iejee

International Electronic Journal of Elementary Education
June 2024, Volume 16, Issue 4

Enhancing the Digital Competence of Prospective Primary School Teachers through Utilizing Kahoot!

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Received : 18 April 2024
Revised : 25 June 2024
Accepted : 27 June 2024
DOI : 10.26822/iejee.2024.346

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Abstract

Given the rapid advancement of modern information and communication technologies, as well as the increasing demand for distance and hybrid learning models, it is imperative that prospective teachers attain a high level of digital competence. This study aimed to determine how effective the technique of using Kahoot! to develop the digital competence of prospective primary school teachers. To diagnose the effectiveness of the developed methodology, testing was used which included various types of tasks and questionnaires in order to assess prospective primary school teachers' readiness to use digital tools in their professional activities. The results obtained (tcrit = 1.982) made it possible to conclude that utilizing Kahoot! interactive platform in prospective primary school teachers' professional training contributes to enhancing their digital competence. According to the findings, the gamified application Kahoot! contributes to students' study motivation, creates a favorable psychological atmosphere. A promising area for further research is to explore the prospective teachers' readiness to create multimedia products using state-of-the-art software iClone Pro, Toon Boom Harmony, Anime Studio Pro , etc.

Keywords:
Interactive Learning Technologies, Kahoot!, Digital Competence Development, Prospective Teachers, Primary School, Gamification.

Introduction

Computerization and informatization of the educational sector have led to a change in approaches in training prospective primary school teachers. Future specialists ought to master the methodology of implementing interactive methods during face-to-face, distance or blended learning. Given the above, during students' professional training in higher education institutions, it is imperative to actively utilize non-traditional methods that would enable teachers to properly organize the educational process in primary school. The teacher's digital proficiency is integral to their capacity for utilizing contemporary and innovative pedagogical approaches. This competence facilitates the visualization of educational materials, expedites assessments of students' comprehension, and enhances the process of knowledge assimilation with interest. Moreover, it diversifies education by introducing a range of forms, methods, and techniques.

Digital competence is a relatively new pedagogical term that has been actively used since the early 21st century. Based on the observations of contemporary scientists, the development of digital proficiency is a novel concept that encompasses aptitudes associated with utilizing computer technologies. The related terms are technological skills, information literacy, digital literacy, digital skills, information culture (Ilomäki et al., 2011). Essentially, prospective teachers' digital competence draws upon basic skills, which include the search for information, its storage and exchange, and the ability to conduct Internet communication. The first publications on the need to form digital competence among student teachers appeared at the end of the XXth century. In December 2006, the need for digital competence was proclaimed in the Recommendations of the European Parliament when considering the issue of lifelong learning (Pérez-Navío et al., 2021))

The Kahoot digital platform enables creating diverse educational games and quizzes, as well as facilitating discussions on specific topics and conducting surveys with a vast pool of respondents simultaneously. Mastering Kahoot technology is extensively applied to test students' progress. This service offers the elaboration of games in three forms: Quiz, Discussion, Survey. Tasks completed with Kahoot! can be done in classrooms and during independent work. A positive aspect of using Kahoot! is that tasks can be shared via email and social media (Facebook, Twitter, Google).

However, despite considerable research on the implementing the interactive service Kahoot! in prospective primary school teachers' professional training, the issues of empirical study as regards this method's effectiveness remain open today. Given the above, the purpose of the current study is to investigate the effectiveness of using Kahoot! to develop prospective primary school teachers' digital competence.

The main tasks that arise from the relevance of the topic raised are as follows:

- to determine the criteria, indicators and levels of prospective primary school teachers' digital competence in accordance with their professional activity specifics;
- to explore the future primary school teachers' digital competence after the introduction of Kahoot! in the educational process and compare it with the traditional methodology;
- to assess the readiness of prospective primary school teachers to use digital tools in their future career.

Literature Review

Digital literacy is a prominent feature in contemporary political discourse and represents a major educational trend of our time. According to Sillat et al. (2021), it is necessary to stimulate the teachers' and educators' digital competence.

In a recent study, Zhao et al. (2021) noted the increased interest in students' digital competence. Research in the above area mainly focuses on the "real state" of teachers' and students' competence.

