## Development of creative competencies in IT bachelors: Ukrainian experience in the context of post-war recovery

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Abstract. This study examines the importance of developing creative competencies in bachelor's-level students in information technology within the Ukrainian educational context. In contemporary society, especially in the IT industry, non-standard thinking and creative approaches to problem-solving are highly valued. The research demonstrates that successful IT careers require developing competencies such as creativity, technical skills, leadership qualities, and teamwork abilities. The paper analyzes theoretical approaches to creativity, reviews current research on IT competency development, and examines the specifics of the Ukrainian IT educational landscape. Using data from employer interviews and labor market analysis, the study identifies key creative competencies demanded by the industry and assesses how these are being developed in higher education. The research highlights the transformative changes in the Ukrainian IT sector resulting from wartime conditions and discusses the critical role of creative IT competencies in post-war reconstruction. The findings suggest that integrating creative competency development into IT education is crucial for preparing professionals who can contribute effectively to technological innovation and economic recovery. This research offers valuable insights for curriculum development, pedagogical approaches, and policy considerations in IT higher education in Ukraine and similar contexts.

**Keywords:** creative competencies, information technology, IT professionals, creativity, IT education, Ukraine

## 1. Introduction

In modern society, unconventional thinking and creative approaches to problemsolving have gained significant importance. These characteristics, inherent to contemporary professionals, become crucial when making decisions in complex situations that arise after employment. In the IT field, as in other progressive areas of today's activities, competence, technical skills, and creativity are most valued. For building a successful career in information technology, it is important to be proactive and innovative. Continuous self-improvement, engagement in various projects, and mastery of the latest technologies are key for modern IT specialists. Career success is also

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achieved by professionals who possess teamwork skills and competencies, creativity, the ability to motivate a team, and leadership qualities.

Regardless of the employment field, mastering creative competencies helps professionals solve problems in non-standard ways, making them valuable to employers. Creative individuals are well-rounded, possess a high level of basic knowledge and experience, which serves as a foundation for acquiring new knowledge [5, 33].

The development of creative competencies in IT bachelor's students is particularly important in the context of Ukraine, a country known for its strong IT sector that has become one of the drivers of the national economy [29]. Despite the ongoing war, which has caused significant economic challenges, the IT industry has demonstrated remarkable resilience and continues to contribute significantly to the country's GDP [39]. As Ukraine looks toward post-war recovery, the IT sector will play a crucial role in rebuilding and modernizing the economy, requiring professionals equipped with both technical expertise and creative problem-solving abilities [40].

The educational system, particularly higher education institutions, bears responsibility for preparing IT professionals who can meet these demands. This requires not only imparting technical knowledge but also fostering creative competencies that enable graduates to adapt to rapidly changing technological landscapes and contribute to innovation [41].

This paper aims to review the Ukrainian experience regarding the formation of creative competencies in bachelors of information technology. It examines theoretical approaches to creativity, analyzes current research on IT competency development, explores the Ukrainian educational context, and provides recommendations for enhancing creative competency development in IT education. The research is particularly timely given the transformation of the IT labor market due to wartime conditions and the anticipated needs of post-war reconstruction.

# 2. Theoretical framework of creativity in information technology education

#### 2.1. Evolution of creativity concepts in educational context

The concept of creativity in education has evolved significantly over time, influenced by various psychological, educational, and economic paradigms. Initially viewed primarily through the lens of artistic expression, creativity is now recognized as a critical competency across disciplines, including technical fields like information technology [1].

Historical perspectives on creativity in education can be traced through several key theoretical frameworks (figure 1). Early approaches, such as Guilford's Structure of Intellect model, distinguished between convergent and divergent thinking, with the latter being central to creative processes [16]. This model identifies 120 different intellectual processes that can be categorized into 15 factors: five operations, four types of content, and six types of mental products.

Maslow's humanistic perspective, on the other hand, connects creativity with selfactualization and personal development [31]. According to Maslow, creativity is primarily related to the development of a creative personality rather than being limited to the products of creative activity or creative behavior. He argues that creativity can manifest in all aspects of human activity, including perception, attitudes, and behavior, and inevitably influences the contractive, cognitive, and emotional spheres of personality [19].

Contemporary approaches to creativity in education have shifted toward more integrated models that recognize both individual cognitive processes and sociocultural influences. The socio-cultural perspective, for instance, emphasizes the role of context



Figure 1: Major theoretical approaches to creativity in educational context.

and collaborative processes in fostering creativity [10]. This aligns with the needs of IT education, where creative solutions often emerge from team collaboration and interaction with complex technological ecosystems.

