

DEVELOPMENT OF PROFESSIONAL COMPETENCIES OF CHEMISTRY TEACHERS IN A DIGITAL AND INTERACTIVE LEARNING ENVIRONMENT*Abdinbeyova R. T.*

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The rapid integration of digital technologies into education has significantly transformed chemistry teaching and learning processes. This study explores the development of professional competencies of chemistry teachers within digital and interactive learning environments. Emphasis is placed on the role of digital tools, interactive platforms, virtual laboratories, and student-centered methodologies in enhancing pedagogical effectiveness. The article highlights how the purposeful integration of technology supports conceptual understanding, active learning, and scientific thinking in chemistry education. The increasing digitalization of education, the expansion of online and blended learning models, and the need for interactive instructional strategies have made the development of chemistry teachers' professional competencies particularly relevant. Modern chemistry teachers are required to possess not only subject expertise but also digital-pedagogical skills to effectively manage interactive learning environments. The aim of the study is to identify key professional competencies required for chemistry teachers in digital and interactive learning environments and to analyze pedagogical approaches that support their effective development. The study proposes an integrated competency framework that combines subject knowledge, digital literacy, interactive teaching strategies, and reflective practice, specifically adapted to the teaching of chemistry.

The analysis shows that a digital and interactive learning environment can become a powerful catalyst for strengthening chemistry teachers' professionalism when technology is used purposefully and pedagogically, rather than as an add-on. The development of teachers' competencies in such environments requires a balanced integration of four major dimensions: strong subject and methodological knowledge, digital literacy (selection and effective use of platforms and tools), interactive instructional design (engagement, collaboration, inquiry), and reflective practice (continuous improvement based on evidence from learning outcomes).

In chemistry education specifically, digital resources such as virtual laboratories, simulations, dynamic visualizations, and interactive assessment tools help teachers present abstract concepts more clearly, increase the safety and accessibility of experimental learning, and support students in connecting theory with real-world applications. At the same time, interactive teaching strategies (problem-based tasks, inquiry cycles, collaborative projects, and discussion-based reasoning) enable learners to actively construct chemical understanding, justify conclusions using evidence, and develop scientific thinking skills. These pedagogical benefits become stronger when teachers are able to differentiate instruction, provide timely formative feedback, and adapt lesson scenarios to students' prior knowledge and learning needs. Furthermore, the study indicates that sustainable professional growth depends on continuous professional development mechanisms: targeted training in digital pedagogy, mentoring and peer-learning communities, lesson study practices, and systematic reflection supported by classroom data. When these mechanisms are in place, teachers become more confident in managing blended or online learning models, more capable of designing interactive chemistry lessons, and more effective in maintaining students' motivation and academic progress. Ultimately, investing in the development of chemistry teachers' digital and interactive competencies improves the quality of teaching, strengthens students' conceptual understanding and laboratory culture, and supports long-term educational outcomes aligned with modern curriculum expectations.

References

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