode in the journey of learning (Egan et al., 2023).

Synergies in the Triad to foster Experiential Learning

The triad of university coordinator (UC), student teacher (ST) and mentor teacher (MT) is created to develop the pedagogical practice activities of student teachers and to ensure that the competences necessary are formed. In the triad, all members have clear roles within their responsibilities. While the university coordinator designs the activities for the teaching practice, assures alignment with educational standards and facilitates opportunities for reflection, the

student teacher is actively involved in the pedagogical practice, applies theoretical knowledge and reflects on experiences, and the mentor teacher guides, monitors, gives feedback and offers models of professional practice.

The alignment to experiential learning cycle is based on passing through the four stages of the cycle via specific learning activities, such as: (i) practicing in authentic teaching situations within the concrete experience, (ii) reflecting on the activities witnessed during reflective observation, (iii) designing lessons by connecting experience with theory in abstract conceptualization, and (iv) implementing and testing strategies through active experimentation. Each member of the triad has a significant role within experiential learning, ST being constantly coordinated to build a bridge between theory and practice in an active and adaptable environment, as can be observed in Figure 2 (Thinh, 2025). This bridge must link theory and practice within the actions shown in the figure below, so that student teachers can apply and continuously improve the competences they have acquired through iterative cycles of reflection and practical application. While UC constantly monitors the results obtained by ST to adjust teacher training programs with a better preparing of future educators, TM observes the lessons of trainee teachers, suggests practical strategies for improvement, offers constructive criticism, and ensures that feedback is in line with the instructional objectives of the trainee program (Thinh, 2025).

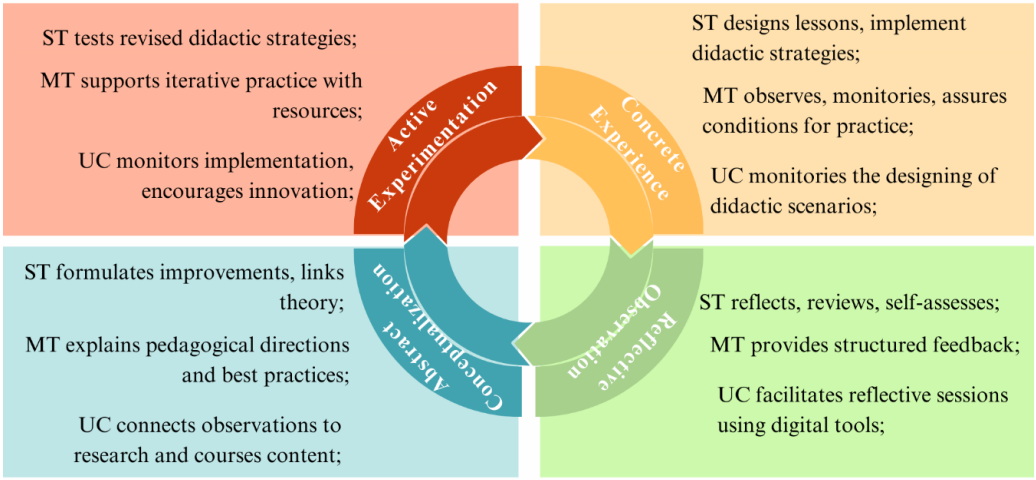

Figure 2. The role of the university coordinator, student teacher, and mentor teacher in the experiential learning cycle within the context of pedagogical practice

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The continuous and iterative nature of experiential learning allows any of the actors involved to step into the cycle at any stage, although optimal learning involves going through all four stages. The model also points out that effective learners balance concrete experience with abstract conceptualization and active experimentation with reflective observation.

Integration of Emerging Technologies across the Experiential Learning Cycle

Education 4.0 involves regulating educational institutions programs and research within the organization in order to design innovative courses and didactic scenarios that integrate advanced learning technologies as teaching tools to enable the creation of more collaborative environment, promoting active and autonomous learning among those engaged (Ramirez & Esparrell, 2024). Cai et al. (2025) design a four-dimensional theoretical framework including pedagogy, psychology, technology and learning analysis for creating and developing virtual reality-based applications and training. Emerging technology's providers offer tools that facilitate the development of complex thinking across different learning approaches: (i) active, (ii) problem-based, (iii) technology-supported, (iv) ongoing and experimental, (v) peer-to-peer, and (v) collaborative driven (Li, 2025; Ramírez-Montoya et al., 2025; Shee et al., 2025).