Caena and Redecker (2019) identified two levels in the context of which teachers' digital competence is enhanced, namely micro- and mesolevel. The generally accepted European Digital Competence Framework for Educators (Ministry of Digital Transformation of Ukraine, 2021) was developed taking into account the recommendations of higher education institutions and is an open system that can be updated and improved (Caena & Redecker, 2019). Its main structural elements are as follows: Educators' professional competence, Learners' competence.

In fact, prospective primary school teachers' digital competence includes information literacy, communication and collaboration, media literacy, creating their own digital content, cybersecurity, awareness of intellectual property, adherence to the principles of academic integrity (Santos et al., 2021).

The problem of teachers' digital competences is addressed by Portillo et al. (2020). The researchers maintain that nowadays teachers consider themselves only partially competent in the development of distance learning technologies (Portillo et al., 2020).

Falloon (2020) substantiates that future teachers should be able to use modern information resources safely, reliably and systematically. Lucas et al. (2021) concluded that personal factors prevail over contextual ones. Accordingly, digital competence includes a set of skills, knowledge, attitudes and strategies that enable citizens to comprehensively use digital technologies creatively, critically, meaningfully and responsibly, both individually and collectively (Lucas et al., 2021).

McGarr and McDonagh (2021) note that pedagogical HEIs are fully aware of the need to use information resources at school, are ready to implement innovations and strive to obtain the relevant knowledge. When analyzing the concept of "digital competence", McGarr and McDonagh (2021) focused on the fact that it should not be limited to certain frameworks and established measurement criteria.

Teachers ought to continuously improve their level of professional excellence and follow the distance education innovations (Garzón Artacho et al., 2020). Therefore, in order to facilitate teacher's work at a primary school, to diversify the educational process, many programs have been created that enable entering educational material quickly and effectively. These include the Kahoot!

Jankovic and Lambic (2022) described a technique for using Kahoot! while studying natural sciences with third-grade students. The results of this study showed that the experimental group that used Kahoot! to study the content of natural sciences achieved significantly higher results in post-testing than the control group.

Other researchers, Purba et al. (2019), examined the use of Kahoot! in the process of studying chemistry with high school students. The results were positive: the application of Kahoot! -generated online games effectively increased students' motivation to delve into chemistry. The successful experience of using Kahoot and Quizizz for educational material consolidation by HEI students is explored in a study by Göksün and Gürsoy (2019). The above researchers described in detail the gamification of the educational environment. In their opinion, it contributes to enhancing the educational process and significantly increases students' motivation and engagement with learning. The above scholars' standpoints on the need for learning gamification in higher education are highlighted by Lestari (2019). It was shown that the use of Kahoot! and Quizizz yielded a good result in increasing learners' motivation to study. However, according to the author, students prefer to work with Kahoot than Quizizz.

The article by Hodovaniuk et al. (2024) investigates the effectiveness of training sessions for developing digital competence among secondary school teachers. During the technology-focused training sessions, teachers from different disciplines were shown tools such as Kahoot, LearningApps, Mentimeter, and others. Pre- and post-training surveys measured self-reported digital competence, with the majority of teachers moving from "sufficient" to "high" competence after participating. The training sessions allowed teachers to practice new skills and experience the tools from the perspective of students.

The work of Aibar-Almazán et al. (2024) examines the impact of gamification on attention, concentration, creativity, and general abilities of students studying for a bachelor's degree in physiotherapy. The study participants had an average age of 19.51 ± 0.9 years. The results show that using Kahoot! for more than 60 minutes a day can improve important student skills such as attention, creativity, critical thinking, independent learning, adaptability, problem solving, and computer literacy. Research has shown that integrating Kahoot! into the learning environment, especially with longer sessions, stimulates different cognitive aspects and improves complex skills.

The article by Sáez-López et al. (2024) explores the use of gamification as an educational methodology and tool that brings motivational benefits and improves pedagogical approach. The study involved 308 teachers from Spanish educational institutions, of which 69.8% were female and 30.2% were male, which is in line with the demographic situation among teachers. The study is based on three aspects: the most frequently used apps, the devices used, and the didactic functionality. The results show that teachers have a positive attitude towards teaching digital competence in the context of gamification, although only 30% regularly use gamified tools in practice.