The developmental perspective on creativity suggests that creative abilities evolve through various stages, influenced by both innate capacities and educational experiences [13]. For IT education, this implies the need for structured approaches to developing creative competencies throughout the bachelor's program, progressively building from basic applications to complex innovation.

Economic perspectives on creativity highlight its value in driving innovation and competitive advantage [30]. In the context of IT education, this connects creative competencies directly to industry needs and economic outcomes, making creativity not just an educational goal but an economic imperative.

#### 2.2. Domain-general vs. domain-specific creativity in IT education

A central debate in creativity research concerns whether creativity is domain-general or domain-specific. This distinction has important implications for IT education, as it influences how creative competencies should be developed and assessed.

Evidence suggests that while some aspects of creativity may transfer across domains, creativity in technical fields like IT is significantly influenced by domain knowledge

and expertise [4]. Table 1 summarizes the key differences between domain-general and domain-specific approaches to creativity in IT education.

#### Table 1

Comparing domain-general and domain-specific approaches to creativity in IT education.

Aspect	Domain-general creativity	Domain-specific creativity	
Theoretical foundation	Creativity as a transferable	Creativity as specialized within	
	cognitive skill applicable across	specific knowledge domains	
	contexts	requiring domain expertise	
Assessment approaches	Generic creativity tests (e.g.,	Performance-based	
	divergent thinking tests)	assessments in IT contexts	
Educational implications	Focus on general creative	Focus on IT-specific creative	
	thinking techniques	problem-solving	
Research evidence	Some correlation between	Stronger evidence for	
	creative performance across	domain-specific creative	
	domains	performance, especially in	
		highly technical fields	
Application to IT education	Generic creativity exercises that	IT-specific creative challenges	
	can be applied to various	rooted in technical knowledge	
	disciplines		
Skills transfer	Assumes creative skills transfer	Emphasizes building creative	
	between domains	capacity within IT context	

Research by Qian, Plucker and Yang [27] using multilevel explanatory item response theory models suggests that creativity is relatively domain-general rather than domain-specific. However, other studies indicate that in fields requiring high technical expertise, such as IT, creative performance is strongly influenced by domain knowledge [2].

For IT education, this debate suggests a balanced approach: developing both general creative thinking abilities and domain-specific applications of creativity within technical contexts. While general creative thinking techniques provide valuable foundations, they must be contextualized within IT-specific challenges and knowledge structures to be maximally effective.

#### 2.3. Integrating creativity models into IT competency frameworks

Various models have been developed to conceptualize creative competencies, each offering valuable perspectives for IT education. The Epstein Creativity Competencies Inventory identifies four key competencies: capturing (preserving new ideas), challenging (taking on difficult tasks), broadening (seeking knowledge outside one's expertise), and surrounding (seeking new stimuli) [8]. These competencies provide a useful framework for developing creativity-enhancing activities within IT curricula.

The Creativity Convergence Competency Test (CCCT) framework, developed by Kim and Lee [15], identifies five factors: creative ability, creative personality, creative leadership, convergent thinking, and convergent value creation. This multi-dimensional approach highlights the need to address both cognitive and personality aspects of creativity in educational settings.

Drawing from these various models, an integrated framework for creative IT competencies can be developed, as illustrated in figure 2. This framework recognizes the interplay between technical foundations and creative processes, showing how they interact to produce various types of creative outputs in IT contexts.

The integration of creativity models into IT competency frameworks highlights several key principles:

1. Technical expertise and creative processes are complementary, not contradictory.



Figure 2: Integrated framework for creative IT competencies.

- 2. Creative competencies in IT require both divergent thinking (generating multiple solutions) and convergent thinking (selecting and implementing optimal solutions).
- 3. Creative IT competencies develop progressively through education, from basic application to sophisticated innovation.
- 4. Effective IT creativity emerges from the interaction between individual capabilities and supportive environments.

These principles provide a theoretical foundation for developing creativity-enhancing approaches in IT education, which will be explored in subsequent sections.

## 3. Creative competencies in IT: conceptual analysis

#### 3.1. Defining creative competencies in IT context

Creative competencies in the IT context encompass a unique combination of technical knowledge, problem-solving abilities, and creative thinking processes. While definitions vary, there is general agreement that creative competencies in IT involve the capacity to generate novel and valuable technological solutions to complex problems [38].

