

PROFESSIONAL READINESS OF FUTURE IT SPECIALISTS IN THE DIGITAL ERA: CONCEPTUALIZATION, STRUCTURE, AND LIFELONG LEARNING DIMENSIONS

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Summary

The article addresses the problem of professional readiness of future IT specialists within the context of digital transformation, lifelong education, and contemporary educational paradigms. The relevance of the study is determined by the growing demands of the digital economy for professionals capable of adapting to rapid technological changes, engaging in continuous professional development, and effectively operating in innovation-driven environments. The aim of the article is to conceptualize the phenomenon of professional readiness of future IT specialists within the lifelong education system, substantiate its theoretical and methodological foundations, and identify its structural components in the context of Education 5.0 and the digital transformation of society. The study is based on a comprehensive theoretical analysis employing methods of scientific literature review, synthesis, comparison, systematization, and conceptual generalization. The methodological framework integrates system, competency-based, activity-oriented, personality-oriented, axiological, and synergetic approaches, which provide a holistic understanding of professional readiness as a multidimensional phenomenon. The findings suggest that professional readiness should be interpreted as an integrative personal and professional construct that combines professional knowledge, technological competencies, value orientations, reflective abilities, innovation capacity, and readiness for continuous self-development. A structural model of professional readiness is substantiated, comprising motivational and value, cognitive, operational and technological, personal and reflective, and innovation and self-educational components. It is argued that the interaction of these components ensures professional adaptability, mobility, innovation, and sustainable professional growth in rapidly changing technological environments. The scientific contribution of the study lies in clarifying the conceptual essence of professional readiness of future IT specialists, substantiating its structural organization, and identifying methodological foundations for further research within the lifelong education paradigm.

Key words: digital transformation; lifelong learning; competency-based education; Education 5.0; professional development; innovation capacity; digital literacy; self-directed learning.

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1. Introduction

The rapid digital transformation of society, the accelerated development of information technologies, and the emergence of the knowledge economy have substantially transformed the requirements for professional training across all sectors, particularly within the information

technology industry. Contemporary IT specialists are expected not only to possess advanced technical knowledge and professional skills but also to demonstrate adaptability, innovative thinking, professional mobility, and the ability to continuously update their competencies in response to ongoing technological change. Consequently, the quality of professional preparation is increasingly determined by graduates' readiness for lifelong professional development rather than by the mere acquisition of specialized knowledge.

Within this context, the concept of Lifelong Learning has gained particular significance, positioning education as a continuous process of personal and professional development throughout an individual's life.

This perspective has led to a gradual shift in educational priorities from knowledge transmission toward the development of learners' capacity for self-directed learning, critical thinking, knowledge renewal, and effective application of acquired competencies in diverse professional contexts. As a result, growing scholarly attention has been devoted to the phenomenon of professional readiness as a key outcome of professional education and an essential prerequisite for successful participation in contemporary labor markets (Koval, Aleksieienko-Lemovska, & Mikhno, 2023). The relevance of this issue is especially evident in the preparation of future IT specialists. The dynamic nature of the IT sector, characterized by rapid technological innovation, continuous emergence of new digital tools, and increasing complexity of professional tasks, requires graduates to be prepared not only for current professional demands but also for future technological and organizational transformations. Therefore, professional readiness should be considered as an integrative personal and professional construct that combines motivation, professional knowledge, technological competencies, reflective abilities, innovation orientation, and readiness for continuous self-development.

Additional methodological significance is provided by the emergence of the Education 5.0 and Industry 5.0 paradigms, which establish new benchmarks for professional education in the digital era. These concepts emphasize the preparation of specialists capable of combining technological expertise with creativity, critical thinking, ethical responsibility, human-centered values, and the ability to collaborate effectively with intelligent technologies (European Commission, 2023). Under such conditions, professional readiness becomes a multidimensional phenomenon that extends beyond professional competence and encompasses the capacity for lifelong learning, innovation, and sustainable professional growth.

Despite the growing body of research devoted to professional training, competency development, and digital education, the theoretical understanding of professional readiness of future IT specialists within the framework of lifelong education remains insufficiently systematized. In particular, there is a need to clarify the conceptual foundations of this phenomenon, identify its methodological determinants, and substantiate its structural composition in accordance with contemporary educational and technological transformations.