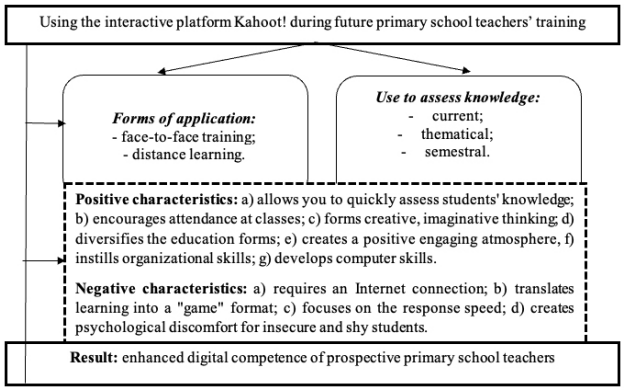
Researchers Rayan and Watted (2024) examined the impact of technology, in particular Kahoot!, on learning outcomes and student motivation to learn science. Using a quantitative methodology, data were collected through pre- and post-experiment surveys among the experimental (N = 53) and control groups (N = 56). The study found that Kahoot! significantly improves students' understanding of science concepts, self-esteem, interest, and enjoyment of learning. It was also found that grade level influences motivation to learn science. The findings highlight the potential of Kahoot! to enhance students' learning experiences, emphasising the importance of creating a dynamic and engaging learning environment.

A positive evaluation of educational gamification is also expressed by Forssell et al. (2023). The authors draw attention to the need to prepare the classroom for the game, in particular, the lighting and size of the board, also taking into account participants' age. According to Nasution et al. (2022), Kahoot! and Quizizz make teachers' job easier because they help assess students' progress more effectively.

Despite a number of positive characteristics, gamified applications still have a number of disadvantages. As noted by Wang and Tahir (2020), working with Kahoot! can cause psychological discomfort: students are afraid of the prospect of losing, anxious about the lack of points and often rush to provide an answer without sufficient consideration. A generalized analysis of modern researchers' works made it possible to develop a model "The use of interactive technologies Kahoot! to enhance prospective primary school teachers' digital competence" (Figure 1).

Figure 1

Using the Interactive Platform Kahoot! during Prospective Primary School Teachers' Training



One of the little-researched issues is the impact of digital literacy on students' psycho-emotional state. Although it is known that working with digital technologies can cause psychological discomfort, such as fear of losing or missing grades, the detailed mechanisms of this impact remain poorly understood. Further research is needed to better understand how different aspects of digital learning affect students' emotional well-being. There is also a need to update the data on how different social and cultural contexts affect the perception and implementation of digital literacy.

Methods and Materials

Research Procedure

The study design was carried out in three stages from January 2023 to December 2023.

The first stage (preparatory) included: preparing the package of methods for studying prospective primary school teachers' digital competence.

The second (main) stage included: the implementation of the Kahoot! into prospective primary school teachers (1st semester of the third year of study). We developed an implementation plan for Kahoot! in the educational environment, which involves the following stages: a) preparatory: instructors who teach professionally oriented disciplines are introduced to the features of utilizing the Kahoot! interactive technology, its possibilities for testing students' knowledge; b) practical: instructors directly develop their own information products using Kahoot!; c) organization and approbation: instructors use the product they created in the educational process, test it with higher education learners; d) final: after using Kahoot! during the study of a particular academic discipline for a certain time, based on students' feedback and recommendations, analysis of their answers to quiz questions, the marks received, teachers make certain edits to the product they have developed, improve the pool of questions, select illustrations if necessary, complicate or, conversely, simplify questions.

The third (final) stage included: interpretation of the obtained indicators, development of recommendations for the introducing digital technologies for prospective teachers.