Virtual reality (VR) as an educational technology contributes to practical skills-based training of ST within experiential and situated learning theories, facilitating the access to virtual environments that complement and not replace classroom teaching scenarios and allowing them to observe, experiment, and practice specific techniques, roles or assignments through the shift from passive observation to active interaction (Bi et al., 2025; Riches & Kaleva, 2025; Tayan et al., 2025). Allcoat et al. (2021) presents the concepts of Augmented Reality (AR) and Mixed Reality (MR), with MR presented as a broad term that encompasses both augmented reality and augmented virtuality, resulting in the merge of real and virtual worlds and objects that coexist and interact within the real world.

Generative artificial intelligence provides tools based on advanced deep learning algorithms that can create new content, such as text, images and videos. Through the use of these tools, students can exchange ideas, make deductions, and participate in activities that enhance their critical thinking and metacognitive skills (Rivera-Novoa & Duarte Arias, 2025). AI applications such as Adaptive Learning Systems, Intelligent Tutoring Systems and Virtual Classrooms are used effectively to enhance teaching efficiency and improve student learning outcomes across four trends: swarm intelligence, Internet of Things, deep learning and neuroscience (Cai et al., 2025). Learning Management Systems equipped with AI to customize the learning paths of ST, Intelligent Pedagogical Agents that adapt to the individual needs of students, Collaborative Platforms that use AI to integrate information and virtual and human-physical robots, represent interactive means for

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transforming the community of practice in a community focused on learning (Cai et al., 2025). The Virtual Intelligence experience uses AI, combining the Internet of Things, AR and VR in an interdisciplinary learning context to create immersive environments where students can integrate virtual materials and real-world settings to design and implement didactic scenarios.

Simulation-based learning platforms emerge as effective methods of training ST, allowing them to interact with virtual characters in realistic didactic scenarios, conduct assessments and implement the strategies designed (Flaherty, 2025). The adoption of emerging technologies like VR, AI and simulated computer role-playing games removes pedagogical barriers by expanding their usability and promotes evidence-based practice by bridging the gap between theoretical knowledge and real-world applications. The use of emerging technology, such as online knowledge hubs, virtual simulations, and interactive videoconferences, could: (i) impact the mentorship of ST, (ii) eliminate as far as possible the educational disparity and (iii) connect competencies with their practical applications in both current and future contexts.

Methodology

The paper focuses on reviewing existing literature on experiential learning, teacher training, and emerging technologies, and analyzing existing scientific literature with the aim of developing a theoretical framework. The objective of this paper is to explore the role of emerging technologies as catalysts in the experiential learning of student teachers, in collaboration with university coordinators and mentor teachers, and to propose a conceptual framework for technology-enhanced pedagogical practice within the experiential learning cycle. The research questions are:

1. How do emerging technologies enhance experiential learning for student teachers in teaching practice?
2. How do emerging technologies augment reflective observation and feedback among student teachers, mentor teachers and university coordinators?

A Conceptual Framework for Emerging Technologies-Enhanced Pedagogical Practice within the Experiential Learning Cycle

The integration of emerging technologies in experiential learning improves the collaboration between the university coordinator, student teacher and mentor teacher, resulting in an active participation in the didactic activities of the ST, which leads to performance and well-being of students.

In the first stage of EL, *concrete experience*, ST is engaged in authentic teaching activities in the pre-university institution, having the opportunity to design and implement lessons engaging

face-to-face with learners and integrating: (i) VR teaching simulators, (ii) AR as means of lesson or (iii) AI as educational tools. While UC assures that pedagogical practice is aligned with teacher education standards, MT observes, provides feedback, and suggests adaptive strategies after the lesson.

Reviewing and analysing experience in *reflective observation* stage is one of the most important phases of pedagogical practice in which lesson records in VR/AR environments or AI analytic dashboards allow for a critical and constructive evaluation of teaching performance, classroom involvement and student outcomes. At this stage, MT offers guided reflections, UC organises online meeting sessions with ST and TM using digital platforms to request reflections, and ST self-evaluates itself using data visualisations, peer feedback, and video replays.

AI-driven analytics enable ST to link theory to observed results at the stage of *abstract conceptualization*. Collaborative platforms facilitate the analysis of teaching strategies, of the most effective training methods and of proposals for improving teaching approaches by the triad members. UC ad notates insights regarding practical pedagogical theories and design directions for future research and MT offers pedagogical reasoning to refine teaching style.

