

IMPROVING INNOVATIVE AND INTEGRATIVE TECHNOLOGIES IN THE PREPARATION OF FUTURE PRIMARY SCHOOL TEACHERS

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Abstract

This article examines the pedagogical significance of improving innovative and integrative technologies in the preparation of future primary school teachers. The study is based on the idea that contemporary teacher education can no longer be limited to the transfer of separate methodological skills or fragmented digital competencies. The professional formation of a primary teacher requires a coherent model in which pedagogical knowledge, subject knowledge, technological literacy, reflective practice, interdisciplinary thinking, and value-oriented educational responsibility are developed as a unified system. The article argues that innovative technologies in teacher education should not be understood only as digital tools, platforms, or interactive devices. Their real educational value emerges when they are integrated into meaningful pedagogical design, collaborative inquiry, microteaching, school-based practice, formative assessment, and problem-solving activities. In this context, integrative technologies are interpreted as technologies that connect theory with practice, university coursework with classroom realities, and different subject areas with one another. Special attention is paid to the preparation of future primary school teachers because primary education demands flexibility, child-centeredness, creativity, and the ability to organize learning across multiple disciplines. The article identifies the main contradictions in current teacher preparation, including the gap between technical familiarity and pedagogical readiness, the overemphasis on tools rather than learning goals, and the insufficient coordination between university training and school innovation.

Keywords: Future primary school teacher, teacher education, innovative technologies, integrative technologies, digital pedagogy, TPACK, interdisciplinary learning, blended learning, primary education, reflective practice.



Introduction

The preparation of future primary school teachers has become one of the most urgent issues in modern pedagogy because the primary school teacher today is expected to act simultaneously as an instructor, educator, diagnostician, facilitator, mentor, and designer of learning environments. In earlier periods, teacher education often focused on the transmission of stable methodological rules and content knowledge. In current conditions, however, this model is no longer sufficient. Educational change, curriculum renewal, digital transformation, and the increasing complexity of child development require a qualitatively new approach to pre-service teacher education. For this reason, the improvement of innovative and integrative technologies in teacher preparation should be considered not as a fashionable addition to university programs, but as a necessary condition for professional relevance. Research on teacher knowledge has shown that effective teaching with technology depends on the meaningful interaction of content, pedagogy, and technology rather than on technological competence alone [1]. Later work in teacher education confirmed that pre-service teachers develop stronger readiness for classroom innovation when technological preparation is embedded into pedagogical design and subject-specific meaning-making [2], [3]. Contemporary teacher education texts also emphasize that digital technologies should be approached critically and pedagogically, not mechanically, and that future teachers need to understand why, when, and under what conditions technologies serve learning [4].

In the context of primary education, this issue becomes even more significant. The future primary school teacher works at the stage when children's motivation, communication style, socialization patterns, and foundational cognitive abilities are actively formed. At this level, the teacher cannot rely on narrow subject transmission alone. Primary teaching naturally requires integration: language is connected with thinking, mathematics with daily experience, art with emotional development, science with curiosity, and digital activity with play, inquiry, and collaboration.

Therefore, the improvement of innovative and integrative technologies in the preparation of future primary school teachers should begin from a redefinition of professional competence itself. Competence must be understood as the ability to combine educational aims, child psychology, teaching methods, digital tools, assessment strategies, and ethical responsibility within a coherent teaching act.



The future primary teacher should know not merely how to operate a tool, but how to transform a tool into a pedagogically justified learning opportunity [1], [4], [5].

One of the key methodological foundations for such preparation is the TPACK framework, which explains that quality teaching with technology emerges from the intersection of technological, pedagogical, and content knowledge [1]. This framework is especially relevant for the training of future primary school teachers because primary educators constantly move between subjects and learning situations. They teach literacy, numeracy, environmental studies, moral education, creativity, and communication, often within the same school day. Thus, their preparation must be synthetic rather than fragmented. If university programs teach digital skills separately from pedagogy, or pedagogy separately from subject content, future teachers may demonstrate technical confidence but remain uncertain about real classroom application. Studies on pre-service primary teachers confirm that technology integration becomes meaningful when it is connected with lesson design, learner needs, and reflective practice [2], [3]. Newer handbook work on TPACK also stresses that the framework continues to evolve in response to context, diversity, and emerging digital environments, which means that teacher preparation must be adaptive rather than static [8].

At the same time, innovative technologies in teacher education should not be reduced to computers, projectors, virtual boards, or artificial intelligence tools. Innovation in pedagogy is broader than digitization. It includes collaborative methods, inquiry-based learning, case analysis, project design, simulation, flexible assessment, reflective portfolios, microteaching, peer feedback, and the creative organization of educational content. In other words, innovation is pedagogically meaningful change that improves the quality of learning, expands teacher agency, and responds to the real developmental needs of children [5]. Educational literature on primary teaching also presents innovation as a process that empowers teachers to create intelligent, creative, and engaging learning experiences rather than simply adopt new instruments [5]. This is an important clarification, because many teacher education programs formally modernize infrastructure while preserving conservative teaching logic. When this happens, innovative technology is present physically but absent pedagogically.