The Kahoot! curriculum is aimed at improving the educational process through the integration of gamified tools. The main goal of the programme is to increase the motivation, engagement and understanding of educational material by students in middle and high schools, as well as universities. The programme begins with an introductory module that aims to familiarise participants with the basics of Kahoot! At this stage, students will learn what Kahoot! is, how to use it, what basic functions and settings it provides, and will look at examples of successful use of Kahoot! in the educational process. By getting to know the tool, participants will understand how gamification can enhance learning by creating a dynamic and interactive environment. The main stage of the programme involves the practical use of Kahoot! to study specific educational topics. Interactive quizzes and tasks are created based on the educational material, which allows students to better absorb information through active participation in the process. Users have the opportunity to answer questions in real time, which helps to develop their attention, creativity and critical thinking.

Sample

Vinnytsia State Pedagogical University named after Mykhailo Kotsyubynskyi was chosen as the experimental base of the study.

As of the beginning of the 2022/2023 academic year, 18,104 people studied in Ukraine at the first (bachelor's) level of specialty 013 Primary Education on a full-time basis, which made up the general population of the sample (Higher and professional pre-higher education in Ukraine in 2021: statistical information, 2022). After calculating the size of the required (representative) sample using an online calculator (with the following parameters: confidence interval – 85%, error – 7%), the size of the valid sample was 115 people. This number was the baseline for the formation of the experimental group (EG) (n = 58) and the control group (CG) (n = 57). Students of the third year of study took part in the experiment, since in the first and second years they had already developed certain professional skills, having done active pedagogical practice at school, where they experienced the needs of children and teachers in information communication.

Data Collection and Analysis

In order to diagnose prospective primary school teachers' digital competence, testing tasks was developed in accordance with the selected criteria and indicators. The tests were practice-oriented. It was based on the Professional Standard for Primary

School Teachers (Verkhovna Rada of Ukraine, 2020), Description of Educator's Digital Competence (2019), UNESCO's ICT Competency Framework for Teachers (Hine, 2023) (Table 1), DigComp UA for Citizens (2021).

Table 1

Diagnostic Tools for Prospective Teachers' Professional Competence

Criterion	Indicators
Cognitive-procedural	Understanding the principles of human interaction with the digital environment. Awareness of modern ICTs. Ability to search, select, analyze, store, transform, transfer information. Mastery of communication technologies within the digital sphere. Awareness of the digitalization directions in human life.
Value-motivational	Embracing the principles of scientific and technical expertise within the realm of digitalization. Contemplation of the digital landscape as a constituent of forthcoming vocational endeavors. Awareness of the importance to master digital culture as a competitive advantage. Engagement in the study and application of ICTs.
Reflective-actionable	Awareness of a critical attitude to information on the Internet. Independent comprehension of digital environment for future career. Compliance with social responsibility and cybersecurity rules. An adequate understanding of virtual identity and reflection on the successful application of digital tools.
Personal-developmental	Awareness of digital culture as a professional characteristic. Mastering and implementing the principles of behavior in the digital environment in accordance with moral and ethical standards. Focus on the creative use of electronic means for mastering and development. Taking initiative and maintaining an active stance in utilizing digital resources.

here were five levels in total: threshold, basic, conscious, effective, creative.

Each indicator was evaluated using 5 answer options. Each answer was evaluated with points according to the following levels: creative – 5, effective – 4, conscious – 3, basic – 2, threshold – 1. So, each criterion is evaluated by the points sum:

21-25 points – creative level;
17–20 points – effective level;
9-16 points – conscious level;
5–8 points – basic level;
1-4 points – threshold level.

Testing was conducted using the Moodle distance learning system.

In order to assess the readiness of prospective primary school teachers to use digital tools in their future career, the "Questionnaire of readiness to use ICT in future professional activities" was created. Questions 1-10 are devoted to the self-assessment of digital competence level in accordance with the descriptors given in the European Digital Competence Framework for Citizens (DigComp 2.0) (Ministry of Digital Transformation of Ukraine, 2021). Questions 11-15 reveal students' subjective attitudes and preferences for using digital media for professional needs. The survey was conducted using Google Forms.