The novelty of this study lies in the conceptualization of professional readiness of future IT specialists as an integrative construct within the lifelong education paradigm, as well as in the substantiation of its methodological foundations and structural organization in the context of digital transformation and Education 5.0. The aim of this article is to conceptualize the phenomenon of professional readiness of future IT specialists within the lifelong education system, substantiate its theoretical and methodological foundations, and develop a structural model reflecting its key components in contemporary digital educational environments. To achieve this aim, the following research objectives were formulated: to analyze contemporary theoretical approaches to professional readiness in IT education; to identify methodological foundations for studying professional readiness within the lifelong learning paradigm; to clarify

the conceptual essence of professional readiness of future IT specialists; to substantiate the structural components of professional readiness in the context of digital transformation and Education 5.0. The study employs a set of theoretical research methods, including scientific literature analysis, comparison, synthesis, systematization, and conceptual generalization. These methods enabled the identification of key theoretical perspectives, methodological approaches, and structural characteristics of professional readiness of future IT specialists.

2. Analysis of Recent Research and Publications

The issue of professional readiness of future specialists remains one of the most relevant areas of contemporary educational research, situated at the intersection of professional education theory, psychology of professional development, digital pedagogy, and lifelong learning studies. The rapid advancement of digital technologies, the proliferation of artificial intelligence, the automation of professional activities, and the transformation of labor markets have significantly changed the understanding of educational outcomes and intensified scholarly interest in the readiness of graduates to function effectively in dynamic professional environments.

In contemporary scientific discourse, professional readiness is increasingly interpreted not as a final outcome of education but as an integrative personal and professional construct that ensures successful professional performance, adaptability to technological change, professional mobility, and continuous competency development. This shift reflects broader transformations in educational paradigms, where emphasis is placed on lifelong professional growth and sustainable employability rather than on the acquisition of static knowledge and skills.

A substantial contribution to the theoretical foundations of professional education and lifelong learning has been made by Ukrainian scholars such as V. Kremen, N. Nychkalo, S. Sysioieva, O. Dubaseniuk, V. Luhovyi, and V. Andrushchenko. Their works emphasize lifelong learning as a key mechanism for human capital development, professional mobility, and adaptation to social and technological transformations. These studies have established important methodological foundations for understanding professional development as a continuous process extending throughout an individual's life.

A separate line of research focuses on the preparation of future IT specialists in the context of digital transformation. Contemporary studies primarily address issues of professional and digital competence development, practice-oriented learning, digital literacy enhancement, and the integration of information and communication technologies into educational processes. Researchers emphasize the importance of project-based learning, interdisciplinary approaches, collaboration with the IT industry, and the development of practical experience as prerequisites for successful professional preparation (*Petrenko, 2025*). In particular, professional competence is increasingly interpreted as a multidimensional system of interconnected components that determine graduates' readiness for real professional activity.

Recent studies also conceptualize IT education as an open pedagogical system whose effectiveness depends on the integration of theoretical and practical preparation, the development of professional values, and the strengthening of partnerships between educational institutions and industry stakeholders. Within this context, scholars argue that contemporary professional training should be oriented not only toward the formation of professional knowledge and technical skills but also toward professional responsibility, teamwork, communication, and professional self-realization (*Shlikhta, 2025*).

Another important research direction concerns digital competence as a fundamental component of professional readiness. Scholars highlight the role of digital educational environments,

innovative pedagogical technologies, STEAM education, interdisciplinary learning, and practice-oriented instructional models in preparing future IT professionals (*Stynskiy, 2026*). At the same time, digital competence is increasingly viewed not merely as a technological skill set but as an essential condition for professional development and successful adaptation within digitally transformed societies (*Shvardak, 2025*).

In the international scientific literature, the concept of professional readiness is increasingly examined through the perspective of Lifelong Learning, which is widely recognized as a prerequisite for sustainable professional competitiveness. UNESCO emphasizes the necessity of fostering individuals' capacity for continuous learning, self-directed education, and adaptation to changing professional environments (*UNESCO, 2020*). Similar conclusions are reflected in OECD Skills Outlook reports (*OECD, 2025*). World Economic Forum's Future of Jobs Report (*World Economic Forum, 2025*), which identify reskilling, upskilling, critical thinking, and continuous professional development as essential competencies for the digital economy.