Based on synthesis of the literature, creative competencies in IT can be defined as:

The ability to apply technical knowledge and skills in novel ways to generate innovative solutions to technological problems, characterized by originality, functionality, and value to users and stakeholders.

This definition highlights several key aspects of creative competencies in IT:

- 1. The integration of technical expertise with creative processes.
- 2. The focus on both novelty (originality) and utility (functionality and value).
- 3. The application-oriented nature of creativity in technological contexts.
- 4. The consideration of user and stakeholder needs in creative solutions.

Figure 3 illustrates the integration of technical competencies with creative processes in IT, highlighting the bidirectional relationship between these domains. Technical competencies provide the knowledge base and tools that enable creative solutions, while creative processes help professionals apply technical knowledge in novel and valuable ways.



Figure 3: Integration of technical and creative competencies in IT.

## **3.2.** Taxonomy of creative competencies for IT professionals

Based on analysis of the literature and industry requirements, a comprehensive taxonomy of creative competencies for IT professionals can be developed. This taxonomy categorizes creative competencies into four main domains: cognitive, technical, social, and personal.

The taxonomy, presented in table 2, provides a framework for understanding the various dimensions of creative competencies required for successful IT professionals. It recognizes that creativity in IT is multifaceted, involving not only cognitive abilities but also technical skills, social capacities, and personal attributes.

Research by Payne et al. [26] on information systems creative self-efficacy highlights the importance of personal factors, such as confidence in one's creative abilities, in determining creative performance in IT contexts. Similarly, studies on workplace creativity in IT emphasize the role of work autonomy and task complexity in fostering creative outcomes [34].

## 3.3. Creative competencies and IT job performance

The relationship between creative competencies and job performance in IT has been explored in various studies. Research indicates that creative competencies contribute significantly to multiple aspects of IT professional performance, including problem-solving, innovation, and adaptability.

Figure 4 presents a theoretical model of the relationship between creative competencies and various aspects of IT job performance, based on synthesis of research findings. The model suggests that while creative competencies contribute positively to all aspects of performance, the relationship is strongest for innovation outcomes and shows diminishing returns at very high levels for some performance dimensions.

#### Table 2

Taxonomy	of crea	tive compe	etencies for	IT	professionals
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Domain	Competencies	Application in IT context		
	Divergent thinking	Generating multiple solution approaches to technical prob-		
		lems		
Cognitive	Convergent application	Selecting and implementing optimal solutions based on		
		constraints		
	Problem reframing	Redefining technical problems to reveal new solution paths		
	Algorithmic creativity	Developing novel algorithms or innovative modifications to		
		existing ones		
Technical	Design innovation	Creating novel and effective user interfaces and experiences		
	Technical integration	Combining technologies in new ways to create innovative		
		systems		
	Collaborative creativity	Co-creating solutions within multidisciplinary teams		
	User empathy	Understanding user needs to inform creative technical so-		
Social		lutions		
	Knowledge sharing	Contributing to and learning from the broader IT commu-		
		nity		
	Creative self-efficacy	Confidence in one's ability to develop creative IT solutions		
Personal	Risk tolerance	Willingness to explore unconventional approaches despite		
		uncertainty		
	Adaptive expertise	Flexibility in applying knowledge to novel technological		
		contexts		



Figure 4: Theoretical model of creative competencies' impact on IT job performance.

Research by Chang and Birkett [6] on managing intellectual capital in professional service firms highlights the need to balance creativity and productivity, particularly in technically-oriented fields like IT. Their findings suggest that while creativity enhances innovation and problem-solving, it must be channeled effectively to maintain productivity standards.

Studies of IT workplace environments indicate that perceived support for creativity positively influences job satisfaction and effective IS use [25]. This suggests that organizational contexts that value and support creative approaches contribute significantly

to IT professional well-being and performance.

The integration of creative competencies with technical expertise appears particularly important for IT professionals. Research on competence integration in creative processes indicates that as new competences are added, creative processes become increasingly complex, requiring deliberate management of both technical and creative aspects [23].

#### 4. Ukrainian context: IT education and industry requirements

#### 4.1. Historical development of IT education in Ukraine

The development of IT education in Ukraine has a rich history dating back to the Soviet era, with significant evolution occurring after independence. The second half of the 20th century saw the establishment of computer science centers in key cities like Lviv, Kyiv, and Kharkiv, initially focused on applications in space exploration, military technology, and industrial systems [12].

