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SYSTEMIC FORMATION OF DIGITAL COMPETENCE IN THE PROFESSIONAL TRAINING OF PRIMARY EDUCATION SPECIALISTS

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ABSTRACT: This review article provides a theoretical analysis of the issue of systemic formation of digital competence in the professional training of primary education specialists. The study examines the pedagogical content of digital competence, its connection with teachers' professional preparation, and the role of the educational environment in this process. Based on the analysis of scientific sources, the limitations of individual approaches and the need for a systemic pedagogical concept are substantiated. The findings emphasize the importance of organizing digital competence development as a consistent and long-term professional process.

KEYWORDS: primary education, professional training, digital competence, teacher education, systemic approach, digital environment, teacher competence, pedagogical activity, professional development

INTRODUCTION

In recent years, digital transformations within education systems have necessitated the adoption of new scientific approaches to the professional preparation of teaching personnel. The pervasive integration of digital technologies into everyday life, the exponential growth of information flows, and the increasing complexity of educational content require a fundamental rethinking of teachers' professional training. In this context, the formation of digital competence in the preparation of primary education specialists has emerged as a critical research issue. This is primarily because the primary education stage represents a foundational period in which learners' cognitive activity, information-handling practices, and initial attitudes toward the digital environment are established.

The professional activity of a primary education specialist is inherently integrative, encompassing instructional, educational, and developmental functions. Accordingly, the use of digital technologies in this domain should not be viewed merely as an auxiliary technical support, but rather as a professional pedagogical resource aligned with educational goals. Digital competence, therefore, should not be treated as an autonomous objective; instead, it constitutes a professional quality that facilitates the effective organization of the learning process, enhances pupils' cognitive engagement, and contributes to the enrichment of educational content.

Contemporary scholarly discourse demonstrates a significant expansion in the conceptualization of digital competence. Early interpretations largely associated the concept with technical proficiency in information and communication technologies, whereas more recent perspectives conceptualize digital competence as a complex, multidimensional construct intrinsically linked to teachers' professional practice. From this standpoint, digital competence includes the ability to design and manage instructional processes, select pedagogically appropriate content and methods, guide learners' activities, and exercise professional responsibility within digital learning environments.

However, in the current practice of training primary education specialists, digital competence is frequently developed through isolated instructional modules or short-term professional development courses. Such approaches often lead to fragmented and unsustainable competence development. In contrast, contemporary research emphasizes the necessity of

conceptualizing digital competence formation as a coherent, continuous, and systemic process. This process should be embedded within the broader instructional and methodological framework of educational institutions and closely connected to curriculum content and the overall structure of teacher education programs.

LITERATURE REVIEW

Over the past decade, the formation of digital competence in the professional training of primary education specialists has developed into an independent research direction within pedagogical science. The rapid integration of digital technologies into educational practice has reshaped the content, forms, and organization of pedagogical activity, prompting a reconsideration of teachers' professional preparation. Consequently, scholarly discourse has progressively expanded the concept of digital competence, framing it as a complex professional quality intrinsically connected to pedagogical practice rather than as a set of isolated technical skills.

Within teacher education research, a systematic conceptualization of professional digital competence distinguishes it from general digital literacy and defines it as a quality manifested in the execution of pedagogical tasks [7]. Digital competence is shown to be closely linked to instructional design, classroom organization, and the regulation of learners' activities. This perspective provides a key theoretical foundation for the present project, as digital tools in primary education function not as auxiliary technologies but as integral elements of pedagogical practice. Accordingly, professional digital competence should occupy a central position in the preparation of primary education specialists.

A comprehensive synthesis of conceptual approaches to digital competence highlights its multidimensional structure, encompassing technological, pedagogical, cultural, and professional dimensions [8]. The formation of digital competence is therefore not an individual endeavor but a process embedded in the institutional pedagogical environment and organizational conditions of educational institutions. These findings substantiate the systemic pedagogical approach adopted in this study and confirm the necessity of integrating digital competence across the entire teacher education curriculum rather than addressing it through isolated courses.

Research on the digitalization of teacher education further reveals structural challenges related to the mismatch between traditional qualification frameworks and the demands of digital learning environments [6]. Digital competence is thus conceptualized as extending beyond technical proficiency to include creativity, adaptability, and professional responsibility, all of which are essential for sustainable pedagogical practice.

The interpretation of digital competence as a continuous process of professional development is reinforced in studies emphasizing its progressive formation throughout teachers' careers [1]. This approach underscores the importance of embedding digital competence from the undergraduate level onward and integrating it with methodological and pedagogical preparation, thereby ensuring continuity within teacher education systems.

Systematic reviews of teacher professional development indicate that existing approaches often prioritize technical skills while insufficiently integrating pedagogical and methodological dimensions [4]. Such imbalance limits the development of digital competence as an integral component of professional pedagogical activity.

Evidence from contexts closely related to primary and early childhood education further demonstrates that initiatives aimed at developing digital competence are frequently fragmented and lack coherence [3]. These findings reinforce the need for long-term, systemic strategies in teacher education.