Particular attention in recent international research has been devoted to the concepts of future readiness and AI-enhanced readiness. These approaches emphasize that professional readiness involves not only professional competence but also the ability to interact effectively with intelligent technologies, utilize artificial intelligence tools, adapt rapidly to technological change, and engage in lifelong self-improvement. Consequently, digital literacy, analytical thinking, creativity, communication skills, and learner autonomy are increasingly recognized as critical dimensions of professional readiness (*Luckin, 2024; Burgos et al., 2024; Redecker, 2022; Holmes et al., 2025*).

The growing influence of Education 5.0 and Industry 5.0 has further transformed discussions concerning professional readiness. Contemporary studies emphasize the need to prepare specialists capable of combining technological expertise with creativity, interdisciplinary thinking, social responsibility, and human-centered values (*Supriya et al., 2024*).

Researchers argue that professional education should promote not only technical competence but also innovation capacity, ethical awareness, collaboration, and adaptability in technology-rich environments (*Zhou et al., 2025*).

Furthermore, recent investigations highlight the significance of AI literacy and advanced digital skills as essential components of future professional readiness. Empirical studies demonstrate a strong relationship between digital literacy and professional adaptability, while AI literacy is increasingly regarded as a prerequisite for successful participation in AI-driven professional environments (*Naseer et al., 2025; Hong, 2025*).

At the same time, growing attention is devoted to the role of soft skills, including communication, teamwork, self-regulation, and project management, as important predictors of both academic success and professional adaptation among future IT specialists (*Popa et al., 2026*).

Despite the substantial body of research devoted to professional competence development, digital literacy, AI-related skills, practice-oriented learning, and lifelong learning, the phenomenon of professional readiness of future IT specialists remains insufficiently conceptualized as a holistic construct within the lifelong education paradigm. Existing studies tend to focus on particular dimensions of professional preparation, whereas the theoretical and methodological foundations of professional readiness, its structural organization, and its role within the context of digital transformation, Education 5.0, and AI-driven professional environments remain insufficiently substantiated. This research gap determines the relevance and scientific significance of the present study.

3. Conceptualizing Professional Readiness in Contemporary IT Education

The rapid development of the digital society is accompanied by significant transformations in the requirements imposed on modern IT professionals. The growing complexity of information technologies, continuous technological innovation, and the increasing demand for professional adaptability have intensified scholarly interest in the phenomenon of professional readiness as a key outcome of professional education. In the context of lifelong learning, professional readiness is no longer understood solely as the possession of professional knowledge and skills; rather, it is viewed as an integrative personal and professional construct that ensures successful professional performance, continuous self-development, and adaptation to dynamic technological environments.

Professional readiness of future IT specialists can be interpreted as a multidimensional phenomenon reflecting the result of an individual's professional development within the lifelong education system. It characterizes the degree of preparedness for productive professional activity, continuous knowledge renewal, creative application of digital technologies, professional self-realization, and lifelong learning. This readiness integrates professional knowledge, digital competencies, value orientations, motivational attitudes, reflective abilities, and personal qualities that support professional mobility, innovation, and responsibility in the context of digital transformation.

Such an understanding emphasizes that professional readiness cannot be reduced to a simple combination of competencies or professional qualifications. Instead, it represents a holistic system in which motivational, cognitive, operational, and personal characteristics interact dynamically and mutually reinforce one another (*Ada, Taş, Dudka, & Aleksieienko-Lemovska, 2023*).

Consequently, professional readiness should be regarded as a complex integrative characteristic that determines the ability of future IT specialists to respond effectively to the challenges of contemporary professional practice and sustain continuous professional growth throughout their careers.

Thus, professional readiness of future IT specialists should be understood as an integrative personal and professional construct formed within the lifelong education system and manifested in the ability to perform professional activities effectively, adapt to technological changes, and continuously develop professional competencies throughout life.

4. Methodological Perspectives on Professional Readiness Formation

The study of professional readiness of future IT specialists requires a comprehensive methodological framework capable of explaining the complexity of professional development processes within the context of digital transformation. Given the multidimensional and dynamic nature of professional readiness, its investigation necessitates the integration of complementary scientific approaches that reveal various aspects of professional formation in contemporary educational environments.

The *system approach* serves as one of the fundamental methodological foundations of this study. According to this perspective, professional readiness is considered an open, dynamic, and holistic system consisting of interconnected structural components that function in constant interaction with educational, social, and professional environments (*Andree, Müller, & Wagner, 2025*).

Professional readiness is therefore viewed not as a collection of isolated competencies but as an integrated phenomenon in which changes in one component inevitably influence the functioning of the entire system.