Following independence in 1991, IT education in Ukraine underwent significant transformations, coinciding with broader changes in the educational system and the economy's shift toward market principles. The period from 1991 to 1997 was characterized by uncertainty regarding competencies and powers of local government bodies in education due to legislative variability and severe economic crisis [20].

The period from 1997 to 2014 saw the establishment of a state-public model of local self-government, with distribution of functions for management, financing, and control of education between state authorities and local governments. During this time, there was significant growth in IT education programs, though funding remained low due to limited local budget revenues [18].

From 2014 onwards, Ukraine has undergone decentralization reforms, including administrative, educational, and budgetary changes. These reforms have made education one of the central issues in local government activities, resulting in increased investment in education, modernization of educational networks, and improvements in quality and accessibility [12].

Figure 5 illustrates the evolution of IT education in Ukraine across key dimensions, showing the impact of different historical periods on infrastructure development, curriculum quality, industry alignment, and international integration.

## 4.2. Current state of IT education in Ukraine

The current state of IT education in Ukraine is characterized by both significant achievements and ongoing challenges, particularly in the context of the war that began in 2022. Ukrainian higher education institutions have demonstrated remarkable resilience in maintaining educational processes despite infrastructure damage, displacement of students and faculty, and economic constraints [11].

IT programs in Ukrainian universities have increasingly focused on developing a combination of technical skills and soft skills, including creative competencies. Research by Glazunova et al. [9] on the development of soft skills in computer science bachelors highlights the importance of project-based learning approaches in fostering skills such as communication, teamwork, and creative problem-solving.

The study of creative competency development in Ukrainian IT education must consider the broader context of higher education transformations. The concept of the "Third mission" of universities, which emphasizes community engagement and social responsibility, has gained prominence in Ukrainian higher education, particularly in response to wartime challenges [35].

The impact of the war on IT education has necessitated significant adaptations by universities. Table 3 summarizes the key challenges faced by IT education programs and the strategies adopted to address them.



Figure 5: Evolution of IT education in Ukraine: key dimensions.

Table 3	3
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Challenges and adaptations in Ukrainian IT education during wartime.

Challenge	Impact on IT education	Adaptation strategies
Infrastructure damage	Destruction of educational	Development of distributed
	facilities and IT equipment	digital infrastructure;
		Cloud-based educational
		resources
Displacement of students and	Disruption of traditional	Implementation of flexible
faculty	educational processes;	distance learning options;
	Migration of talent	Asynchronous course delivery
Internet and power	Difficulties in accessing online	Development of offline
disruptions	learning resources	learning materials; Backup
		power systems for critical
		infrastructure
Psychological stress	Reduced capacity for complex	Integration of psychological
	learning and creative activities	support services; Flexible
		assessment approaches
Financial constraints	Limited resources for	International partnerships
	educational innovation	and funding; Open
		educational resources
Changing labor market needs	Shift in employer	Curriculum adaptation to
	requirements and job	emerging needs; Focus on
	availability	skills for remote work

Despite these challenges, Ukrainian universities have demonstrated innovation in maintaining educational quality. The integration of online and mixed learning formats has become widespread, with universities developing digital services to ensure continuity of education [17]. This transition has required not only technological adaptations but also pedagogical innovations to maintain engagement and foster creative competencies in virtual environments.

#### 4.3. IT labor market demands and creative competencies

The Ukrainian IT sector has experienced significant growth over the past decade, becoming one of the key drivers of the national economy. Recent data indicates that

the IT industry is among the top three export sectors, contributing approximately 5% to the GDP and employing over 300,000 people [39].

The war has had a mixed impact on the IT labor market. On one hand, it has caused disruptions and potential losses ranging from 0.4 to 1.9 billion US dollars in the first year of the conflict [39]. On the other hand, the IT sector has demonstrated remarkable resilience, adapting to changing conditions and maintaining positive growth trends despite the challenges [28].



Figure 6: Changes in Ukrainian IT labor market (2020-2023).

The changing IT labor market has implications for the creative competencies required of IT professionals. Figure 6 illustrates key trends in the Ukrainian IT labor market from 2020 to 2023, showing how the war has affected market growth, hiring patterns, remote work adoption, and demand for creative skills.