For future primary school teachers, innovation should first be experienced during university study itself. A student cannot become an innovative teacher in a



learning environment that is entirely reproductive, lecture-dominated, and assessment-centered. If the future teacher is only asked to memorize theories, reproduce definitions, and pass isolated exams, then later professional practice will reproduce the same instructional model. Therefore, the improvement of innovative technologies must begin with the redesign of teacher education classes. University instructors should organize learning through model lessons, collaborative workshops, school-based tasks, design challenges, observation protocols, and digital reflection diaries. In this way, students do not just learn about innovation; they learn through innovation. Such experiential preparation helps future teachers internalize the logic of active learning and understand how methods influence learner engagement and understanding [4], [5].

The concept of integrative technologies is equally important. In this article, integrative technologies are understood as pedagogical technologies that connect different dimensions of teacher preparation into a single developmental system. First, they integrate theory and practice. Many problems in pre-service teacher education arise because students study psychology, pedagogy, methodology, and subject theory at the university, but struggle to apply them during practicum. Integrative technologies help overcome this contradiction by placing students in situations where theoretical concepts must be used to solve teaching problems. Lesson study, case-based analysis, video reflection, digital portfolios, and scenario planning are useful here because they require future teachers to connect concepts with pedagogical action. Second, integrative technologies unite subjects and methods. Since primary school learning is naturally interdisciplinary, future teachers should be trained to design lessons in which literacy, communication, creativity, mathematics, and environmental understanding support one another. Third, integrative technologies connect university preparation with school innovation by creating partnership-based practicum models rather than short-term observational visits. This direction is consistent with contemporary policy discussions that emphasize the need to develop human capacity, pedagogical adaptation, and quality professional learning for effective digital education [6]. A major weakness of many existing programs is that technological preparation remains superficial. Students often become familiar with presentation software, online resources, or digital platforms, but they are not always taught to evaluate whether these resources are developmentally appropriate for younger learners, whether they support conceptual understanding, or whether they contribute to



inclusion and participation. Research and policy literature increasingly warn that the effectiveness of digital tools is not guaranteed by access alone. Their impact depends on strategic implementation, alignment with pedagogical goals, and thoughtful management of risks such as distraction, inequality, and weak instructional coherence [7]. UNESCO's work on technology in education similarly underlines that technology can support access and learning, but its value depends on context and appropriate use rather than on simple expansion [9]. This means that the preparation of future primary school teachers should include not only digital skills, but also critical technological judgment. They need to ask: What educational problem does this tool solve? How does it support child participation? Does it simplify or deepen understanding? Does it encourage dependence or autonomy? Does it strengthen inclusion or widen gaps?

Another contradiction lies in the separation between innovation and child development. In some training environments, future teachers are introduced to modern technologies without serious attention to age characteristics, play, emotional safety, and the sensory-motor needs of primary learners. Yet primary education cannot be guided by adult assumptions about efficiency alone. Young children learn through movement, repetition, language interaction, visual cues, imagination, and concrete experience. For this reason, innovative and integrative technologies for primary teacher preparation must always remain child-centered. A future teacher should know how to combine digital materials with storytelling, manipulative resources, drawing, discussion, role play, observation, and practical exploration. In this model, technology does not replace pedagogy; it extends pedagogical possibilities. The teacher remains the one who structures meaning, regulates pace, supports motivation, and protects the educational value of the learning process [4], [6], [9]. From a curricular perspective, improving innovative and integrative technologies in teacher education requires structural change. It is not enough to add one course called "ICT in education" or "innovative methods." Such an approach often isolates innovation instead of mainstreaming it. A more effective model is curricular embedding. This means that each professional subject in the teacher education program should include an innovation component. For example, courses in literacy methodology should train students to design multimodal reading activities, interactive storytelling, and formative digital feedback. Mathematics methodology should include visual modeling, virtual manipulatives, and inquiry tasks appropriate for younger learners.



Classroom management should address digital attention, cooperative learning, and inclusive participation. Teaching practice seminars should require students to evaluate the pedagogical value of the technologies they use. In this way, innovation becomes a cross-cutting principle rather than a separate topic [1], [4], [8].

An especially productive direction is the development of blended professional learning models in pre-service education. Blended learning in teacher preparation does not simply mean combining online and face-to-face instruction. It means designing a pedagogically coherent learning environment in which university seminars, school observations, digital collaboration, reflective writing, and independent inquiry reinforce one another. When well designed, such models can strengthen student autonomy, continuity of practice, and access to diverse educational materials. At the same time, the literature makes clear that blended learning is effective only when implementation challenges are addressed and when pedagogical aims remain central [7]. For future primary school teachers, blended learning can be especially useful in supporting lesson planning, peer review, video-based reflection, and the gradual development of classroom confidence. It also allows teacher educators to model flexible instructional design, which students can later adapt to their own classrooms.