A central role in understanding professional readiness belongs to the *competency-based approach*, which currently constitutes one of the leading paradigms of educational modernization (Selwyn, 2021). Within this framework, educational outcomes are assessed through an individual's ability to effectively perform professional tasks by mobilizing knowledge, skills, values, and personal resources. Consequently, professional readiness emerges as an integrated result of professional, digital, communicative, and innovative competencies required for successful functioning in the contemporary IT industry.

The *activity approach* complements the competency paradigm by emphasizing the role of active participation in professional activities as a mechanism of personal development. In IT education, this approach focuses on creating opportunities for students to acquire practical experience through programming projects, software development, participation in hackathons, start-up initiatives, and problem-based learning (Myastkovska, Kobylanska, & Kysiuk, 2023). Professional readiness is therefore understood as a result of active engagement with professional contexts and gradual acquisition of practical experience.

The *personality-oriented approach* views future IT specialists as active subjects of their own professional development rather than passive recipients of educational influences. Within this framework, professional readiness is associated with the development of professional subjectivity, self-realization, self-determination, and self-development (Hagadone-Bedirr, Voithofer, & Kulp, 2023). The approach highlights the importance of considering individual educational needs, professional interests, and personal characteristics in designing educational trajectories.

The *axiological approach* enables the examination of professional readiness through the prism of values, motivations, and professional meanings. Contemporary IT education should not be limited to technological competence development alone. It must also promote professional responsibility, digital ethics, academic integrity, effective communication, and awareness of the social significance of technological solutions (Bykov, Spirin, & Pinchuk, 2020). Therefore, the value dimension becomes an essential component of professional readiness.

Particular relevance in the digital era is acquired by the *synergetic approach*, which conceptualizes professional readiness formation as a nonlinear process characterized by self-organization, self-regulation, and continuous development. Professional growth is understood not as a linear accumulation of knowledge and skills but as a complex interaction of multiple internal and external factors that lead to the emergence of new qualitative characteristics of the individual (Fullan, 2016). This perspective is especially important in the IT sector, which is characterized by uncertainty, rapid innovation, and constant technological change.

Taken together, these methodological approaches provide a comprehensive framework for understanding professional readiness as a multifaceted phenomenon shaped by educational, technological, social, and personal factors within the lifelong learning system.

5. Lifelong Learning and Education 5.0: New Imperatives for Future IT Specialists

A significant place in contemporary theoretical interpretations of professional readiness belongs to the concept of Lifelong Learning, which views education as a continuous process of personal and professional development extending throughout an individual's life (Aleksieienko-Lemovska, 2024). In the context of IT specialist preparation, this concept acquires particular importance due to the rapid pace of technological advancement and the constant emergence of new digital tools, programming languages, and technological solutions.

From the perspective of Lifelong Learning, professional readiness should not be viewed as a static outcome of formal education. Rather, it constitutes a dynamic personal characteristic

that enables continuous professional development, self-directed learning, and adaptation to evolving professional environments. The capacity for lifelong learning becomes a prerequisite for sustainable professional success in the information technology sector.

These ideas are further developed within the framework of Education 5.0, which has become one of the strategic directions of educational transformation in the digital era. Unlike previous educational paradigms, Education 5.0 emphasizes not only professional competence development but also creativity, innovation, critical thinking, emotional intelligence, and effective interaction between humans and intelligent technologies.

Within this framework, professional readiness of future IT specialists can be understood as the integrated result of technological preparedness, personal maturity, innovative thinking, and responsible use of digital technologies for societal benefit. Education 5.0 shifts attention from purely technical training toward the formation of holistic professionals capable of generating innovative solutions while maintaining ethical and social responsibility.

Consequently, Lifelong Learning and Education 5.0 provide a contemporary conceptual framework for understanding professional readiness as a dynamic and continuously evolving characteristic of future IT specialists, ensuring their adaptability, innovation capacity, and sustainable professional development in a rapidly changing digital environment.

6. A Structural Model of Professional Readiness of Future IT Specialists

Based on the analysis of psychological and pedagogical studies, the specific nature of professional activity in the information technology sector, and current requirements for competitive specialists, the structure of professional readiness of future IT specialists is represented by five interrelated components: motivational and value, cognitive, operational and technological, personal and reflective, and innovation and self-educational.