According to data from industry sources, at the beginning of 2022, nearly 309,000 specialists were employed in the Ukrainian IT sphere [7]. The war has led to an increase in fully remote positions, from 27% to 50%, helping to prevent mass layoffs. However, IT personnel hiring decreased by 13% in 2022, particularly affecting entry-level specialists with minimal or no experience.

Interviews with employers reveal changing expectations regarding the competencies of IT graduates. While technical skills remain fundamental, there is increasing emphasis on soft skills, including creativity, time management, communication, networking, project management, and effective teamwork. These findings align with research on twenty-first century digital skills for the creative industries workforce, which highlights the importance of technical, information management, communication, collaboration, creativity, critical thinking, and problem-solving skills supported by ICT use [37].

#### 4.4. Creativity requirements in the Ukrainian IT sector

Analysis of employer interviews and job market trends reveals specific creativityrelated requirements in the Ukrainian IT sector. Table 4 summarizes the key creative competencies sought by IT employers, based on discussions with industry representatives.

These employer requirements highlight the multifaceted nature of creativity demanded in the IT sector. Beyond generic creative thinking, employers seek professionals who can apply creativity within specific technical contexts and collaborative environments. This aligns with the concept of domain-specific creativity discussed in

#### Table 4

Creative competencies required by Ukrainian IT employers.

Competency category	Specific requirements	Industry application
Non-standard problem-solving	Ability to approach technical	Software development; system
	challenges from multiple per-	architecture; debugging com-
	spectives; application of un-	plex issues
	conventional solutions to algo-	
	rithmic problems	
Design thinking	User-centered approach to	UI/UX design; product devel-
	product development; balance	opment; mobile application de-
	of aesthetic and functional con-	sign
	siderations; interface innova-	
	tion	
Adaptive learning	Capacity to quickly master new	Technology integration; cross-
	technologies; transfer of knowl-	platform development; emerg-
	edge between different techni-	ing technology adoption
	cal domains	
Innovative teamwork	Collaborative idea generation;	Agile development teams;
	integration of diverse perspec-	cross-functional projects;
	tives into unified solutions	international collaboration
Strategic creativity	Ability to align creative so-	Product management; IT
	lutions with business objec-	entrepreneurship; technology
	tives; balancing innovation	strategy
	with practical constraints	

section 2, emphasizing the importance of integrating creative processes with technical expertise.

Research by Scarmozzino and Corvello [32] on employee creativity as a driver for organizational performance improvement suggests that creative self-efficacy significantly impacts creative behavior and organizational outcomes. For Ukrainian IT companies facing the challenges of wartime conditions, employee creativity becomes particularly important for maintaining competitiveness and adapting to rapidly changing circumstances.

The post-war recovery context adds another dimension to creativity requirements in the Ukrainian IT sector. As the country looks toward reconstruction, IT professionals with creative competencies will play a crucial role in digital transformation efforts across sectors, including energy, transport, and logistics systems [39]. This creates both challenges and opportunities for IT education, which must prepare graduates not only for current industry needs but also for their role in the country's future economic development.

#### 5. Educational approaches to developing creative competencies

#### 5.1. Pedagogical strategies for creativity development

Effective development of creative competencies in IT education requires intentional pedagogical strategies that integrate creativity development with technical skill acquisition. Various approaches have been proposed and implemented in educational settings, with varying degrees of success.

Figure 7 illustrates key pedagogical approaches for developing creative competencies in IT education. Each approach offers unique benefits and can be integrated into IT curricula in various ways.

Problem-based learning (PBL) provides students with authentic, complex problems that require creative solutions. In IT education, PBL can involve industry-relevant challenges that require students to move beyond standard applications of algorithms



Figure 7: Pedagogical approaches to developing creative competencies.

or programming techniques to develop innovative approaches [14]. The effectiveness of PBL for creativity development lies in its emphasis on divergent thinking in the solution generation phase and convergent thinking in the solution evaluation and implementation phases.

Project-based learning extends the problem-solving approach over longer timeframes, allowing students to engage deeply with complex challenges and develop comprehensive solutions. Research by Glazunova et al. [9] on computer science bachelors found that project learning processes effectively develop soft skills, including creativity. Project-based approaches are particularly valuable for IT education as they mirror industry practices and allow students to experience the full cycle of technology development.