For statistical data processing, MS Excel was used. To statistically confirm the study results and substantiate the homogeneity of students' samples, the Student's t-test was used, the value of which is calculated by the formula using the classical notation:

$$t_{\text{емп}} = |\bar{x} - \bar{y}| \cdot \frac{\sqrt{n_1 n_2} \cdot (n_1 + n_2 - 2)}{(n1+n2)\sqrt{n1 \cdot D(x) + n2 \cdot D(y)}}$$

Ethical Criteria

The study participants were engaged in the research voluntarily; during the data collection, ethical principles were strictly observed, guaranteeing the protection of their rights, security and confidentiality of information.

Results

Following are the answers to the questionnaire on the readiness to use ICT in future professional activities. The answer to the first question involved an assessment of how significantly digitalization affects society. The majority of respondents (17.88%) indicated that digital environment and ICT are used mainly for information processing and entertainment. A significant part of respondents (34.48%) is convinced that the digital environment and ICT are most actively implemented in the production and distribution of goods and services. It should be noted that 47.64% of respondents agreed that digitalization is a significant trend in social development, and digital technologies are in demand in the industrial and social spheres, considerably affecting people's lives.

In the proposed questionnaire, questions were asked about the perception of the digital environment as an attribute of professional activity. When answering the question "Is interaction with the digital environment a mandatory attribute of professional activity and person's professional characteristic?", 18.84% noted that digitalization currently concerns a limited range of high-tech professions. Yet another group of interviewees, who accounted for 26.48%, specified that the digital environment provides a small part of employees' information operations. More than half of

the respondents (54.68%) showed an understanding that digitalization is a mandatory component of professional activity as part of the professional functions.

Further, the question was to determine whether digital literacy, digital competence and digital culture can be considered as a significant competitive advantage in the professional field. When answering this question, 21.38% noted that such characteristics as professional knowledge and skills are more important for a future specialist's training. Part of the respondents (38.84%) agreed that mastering digital literacy is mandatory for a good resume, but the employer exhibits a greater inclination towards the practical (applied) aspect of digital technology. Another part of respondents (33.42%) noted that the presence of digital competence is taken into account when applying for a job, but does not affect development and career growth. Only 6.36% of respondents agreed with the statement that digital literacy, digital competence and digital culture are "conversational" characteristics that distinguish a professional in any field of career.

The next question clarified the scope of digital technologies for future specialists. The response to this question facilitated the determination of perspectives regarding whether the utilization of IT constitutes a customary and mundane labor practice. The answer involved multiple choices. The results are presented in Table 2.

Table 2

Empirical Data Based on the Results of Responses to the Questions:
"For What Purposes Do You Intend to Use Icts in Your Future Career?"

Name of the activity	% of respondents
Entering and reading business and professional documentation	92.26%
Search, processing and transfer of professionally relevant information in the digital environment.	84.48%
Analysis and transformation of information in professional digital environment.	42.24%
Exchange of professionally relevant information, support and engaging in professional communication with colleagues.	22.62%
Achieving the ideal alignment and efficient exchange of ideas within expert networks manifested in the virtual environment.	14.64%
Optimization and design of production processes	6.82%
Development of new products and services within the framework of professional activity.	4.42%

The responses to the question "How important is the need for a critical attitude to professional information and data presented on the Internet" were distributed as follows. A large group of students (26.62%) answered that a critical attitude to information is not important. Another group of respondents (46.42%) believes that independent critical analysis of information does not belong to the specialist's crucial skill. A small part (20.48%) of respondents believed that general and special criteria for identifying unreliable, false or biased information should be trusted. Only 6.48% of respondents indicated that it is necessary to take a responsible and active stance to information reliability.

Students' attitude to compliance with social responsibility guidelines and cybersecurity rules in working with electronic information sources and implementing digital communication was presented as follows. Further, 32.42% of respondents agreed that data protection and information confidentiality should be ensured by the organization in which the employee works, this is the responsibility of technical specialists. The next group of respondents indicated that data protection is not a priority for the employee, but it is worth following technical specialists recommendations for the stable functioning of the organization's digital environment (39.28%). A minority of respondents (18.68%) share the opinion that data protection and responsibility for their misuse, mal-use or loss may be part of employee's professional duties. High responsibility for professional information was demonstrated by 9.62% of respondents.

