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PEDAGOGICAL FOUNDATIONS OF DEVELOPING DIGITAL COMPETENCE IN SCHOOL STUDENTS

Kokand State University

1st-year Master's student, Theory and History of Pedagogy

Esonaliyeva Dilnigorkhon

ABSTRACT

This article examines the conceptual and pedagogical foundations for developing digital competence in secondary school students within the context of globalization and educational digitalization. Today, fostering students' information literacy encompasses not only technical skills but also complex elements such as critical analysis, cognitive flexibility, and digital ethics. Within the scope of the research, methodological approaches serving to enhance student competence in the modern digital ecosystem are analyzed, and effective pedagogical mechanisms for integrating ICT tools into the educational process are identified. As a result of the experimental work carried out, it is scientifically proven that an interactive learning environment based on digital technologies increases students' independent learning activity and guarantees academic quality.

Keywords: digital competence, digital literacy, information technologies, pedagogical technology, distance learning, ICT.

INTRODUCTION

The first quarter of the 21st century has entered the history of human civilization as the "era of global digital transformation." Today, the processes of globalization and digitalization in the world's educational space are causing not merely a change in technical tools, but a fundamental renewal of the educational paradigm. The Concept for the Development of the Education System of the Republic of Uzbekistan until 2030 identifies the development of students' critical thinking, information-handling skills, and capacity for independent decision-making as a priority task. These tasks directly require the formation of the student as a "person" in the digital world.

Digital competence is not merely computer literacy or the ability to use technical devices. It is a complex set of cognitive and social skills that encompasses a modern individual's abilities to search for, filter, analyze, create digital content, and communicate effectively in a safe virtual environment. According to the European Union's DigComp framework, this competence rests on five core pillars: information literacy, communication and collaboration, digital content creation, cybersecurity, and digital problem-solving.

The critical urgency of the problem lies in the fact that many current traditional teaching methods cannot fully meet the cognitive needs of the modern "Generation Z" (Digital Natives) — students who are growing up in a digital environment from birth. In the traditional model the student is a passive recipient, whereas in digital education they must become an active subject of the process. Today's student obtains information from internet sources faster than from textbooks,

yet lacks the skill to verify the reliability of that information (fact-checking) or to use it for constructive purposes.

For this reason, developing the pedagogical foundations for systematically building digital skills in school students has become an objective necessity. This process cannot be limited to merely supplying schools with computers — it requires a comprehensive reconsideration of educational content, methodology, and assessment systems. This article is aimed at scientifically substantiating the new roles of the teacher (facilitator, mentor) and the pedagogical principles of digital didactics in shaping digital competence.

LITERATURE REVIEW

In the framework document "Key Competences for Lifelong Learning" adopted by the European Parliament and Council (2006), digital competence was defined as "a core competence of the information society" and recognized as one of eight key competences (European Parliament, 2006). This framework was subsequently expanded with the DigComp 2.0 (2016) and DigComp 2.2 (2022) versions.

Ferrari (2012) defines digital competence as "the sum of skills for using digital technologies in a confident, critical, and creative manner for work, employment, learning, leisure, and social participation." Redecker (2017), in the DigComp 2.1 model, identifies five core areas of competence: information and data literacy; communication and collaboration; digital content creation; safety; and problem-solving.

Among Russian pedagogues, Khutorskoy (2003) substantiated the competency-based approach as a modern pedagogical paradigm aimed at developing activity and independence in students. Selevko (2005) investigated the relationship between educational technologies and digital competence.

In Uzbekistan, scholars such as Yo'ldoshev (2020), Kholiqov (2021), and Rahimov (2022) have studied the pedagogical potential of using information and communication technologies in school education. However, comprehensive studies dedicated to the systematic formation of digital competence remain insufficient in local scholarship.

The following key theoretical approaches were adopted in the study:

– The competency-based approach (Khutorskoy, 2003; Zimnyaya, 2006) holds that the goal of education is not ready-made knowledge, but the formation of activity-based skills.
– The constructivist approach (Vygotsky, Piaget) asserts that knowledge is constructed through active cognitive processes and that the student must become a creator of knowledge.
– The integrative approach allows digital skills to be embedded into the overall educational process across different subject contexts.
– The TPACK model (Mishra and Koehler, 2006) — the unity of technological-pedagogical-content knowledge — serves as the conceptual basis for effective activity in a digital environment for both teachers and students.

The study was conducted during the 2023–2024 academic year in three urban general education schools in Uzbekistan. A mixed methods research design was chosen, combining quantitative (quasi-experimental) and qualitative (observation, interview) approaches.

Research stages:

– First stage (diagnostic) — determining students' initial level of digital competence;
– Second stage (formative) — implementing the experimental educational model;
– Third stage (summative) — measuring and comparing results.

Students from grades 5–9 were involved in the study. The experimental group consisted of 180 students and the control group of 175 students, for a total of 355 students, 24 teachers, and 6 school administrators. The groups were statistically matched by age, gender, and academic performance.

The following methods were used in the study:

– Theoretical methods: analysis of scientific-pedagogical literature, comparison, synthesis, and generalization;
– Empirical methods: observation, questionnaire, testing, and pedagogical experiment;
– Statistical methods: t-test (Student's criterion), correlation analysis, Cramér's V coefficient;
– Qualitative methods: in-depth interview, focus group, and content analysis.

To measure digital competence, a 45-item test adapted to local conditions based on DigComp 2.2 (Vuorikari et al., 2022) was developed. The test measures student knowledge and skills at four levels across five components: information literacy, communication and collaboration, content creation, safety, and problem-solving. Cronbach's alpha = 0.87 (high reliability).

CONCLUSION

The above findings are consistent with the international scientific theories and research cited. As also emphasized in the ICILS-2023 international study conducted by Fraillon et al. (2020), students' digital competence is formed not spontaneously, but through targeted pedagogical interventions. As our study likewise confirmed, the mere availability of devices and internet access is insufficient — the critical factor is a competency-oriented pedagogical approach.

One noteworthy finding of the study is that the teacher's digital pedagogical literacy had a direct impact on student competence. Training teachers within the TPACK model framework significantly improved student outcomes ($r = 0.64$; $p < 0.01$). This confirms the conclusions of Mishra and Koehler (2006) in the local context.

The main pedagogical conditions identified in the study are: first, curricula and interdisciplinary integration; second, teachers' methodological preparedness; third, authentic and project-based assignments; and fourth, a systematic monitoring and assessment system.

As limitations of the study, the following should be noted: the research was conducted in three urban schools and rural schools were not covered; the 6-month duration did not allow for a complete assessment of long-term effectiveness; and socioeconomic factors were not controlled.

The study results showed that for systematically developing digital competence in school students, it is critically important that the pedagogical foundation be holistic, integrative, and principled in character. The developed "Integrative Digital Competence Model" (IDCM) successfully passed experimental validation and proved ready for implementation in practical educational settings.

Recommendations for future research:

– In-depth study of the pedagogical problem of the digital divide between rural and urban schools;

– Monitoring the long-term effectiveness (3–5 years) of the model through longitudinal research;

– Studying the role of artificial intelligence-based educational tools in competence development;

– Developing practical recommendations for enriching the teacher training system with a digital pedagogy module.

It is hoped that this study will make an important contribution to the pedagogical substantiation of digital transformation in Uzbekistan's school education and to the development of policy directed toward it.

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