Collaborative learning leverages the creative potential of diverse perspectives and knowledge bases. When implementing collaborative approaches in IT education, attention should be paid to team composition, ensuring diversity of technical backgrounds, thinking styles, and perspectives [36]. Collaborative creativity in IT education can be enhanced through structured brainstorming sessions, peer feedback processes, and interdisciplinary project teams.

Reflective practice encourages students to analyze their creative processes, identifying factors that enhance or inhibit their creativity. This metacognitive approach helps students develop awareness of their creative strategies and transfer these strategies across different IT contexts [21]. Reflection can be integrated into IT education through process journals, peer discussions of solution approaches, and explicit analysis of creative problem-solving strategies.

## 5.2. Curriculum design for creative competency development

Effective development of creative competencies requires thoughtful curriculum design that integrates creativity development throughout the educational program. Table 5 presents a framework for sequentially developing creative competencies across a four-year IT bachelor's program.

## Table 5

Program	Creative competency	Integration	Assessment enpresence
stage	focus	with technical content	Assessment approaches
Year 1	Foundation creative think-	Integration with introduc-	Process portfolios; multi-
	ing skills; divergent think-	tory programming; applica-	ple solution exercises; peer
	ing exercises; basic design	tion to simple algorithm de-	feedback on creative as-
	principles	velopment; visual design in	pects
		basic interfaces	
Year 2	Domain-specific creative	Application to data struc-	Design journals; solution
	applications; structured	tures and algorithms; cre-	variety analysis; team cre-
	problem-solving; collabora-	ative approaches to soft-	ativity assessment
	tive creativity	ware design; team-based	
		creative challenges	
Year 3	Complex problem refram-	Integration with advanced	Innovation rubrics;
	ing; synthesis across tech-	programming; application	technical-creative balance
	nical domains; innovation	to system architecture; cre-	evaluation; stakeholder
	within constraints	ative approaches to opti-	value assessment
		mization	
Year 4	Strategic creativity; inte-	Application to capstone	Impact assessment;
	gration with business ob-	projects; industry-linked in-	novelty-utility balance;
	jectives; leading creative	novation challenges; en-	professional portfolio devel-
	teams	trepreneurial IT projects	opment

Sequential development of creative competencies in IT curriculum.

This sequential approach recognizes that creative competencies develop progressively, building from foundational creative thinking skills to sophisticated application in complex technical contexts. The integration with technical content ensures that creativity is not treated as a separate "add-on" but is woven into the core of IT education.

Curriculum design for creative competency development should also consider crosscutting themes that span the entire program. These may include:

- 1. Design thinking methodologies that encourage user-centered approaches to technology development
- 2. Creativity-enhancing techniques specific to IT contexts, such as TRIZ (Theory of Inventive Problem Solving) applied to software development
- 3. Ethical dimensions of creative technology development, considering the societal impacts of innovative solutions

4. Entrepreneurial approaches that connect creative technical solutions to market opportunities

Research by Meng, Xiong and Zang [22] on information technology-driven teaching reform of innovation and entrepreneurship in higher education highlights the importance of creating a cultural environment of digital innovation and entrepreneurship. This suggests that curriculum design should extend beyond formal coursework to include co-curricular activities, industry engagement, and creative community development.

## 5.3. Assessment of creative competencies in IT education

Assessing creative competencies presents unique challenges, particularly in technical fields like IT where both creative processes and technical outcomes must be evaluated. Effective assessment approaches should capture both the quality of creative processes and the value of creative products.

Figure 8 presents a comprehensive framework for assessing creative competencies in IT education, addressing both process and product dimensions. This balanced approach recognizes that creativity involves both the journey (process) and the destination (product).



Figure 8: Creative competency assessment framework for IT education.

Process assessment focuses on how students approach creative challenges, tracking factors such as idea generation, problem reframing, exploration of alternatives, reflection, and collaboration. Methods for process assessment include creativity journals, process portfolios, video documentation of creative sessions, and peer evaluations of collaborative creativity.

Product assessment evaluates the outcomes of creative processes, considering technical quality, originality, user value, efficiency, and adaptability. Methods include expert evaluation using rubrics, user testing of creative solutions, comparative analysis with existing approaches, and technical performance metrics.

Research by Epstein, Schmidt and Warfel [8] on measuring and training creativity competencies suggests that valid assessment tools can not only evaluate creative competencies but also help develop them. Their findings indicate that assessment approaches that provide meaningful feedback on specific creativity competencies can lead to significant increases in creative output.