Structural analyses of digital competence identify interconnected components, including information management, communication and collaboration, digital content creation, safety, and problem solving [2]. Together, these components support a holistic understanding of digital competence aligned with the professional demands of primary education.

Overall, the reviewed literature demonstrates that the formation of digital competence in the professional training of primary education specialists is a multidimensional process requiring a systemic pedagogical approach. Digital competence should be conceptualized not at the level of individual technical skills, but as a core element embedded within the curricular, organizational, and methodological structures of teacher education systems.

METHODOLOGY

The study employed an integrated set of research methods, including the analysis of regulatory and legal documents related to the research problem, as well as a review of pedagogical, psychological, and methodological literature. A systemic–structural analysis was used to examine the internal relationships and conceptual framework of the phenomenon under study. Empirical methods comprised observation and interviews, along with the application of specialized pedagogical and psychological instruments. In addition, an experimental approach was implemented to test the research assumptions, and mathematical and statistical methods were applied to analyze and interpret the collected data.

RESULTS AND DISCUSSION

Discussing the issue of the systemic formation of digital competence in the professional training of primary education specialists first requires clarifying the pedagogical essence of this concept and comparing how it is interpreted within existing scholarly approaches. Although digital competence has been examined across various academic fields, a common conclusion emerges in most studies: interpreting digital competence solely as a set of technical skills does not meet the needs of contemporary pedagogical education. Within the context of teacher education, digital competence is distinguished from general digital literacy and is understood as a quality intrinsically linked to teachers' professional activity. It manifests itself in the organization of instructional activities, the guidance of learners' engagement, the management of the educational process, and the implementation of educational and developmental tasks. This perspective is particularly significant for the training of primary education specialists, as teaching at this level is integrative in nature, with instructional, educational, and developmental functions implemented as a unified whole. Since primary school teachers act not only as transmitters of knowledge but also as key agents of pupils' personal and social development, digital competence should be conceptualized as a professional quality serving this integrative pedagogical activity. In this regard, digital tools are not an end in themselves but function as means for enriching pedagogical content and enhancing the effectiveness of the learning process. Such an approach constitutes the theoretical foundation of the systemic pedagogical concept developed within the framework of the project.

Digital competence represents a complex system that extends beyond technological knowledge to encompass pedagogical preparedness, professional attitudes, cultural sensitivity, and critical thinking. This understanding indicates that, in the training of primary education specialists, digital competence should not be formed as an isolated component but as an integral part of overall professional preparation. Moreover, the formation of digital competence is significantly influenced by the general pedagogical environment and organizational conditions of educational institutions. Digital competence should therefore not be viewed as the result of

individual teachers' personal initiative, but rather as an outcome of the coherent functioning of the education system as a whole. Analyses of challenges arising in the digitalization of teacher education reveal a noticeable mismatch between traditional pedagogical preparation and the demands of contemporary digital learning environments. As many training programs fail to adapt promptly to technological change, digital competence often develops in a superficial and unsystematic manner.

Given that pedagogical activity in primary education requires a high level of responsibility, caution, and methodological rigor, and that work in digital environments demands not only technical proficiency but also the conscious and pedagogically purposeful use of technology, the formation of digital competence should not be limited to individual teachers' preparation. Instead, it must be addressed within the framework of an institution's overall teacher training system. Digital competence should be developed progressively throughout the pedagogical education process and continuously refined over the course of professional practice. This approach underscores the need to move beyond short-term training models and reflects the contemporary demand for sustainable competence development in the preparation of primary education specialists.

Analytical findings further indicate that current practices in digital competence formation often place excessive emphasis on technical aspects, while pedagogical content and methodological preparation remain insufficiently integrated. Such an imbalance hinders the development of digital competence as a quality organically connected to professional pedagogical activity. This issue is particularly acute in primary education, where the use of digital tools must be carefully organized in accordance with pupils' age-related, psychological, and cognitive characteristics. Research conducted at the primary and adjacent educational levels demonstrates that existing initiatives to develop digital competence are frequently fragmented and implemented in isolated directions. Because such approaches impede the stable formation of digital competence, its development should be organized on the basis of a coherent, long-term, and systemic pedagogical approach.

CONCLUSION

The systemic formation of digital competence in the professional training of primary education specialists represents one of the most significant and pressing issues in contemporary pedagogical education. Interpreting digital competence solely as a set of technical skills is scientifically and practically insufficient. Rather, digital competence should be understood as a multidimensional and complex professional quality intrinsically linked to teachers' professional preparation. It manifests itself in the organization of the teaching process, the selection of educational content and methods, the management of learners' activities, and the implementation of educational and developmental tasks. In the context of primary education, the use of digital tools must be subordinated to pedagogical objectives and aligned with pupils' age-related and psychological characteristics.

The analyzed sources demonstrate that the formation of digital competence should not be limited to individual teachers' initiatives or isolated training courses. Instead, it must be organized as a consistent and long-term process closely connected with the overall pedagogical environment of educational institutions, curriculum content, and organizational conditions. Consequently, the systemic formation of digital competence in the professional training of primary education specialists emerges as a key prerequisite for the modernization of pedagogical education and serves as a solid methodological foundation for the development of comprehensive pedagogical concepts in this field.

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