Another question posed to evaluate the extent of imaginative liberty of prospective educators when employing components of the digital realm to tackle contemporary problems. Responding to this question, 36.42% of interviewees answered that the simplest digital technologies for information processing and communication are used to provide work tasks. 42.28% suggested that when addressing issues, one can choose, customize and integrate diverse digital tools for managing information. A relatively small part of the respondents (21.3%) agreed with the opinion that when solving problems, it is possible to analyze, find applications for objects' creative transformation, improve and develop their digital environment.

Another question was formulated as follows: "Is mastering digital literacy, digital competence and digital culture a means of personal and professional development?". When answering this question, 38.24% of respondents indicated that digital technologies help to solve everyday educational tasks, they should be mastered to a minimum. The opinion that digital technologies offer separate solutions for learning and mastering the professional activity means was supported by 56.68% of respondents. Only 5.08% respondents clarified that digital technologies and

the digital environment are the sphere of personal self-realization, which has great potential for self-development.

An important place in the questionnaire is given to questions that revealed digital environment possibilities at HEIs for enhancing digital culture. One of the questions was aimed at identifying attitudes towards the study and use of professionally oriented digital technologies in HEIs educational environment. Thus, 12.24% respondents agreed with the statement that they did consider it, and that digital technologies could be mastered later in the production process. Further, 44.64% respondents showed limited interest, specifying that it is enough to get acquainted with general information about professionally oriented digital technologies and their capabilities during training. A total of 18.12% of respondents expressed significant interest. The data obtained during the processing of the responses to the question "What digital tools do you usually use to tackle educational tasks?" are presented in Table 3.

Table 3.
Empirical Data Based on Responses to the Questions: What Digital Tools do You Usually Use to Tackle Educational Problems?

Name of digital technology	% of respondents
Internet, search engines, databases.	68.45%
Computer means of information processing	74.46%
Means of information exchange with fellow students and teachers (e-mail, messengers).	62.68%
Networked means of communication for interacting with fellow students (social media groups).	52.68%
Tools for monitoring educational achievements (HEI website)	48.64%
Cloud technologies (shared drives, servers).	16.24%
Professional network communities for communication with representatives of the professional environment.	6.42%
Blog, forum, website.	1.22%

The last question was aimed at self-assessment of one's own experience in the use of digital technologies in the educational process. When answering this question, 12.46% of respondents answered that they are generally digitally literate, but the development of new digital tools causes some discomfort and uncertainty. Most of the respondents (36.46%) indicated that they are digitally literate and the use of digital technologies does not cause significant difficulties. Less than a quarter of respondents (22.86%) answered that the use of digital technologies greatly facilitates the educational process, the independent development of new digital tools increases interest in studying program material and mastering digital competence. Only 3.22% of respondents indicated that they are good at digital literacy and competence. The results of the pre-experimental measurement are shown in Table 4.

Table 4
Results of Pre-Experimental Measurement of Prospective Primary School Teachers' Digital Competence

Criteria for shaping digital competence							
Cognitive-procedural		Value-motivational		Reflexive-actionable		Personality-developmental	
EG	CG	EG	CG	EG	CG	EG	CG
Threshold level (person/%)							
13/22.4	15/26.3	14/24.1	12/21.0	15/25.9	14/24.6	14/24.1	12/21.1
Baseline (person/%)							
15/25.9	10/17.5	16/27.6	13/22.8	13/22.4	12/21.0	15/25.9	17/29.8
Conscious level (person/%)							
15/25.9	16/28.1	16/27.6	15/26.3	18/31.0	16/28.1	19/32.8	14/24.6
Effective level (person/%)							
13/22.4	12/21.1	10/17.3	14/24.6	10/17.3	12/21.0	8/13.8	12/21.0
Creative level (person/%)							
2/3.4	4/7.0	2/3.4	3/5.3	2/3.4	3/5.3	2/3.4	2/3.5

The substantiation of student samples homogeneity was carried out by applying the Student's criterion. Applying the general formula, we calculated the empirical values of temp for the criteria of digital culture (Table 5)

Table 5
Empirical Values of the Student's Criterion (t_{emp}) for Digital Competence Criteria Based on the Results of Pre-Experimental Measurement