For IT education in Ukraine, assessment approaches should be adapted to the specific context, considering both industry requirements and educational constraints. In particular, assessment methods should be resilient to the challenges of wartime conditions, including potential disruptions to traditional assessment environments and processes.

## 5.4. Implementing creative competency development in Ukrainian IT education

Implementing effective approaches to creative competency development in Ukrainian IT education requires consideration of the specific contextual factors, challenges, and opportunities discussed in previous sections. Based on the analysis, several key recommendations emerge:

- 1. Integrate creativity development throughout IT curricula, rather than treating it as a separate or add-on component
- 2. Adopt a sequential approach to creative competency development, progressively building from foundational to advanced creative skills
- 3. Leverage project-based and problem-based learning approaches that mirror real-world IT challenges
- 4. Foster collaboration between educational institutions and industry to ensure alignment with current and emerging creativity requirements
- 5. Develop flexible approaches to creativity development that can adapt to changing conditions, including wartime disruptions
- 6. Emphasize the connection between creative competencies and post-war reconstruction needs, motivating students through meaningful applications
- 7. Balance technical skill development with creative competency development, recognizing their complementary nature

Case studies of successful implementation in Ukrainian universities highlight the importance of institutional commitment, faculty development, and supportive learning environments. For example, research by Osadcha and Chemerys [24] on graphic competence development in computer science bachelors emphasizes the need for deliberate formation of these competencies, considering the specific professional activities of future IT specialists.

The development of soft skills, including creativity, in computer science bachelors has been successfully implemented through project learning processes [9]. This approach integrates creativity development with technical skill acquisition, providing authentic contexts for applying creative problem-solving approaches.

For Ukrainian IT education, implementation approaches must also consider the challenges of the current context, including infrastructure damage, displacement of students and faculty, and resource constraints. This necessitates innovative approaches that leverage digital technologies, international partnerships, and flexible educational models to maintain and enhance creativity development despite these challenges.

## 6. Discussion and implications

This research delves into the development of creative competencies among IT bachelors within the Ukrainian context, weaving together theoretical perspectives, industry expectations, and educational strategies. The analysis reveals a compelling picture: creative competencies are gaining prominence among IT professionals, serving as a vital complement to technical expertise rather than a rival to it. In the Ukrainian IT sector, these competencies hold particular value, especially given the need to adapt to wartime challenges and to lay the groundwork for post-war recovery. The effective cultivation of such creativity demands deliberate pedagogical efforts, thoughtful curriculum design, and nuanced assessment approaches. Moreover, creativity in this domain emerges as a blend of general creative thinking skills and their tailored application within technical settings. For Ukrainian higher education institutions, fostering these competencies during wartime presents a dual reality of obstacles and possibilities, underscoring the need for an integrated approach that balances technical mastery with creative processes. This approach must remain flexible, attuned to Ukraine's unique circumstances while equipping graduates to meet both immediate industry demands and the longer-term needs of national reconstruction.

The findings of this study enrich theoretical perspectives on creativity within IT education in several meaningful ways. They lend credence to domain-specific views of creativity, highlighting how context shapes both the understanding and development of creative competencies. This resonates with the work of Baer [3], who argues that creativity is deeply tied to specific domains, reliant on relevant knowledge and skills for its expression. Furthermore, the research illuminates the multifaceted nature of creative competencies in IT, spanning cognitive, technical, social, and personal dimensions. This broader conceptualization moves beyond traditional views of creativity as a purely cognitive endeavor, recognizing the social and personal elements that enable its practical application in professional settings. Additionally, by examining Ukrainian IT education amid wartime, the study sheds light on how creativity development can persist and adapt under crisis conditions. This insight carries wider significance, offering a lens into educational resilience and the role of creativity in navigating adversity.

The insights from this research carry substantial practical weight for IT education, particularly in Ukraine and comparable settings. Curriculum development stands out as a key area, where creativity should be woven seamlessly throughout IT programs, progressing from foundational skills to more advanced capabilities in a structured manner. Pedagogical strategies also play a critical role, with approaches such as problem-based learning, project-based activities, collaboration, and reflection proving effective in nurturing both technical proficiency and creative growth. Assessment, too, requires careful consideration, capturing both the processes and outcomes of creativity through diverse methods that reflect its complexity. Faculty development emerges as another priority, with educators needing training to guide creative processes and evaluate them effectively. Strong partnerships with industry are equally essential, ensuring that creativity initiatives align with current and emerging professional needs. Finally, resilience planning becomes indispensable, as IT programs must devise adaptable strategies for creativity development that can withstand disruptions like those posed by wartime. Together, these elements provide a robust framework for enhancing creative competency in IT education, preparing graduates to apply their creativity meaningfully in practice.