The *motivational and value component* serves as the system-forming basis of professional readiness because it determines an individual's orientation toward professional activity and awareness of its social significance. This component includes professional motives, value orientations, professional interests, aspirations for self-realization in the IT field, responsibility for professional outcomes, and awareness of ethical aspects of digital technology use (Siemens, 2005). It largely determines the willingness of future specialists to engage in continuous professional improvement and lifelong learning.

The *cognitive component* reflects the system of professional knowledge required for future professional activity. It encompasses not only theoretical foundations of computer science, programming, information systems, and digital technologies but also understanding of the broader trends shaping contemporary digital ecosystems (Polets, 2024). An important indicator of this component is the ability to integrate interdisciplinary knowledge, critically evaluate information, and apply it to solving professional problems.

The *operational and technological component* characterizes the practical dimension of professional readiness. It includes professional skills related to software design, development, testing, maintenance, data processing, project management, and teamwork (Ada, Taş, Dudka, & Aleksieienko-Lemovska, 2023). This component demonstrates the ability to apply acquired knowledge effectively in real or simulated professional situations and reflects the practical preparedness of future specialists.

The *personal and reflective component* concerns the development of future specialists as active subjects of professional activity and self-development. It encompasses self-analysis, critical reflection, evaluation of personal achievements and challenges, and planning of future

professional growth (Damek, Söbke, Weise, & Reichelt, 2022). In addition, it includes such qualities as responsibility, independence, persistence, communication skills, emotional stability, and readiness for collaborative professional interaction.

The *innovation and self-educational component* reflects the specific demands of the IT sector, where technological changes occur rapidly and continuously. Professional success increasingly depends on an individual's ability to engage in self-directed learning, acquire new knowledge independently, adopt innovative technologies, and adapt quickly to professional changes (Siemens, 2005). This component therefore includes openness to innovation, readiness for continuous learning, capacity for self-education, and commitment to ongoing professional development.

The proposed structural model demonstrates that professional readiness of future IT specialists is not a collection of isolated competencies or personal qualities but an integrated system of motivational, cognitive, operational, reflective, and self-developmental characteristics (Paliy, Yelchaninova, & Shevchenko, 2024). The interaction of these components ensures professional mobility, adaptability, innovation capacity, and sustainable professional growth within the lifelong learning paradigm.

7. Conclusions

The conducted study confirms that the problem of professional readiness of future IT specialists has gained particular relevance in the context of digital transformation, rapid technological advancement, and the growing importance of lifelong learning. Contemporary requirements for IT professionals extend beyond the acquisition of specialized knowledge and technical skills, emphasizing the ability to adapt to technological change, engage in continuous professional development, and effectively respond to emerging challenges within the digital environment.

The theoretical analysis made it possible to substantiate professional readiness of future IT specialists as an integrative personal and professional construct that reflects the outcome of professional development within the lifelong education system. This construct encompasses not only professional knowledge and competencies but also motivational, value-based, reflective, and self-developmental characteristics that ensure effective professional performance, adaptability, and sustainable professional growth.

The study demonstrated that a comprehensive understanding of professional readiness requires the integration of complementary methodological perspectives, including the system, competency-based, activity, personality-oriented, axiological, and synergetic approaches. Their combined application provides a holistic framework for interpreting professional readiness as a multidimensional phenomenon shaped by educational, technological, social, and personal factors.

It was established that the concepts of Lifelong Learning and Education 5.0 create an appropriate theoretical foundation for understanding professional readiness as a dynamic and continuously evolving characteristic of future IT specialists. Within this framework, professional readiness is viewed as a prerequisite for professional mobility, innovation capacity, responsible use of digital technologies, and lifelong professional self-improvement.

As a result of the study, a structural model of professional readiness of future IT specialists was substantiated, comprising five interrelated components: motivational and value, cognitive, operational and technological, personal and reflective, and innovation and self-educational. The interaction of these components ensures the integrity of professional development

and creates the foundation for successful professional activity, adaptability, innovation, and continuous learning in a rapidly changing technological environment.

The findings allow us to conclude that professional readiness of future IT specialists represents a complex multidimensional phenomenon that integrates professional, personal, value-based, and activity-related characteristics and serves as a critical condition for successful professional self-realization in the digital era.

Future research should focus on developing a conceptual model for the formation of professional readiness of future IT specialists within the lifelong education system, identifying pedagogical conditions that facilitate its development, designing diagnostic tools for assessing its formation levels, and empirically validating the effectiveness of educational strategies aimed at enhancing professional readiness in IT education.

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