Criteria	*EG* (N1 = 58)		*CG* (N2 = 57)		EG& CG
	$\bar{x}$	*D(x)*	$\bar{y}$	*D(y)*	T_{emp}
Cognitive-procedural	2.59	1.37	2.65	1.62	0.261
Value-motivational	2.48	1.31	2.70	1.46	0.994
Reflective-actionable	2.50	1.34	2.61	1.49	0.492
Personal-developmental	2.47	1.24	2.56	1.32	0.423

The critical value of Student's statistical criterion (t_{crit}) is found from special tables for the level of static significance p = 0.05 and the number of freedom degrees 113 ($n_1 + n_2 - 2 = 58 = 57 - 2$): t. Comparing t_{emp} and t_{crit}, we came to the conclusion that there are no statistically significant differences in the traits distribution we applied. This circumstance is sufficient reason to talk about the homogeneity of the experimental and control groups' homogeneity. Following the technique implementation, an experimental exchange was carried out. The results are presented in Table 6.

Summary data obtained as a result of diagnosing students' digital competence before and after the experiment is given in Table 7.

To prove the statistical discrepancy between the distributions of the studied traits in the EG and CG groups, we again used the Student's statistical criterion (Table 8)

Table 6

Results of Post-Experimental Measurement of Prospective Primary School Teachers' Digital Competence

Criteria for shaping digital competence							
Cognitive-procedural		Value-motivational		Reflexive-actionable		Personality-developmental	
EG	CG	EG	CG	EG	CG	EG	CG
Threshold level (person/%)							
6/10.3	11/19.3	4/6.9	8/14.1	4/6.9	9/15.8	4/6.9	9/15.8
Baseline (person/%)							
6/10.3	10/17.5	8/13.8	11/19.3	7/12.1	11/19.3	7/12.1	14/24.5
Conscious level (person/%)							
10/17.3	17/29.8	10/17.2	19/33.3	12/20.7	20/35.1	12/20.7	17/29.8
Effective level (person/%)							
27 / 46.6	14/24.6	28/48.3	15/26.3	25/43.1	13/22.8	26/44.8	14/24.6
Creative level (person/%)							
9/15.5	5/8.8	8/13.8	4/7.0	10/17.2	4/7.0	9/15.5	3/5.3

Table 7

Data on Diagnosing Future Primary School Teachers' Digital Competence Before and After the Experiment

Level	Ascertaining experiment (%)		Formative experiment (%)		Dynamics (%)	
	EG	*CG*	*EG*	*CG*	*EG*	*CG*
Cognitive-procedural criterion						
Threshold	22.4	26.3	10.3	19.3	-12.1	-7.0
Base	25.9	17.5	10.3	17.5	-15.6	0
Conscious	25.9	28.1	17.3	29.8	-8.6	1.7
Effective	22.4	21.1	46.6	24.6	24.2	3.5
Creative	3.4	7.0	15.5	8.8	12.1	1.8
Dynamics at an actionable and creative level					36.3	5.3
Value-motivational criterion						
Threshold	24.1	21.0	6.9	14.1	-17.2	-6.9
Baseline	27.6	22.8	13.8	19.3	-13.8	-3.5
Conscious	27.6	26.3	17.2	33.3	-10.4	7.0
Effective	17.3	24.6	48.3	26.3	31.0	1.7
Creative	3.4	5.3	13.8	7.0	10.4	1.7
Dynamics at an actionable and creative level					41.4	3.4
Reflexive-actionable criterion						
Threshold	25.9	24.6	6.9	15.8	-19.0	-8.8
Baseline	22.4	21.0	12.1	19.3	-10.3	-1.7
Conscious	31.0	28.1	20.7	35.1	-10.3	7.0
Effective	17.3	21.0	43.1	22.8	25.8	1.8
Creative	3.4	5.3	17.2	7.0	13.8	1.7
Dynamics at an actionable and creative level					39.6	3.5
Personal-developmental criterion						
Threshold	24.1	21.1	6.9	15.8	-17.2	-5.3
Baseline	25.9	29.8	12.1	24.5	-13.8	-5.3
Conscious	32.8	24.6	20.7	29.8	-12.1	5.2
Effective	13.8	21.0	44.8	24.6	31.0	3.6
Creative	3.4	3.5	15.5	5.3	12.1	1.8
Dynamics at an actionable and creative level					43.1	5.4