The cultivation of creative competencies in IT education holds profound implications for Ukraine's post-war recovery. Creative IT professionals are poised to drive digital transformation across various sectors, fueling economic renewal and modernization, as Zakharova, Usyk and Petchenko [41] suggests. Their contributions will be especially impactful in areas such as infrastructure reconstruction, where innovative solutions can rebuild digital systems with an eye toward resilience and sustainability. In the realm of e-government, creative approaches can enhance the efficiency, transparency, and accessibility of digital public services. Industry digitalization offers another avenue, where novel technological applications can breathe new life into traditional sectors. Social innovation, too, stands to benefit, with technology harnessed creatively to tackle war-related societal challenges. Finally, in cybersecurity, innovative strategies will be crucial to safeguarding critical systems against future threats. Educational institutions bear a significant responsibility here, tasked with preparing IT graduates not only for today's industry but also for their role in shaping Ukraine's future. This demands a focus on both technical expertise and the creative competencies that will empower graduates to devise groundbreaking solutions to the multifaceted challenges of recovery.

## 7. Conclusion

## 7.1. Summary of key points

This research has examined the development of creative competencies in IT bachelors within the Ukrainian context, providing insights into theoretical perspectives, industry requirements, educational approaches, and implications for practice. Key findings include:

- 1. Creative competencies are essential for IT professionals, complementing technical skills and enhancing problem-solving, innovation, and adaptability.
- 2. The Ukrainian IT sector values creative competencies, particularly in the context of adaptation to wartime conditions and preparation for post-war recovery.
- 3. Effective development of creative competencies requires integration throughout IT curricula, using appropriate pedagogical strategies, curriculum design, and assessment approaches.
- 4. Domain-specific creativity in IT involves both general creative thinking abilities and their application within technical contexts.
- 5. Ukrainian higher education institutions face both challenges and opportunities in developing creative competencies during wartime.

These findings provide a foundation for enhancing creative competency development in IT education, contributing to the preparation of graduates who can effectively apply creativity in their professional practice and contribute to Ukraine's post-war recovery.

## 7.2. Limitations and future research directions

This research has several limitations that suggest directions for future research:

- 1. The focus on Ukrainian experience limits generalizability to other contexts, suggesting the need for comparative studies across different educational systems.
- 2. The reliance on existing literature and expert opinions could be complemented by empirical studies of creative competency development in IT education.
- 3. The rapidly changing context of wartime conditions means that some findings may become dated, necessitating ongoing research to track developments over time.
- 4. The focus on bachelor's education could be expanded to include other educational levels, from secondary education to graduate studies and professional development.

Future research directions could include:

- 1. Longitudinal studies tracking the development of creative competencies throughout IT education and into professional practice.
- 2. Intervention studies testing specific approaches to creativity development in IT education.
- 3. Investigation of the relationship between creative competencies and other professional competencies in IT.

- 4. Research on the role of technology itself in facilitating creative competency development.
- 5. Studies examining the impact of creative IT solutions on post-war recovery efforts.

## 7.3. Closing thoughts

The development of creative competencies in IT education represents a critical investment in Ukraine's future. As the country navigates the challenges of wartime conditions and looks toward post-war recovery, creative IT professionals will play a crucial role in driving innovation, economic revitalization, and societal transformation.

Educational institutions have both a responsibility and an opportunity to foster these creative competencies, preparing graduates who can apply their technical expertise creatively to address complex challenges. By integrating creativity development throughout IT curricula, adopting effective pedagogical approaches, and maintaining strong connections with industry, universities can contribute significantly to the development of a creative IT workforce.

The resilience demonstrated by Ukrainian IT education during wartime conditions provides a foundation for innovative approaches to creativity development. Building on this foundation, educational institutions can enhance their approaches to preparing creative IT professionals who will contribute not only to the sector's continued success but also to Ukraine's broader recovery and development.

Creativity in IT is not a luxury but a necessity – for individual professional success, for organizational innovation, and for national recovery and growth. By recognizing this importance and acting intentionally to develop creative competencies, IT education can fulfill its potential to prepare graduates who will shape a better future through creative applications of technology.

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