In the *active experimentation* stage, a refinement of didactic strategies for future practice is suggested, UC encouraging the innovative use of emerging technologies to design and implement innovative didactic strategies and TM monitoring the implementation and evaluating the didactic activities for continuous improvement. ST can apply refined techniques in either live or simulated classrooms using AI-driven lesson planners, simulation-based practice in the metaverse, and interactive whiteboards for testing improved teaching strategies in safe and authentic educational environment.

A representation of ET integration as catalysts at the stages of experiential learning, together with innovative pedagogical methods used by the university coordinator, student teacher and mentor teacher, can be observed in Figure 3.

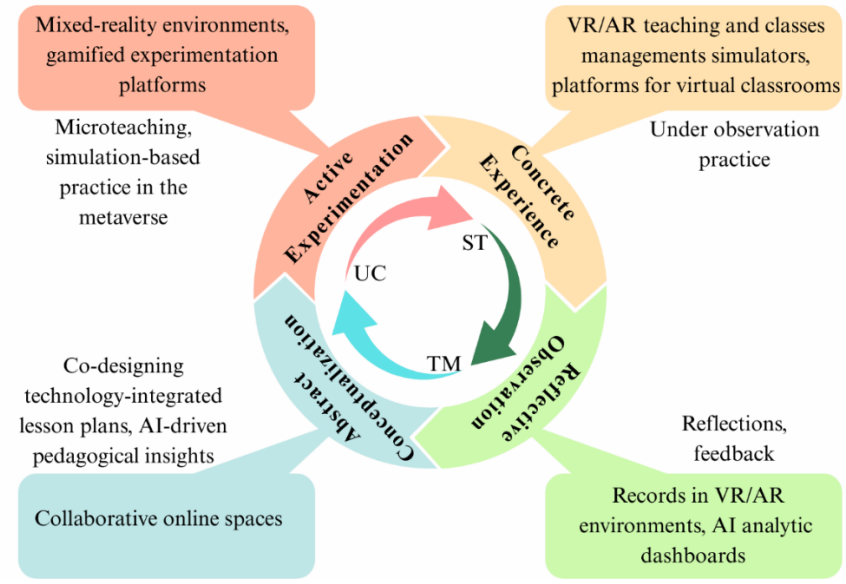

Figure 3. Emerging technologies and pedagogical approaches in the stages of experiential learning

ETs integrated into the EL stages help ST to test during pedagogical practice activities the didactic competences which includes 21st century skills such as: (i) self-efficacy by combining real or simulated teaching buildings with real confidence, (ii) adaptability through the application of revised didactic strategy, (iii) creativity through the development of innovative teaching resources, (iv) collaboration through co-teaching in digital environments, (v) critical thinking through the use of data analysis to improve teaching strategy and (vi) communication through the presentation of concepts using multimodal platforms.

Discussions and conclusions

Experiential learning is significant for student teachers to recognize their professional identity as a teacher. Through the integration of emerging technologies, safe environments for experimentation are developed, allowing learners to test didactic strategies for real learners. Adaptive learning platforms help to regulate pedagogical approaches according to the needs, rhythm and competences of individual facilitating differentiated and personalised learning. Teachers can use technology to provide personalized feedback, track learning outcomes and adjust instructional strategies dynamically. Filling digital literacy gaps becomes a priority in initial and continuing education to maximise technological benefits, while also addressing ethical and privacy

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concerns. This is because using digital resources through AI analytics and video recordings can have a negative impact if they are shared on social media or if they violate intellectual property rights.

Collaborative platforms, records, simulators and videos in VR or AR environments, AI chatbots and driven analytics, digital portfolios etc connect student teachers, mentor teachers and university coordinators through: (i) continuous feedback and co-designing, (ii) reflection on teaching practices, (iii) nurturing the 4Cs: creativity, collaboration, communication, and critical thinking and (iv) adapting to diverse learning environments to make it measurable and actionable. The catalytic role of emerging technologies is evidenced by: (i) VR or AR simulations and AI-based feedback tools that allow student teachers to experiment without uncertainty, (ii) video reflection tools that provide progress and reinforce positive beliefs about didactic skills, (iii) collaborative online spaces that enable peer-to-peer teacher validation and encourage pedagogical decision making. The integration of emerging technologies within the experiential learning cycle during pedagogical practice develops not only the didactic competence of student teachers, but those of university coordinators and mentor teachers, along with resilience, adaptability and long-term professional identity.

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