The role of reflective practice in innovative teacher preparation should be highlighted separately. No technology becomes educationally valuable unless the teacher can evaluate its use, recognize limitations, and revise future action. Therefore, innovative and integrative technologies should be linked with systematic reflection. Reflective journals, e-portfolios, lesson recordings, peer observation protocols, and post-practicum analytical conferences help future teachers move from spontaneous use of tools to evidence-based pedagogical choice. Reflection also supports professional identity formation. When students analyze not only what they taught, but why they taught it in a certain way, they begin to understand themselves as decision-makers rather than executors of prescribed methods. This is particularly important in primary education, where classroom situations are dynamic and require responsive adjustment. Reflective preparation is also consistent with the broader understanding that effective digital education depends on careful pedagogical adaptation rather than the replication of traditional teaching in digital form [6].



In addition, improving innovative and integrative technologies requires stronger partnership between higher education institutions and schools. In many cases, university courses speak the language of reform while school placement experiences reproduce routine practice. This disjunction weakens professional formation. To solve this problem, practicum design should become more collaborative and developmental. University instructors, mentor teachers, and students should co-construct practicum goals related to innovation, integration, assessment, and child participation. Students should not be sent to schools merely to observe or to deliver isolated lessons. They should be involved in cycles of planning, implementation, feedback, revision, and documentation. Digital tools can support this process through shared planning spaces, observation templates, mentoring comments, and archived lesson materials. When such structures are created, technology serves as a medium of professional dialogue rather than a decorative addition. Another important dimension is inclusion. The innovative preparation of future primary school teachers must account for learners with different abilities, language backgrounds, learning tempos, and social experiences. Integrative technologies can support inclusion when they offer multiple ways of representation, participation, and expression. However, inclusion is not achieved automatically by digitalization. A pre-service teacher must be trained to select and adapt resources responsibly, to avoid cognitive overload, and to preserve meaningful interaction. In primary classrooms, inclusive teaching often depends on the skillful combination of visual support, oral explanation, tactile experience, pair work, and differentiated tasks. Technology can amplify these options, but only if the future teacher is prepared to use it in a pedagogically balanced way. Policy and research discussions on digital education repeatedly underline the need to balance opportunities with attention to equity and quality [7], [9].

On the basis of the analysis above, several concrete pedagogical proposals can be formulated for improving innovative and integrative technologies in the preparation of future primary school teachers. First, teacher education programs should move from a tool-centered model to a design-centered model. Students should be assessed not on whether they know many platforms, but on whether they can justify technological choices in relation to learning objectives, age characteristics, and assessment strategies. Second, innovation should be distributed across the curriculum and not confined to a single isolated course.



Third, integrative modules should be developed in which future teachers design interdisciplinary primary lessons, combining language, numeracy, creative activity, and exploratory learning. Fourth, reflective technologies such as e-portfolios, lesson video analysis, and digital mentoring logs should become mandatory elements of practicum. Fifth, microteaching and simulation should be expanded so that students repeatedly test and refine innovative methods before entering full classroom responsibility. Sixth, university-school partnerships should be reorganized around shared professional inquiry. Seventh, teacher educators themselves should model the balanced and critical use of innovative technologies, because the culture of preparation influences the culture of future teaching [1], [4], [6], [8].

Thus, the improvement of innovative and integrative technologies in the preparation of future primary school teachers should be interpreted as a multidimensional pedagogical strategy. Its essence lies not in the external modernization of teacher education, but in the deep restructuring of how professional competence is formed. The future primary teacher must be prepared to think systemically, teach creatively, integrate disciplines, use technologies critically, and organize child-centered learning environments that are both intellectually rich and emotionally supportive. Such preparation is possible only when innovation is linked with reflection, integration with practice, and technology with pedagogical purpose. In this sense, the modernization of teacher education is not a technical task but a humanistic one: it seeks to prepare teachers who can guide children into learning, communication, inquiry, and responsible participation in a rapidly changing world [3], [6], [7], [9].

Conclusion

Improving innovative and integrative technologies in the preparation of future primary school teachers is a strategic priority for modern higher education. The analysis shows that effective teacher preparation depends on the meaningful synthesis of pedagogy, technology, subject knowledge, reflection, interdisciplinary design, and school-based practice. Innovative technologies should not be treated as isolated digital tools, and integrative technologies should not be reduced to formal curriculum combinations. Their real value emerges only when they help future teachers connect theory with classroom action, organize child-centered learning, and make justified pedagogical decisions. The most

important conclusion is that the professional readiness of a future primary teacher grows in an environment where innovation is experienced, critically evaluated, and integrated into authentic practice. Therefore, universities preparing primary teachers should redesign curricula, assessment, practicum, and mentoring systems in accordance with this logic. Only under these conditions can innovative and integrative technologies become a real factor in improving the quality of teacher education and, consequently, the quality of primary schooling.

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