Table 8

Sample Means ($\bar{x}$ and $\bar{y}$), Sample Variables (D(x) and D(y)) and Empirical Values of the Student's Criterion (t_{emp}) for the Digital Competence Criteria (drawing on the results of post-experimental measurement)

Criteria	*EG* (N1 = 58)		*CG* (N2 = 57)		*EG*& CG
	$\bar{x}$	*D(x)*	$\bar{y}$	*D(y)*	T_{emp}
Cognitive-procedural	3.47	1.41	2.86	1.55	2.666
Value-motivational	3.48	1.24	2.93	1.32	2.584
Reflective-actionable	3.52	1.27	2.86	1.34	3.071
Personal-developmental	3.50	1.24	2.79	1.31	3.342

Comparing t_{emp} and t_{crit} (t_{crit} = 1.982), we can state the presence of statistically significant differences in the distribution of the studied traits. This circumstance confirms our conclusions that the use of the interactive service Kahoot! has a positive impact on forming future primary school teachers' digital competence.

Discussion and Conclusion

The survey results showed that prospective primary school teachers are generally familiar with the digital environment and during the experiment faced the need to use digital technologies in the learning process. At the same time, they lack substantial expertise and proficiency that may demonstrate a superior level of digital literacy, as validated by preliminary experimental assessment. Most respondents possess knowledge regarding the domains and orientations of digitalization in their professional pursuits, albeit they tend to utilize ICT for information retrieval and processing. The innovative information transformation as well as professional and personal growth are in some cases linked to digital environment constituents. Moreover, digital technologies are regarded as an integral aspect of professional activity. However, the respondents do not prioritize enhancing their proficiency and expertise in this domain. They believe that adeptness in navigating the digital milieu can confer a substantial competitive edge to a specialist It is also worth noting the insufficiently responsible attitude to digital interaction ethics. In our opinion, such answers were due to the fact that teachers use traditional teaching methods more than digital technologies during their training. Students lack proper integration into the digital educational landscape and possess limited awareness of the vast potential that these technologies offer for both academic advancement and personal growth.

The study conducted by Ramdania et al. (2021), as well as Schraube (2022), explored the importance of introducing digital technologies into the learning process. Similar conclusions were reached by Timotheou et al. (2023), as well as Licorish et al. (2018), who maintained that the integration of ICT into school education benefits not only students' academic achievements, but also other school-related aspects, the partnership of teachers and learners. That said, after conducting the experimental work, the number of students with a creative and active level in the experimental group increased: according to the cognitive-procedural criterion – by 36.3%; value-motivational criterion – by 41.4%; reflexive-actionable criterion – by 39.6%; personal-developmental criterion – by 43.1%. Elshareif and Mohamed (2021) noted that the integration of digital technologies into education enhanced the level of student motivation and involvement, which also confirms our results of diagnosing the motivational criterion of digital competence. In addition, in the experimental group, there was a marked decrease in the number of students who were able to move from the lowest (threshold) level to the highest level. Thus, the cognitive-procedural criterion of such students was 12.1%, the value-motivational criterion – 17.2%, the reflective-actionable criterion – 19.0%, the personal-developmental criterion – 17.2%. It should be noted that the corresponding positive changes are also observed among the students from the control group. First, such changes were much smaller than in the experimental group. Second, they are fully explained by natural conditions of university's information and educational environment.

The use of Kahoot! during the experimental work made it possible to identify a number of advantages. First, interactivity, the ability to diversify the educational process with online quizzes, games and tests; Kahoot! creates engaging learning and has an excellent balance between positive and negative motivation (Ramdania et al., (2021). The platform's user-friendly interface accommodates a diverse range of subjects and educational levels. As a conclusion, using a certain level of game-based learning has a positive effect on students' outcomes and their perception of learning, which is also confirmed by Tóth et al. (2019).

Professional training of future teachers ought to incorporate contemporary advancements in the realm of information and communication technology. Currently, there is a shift in the educational landscape, as universities and schools move towards prioritizing learners' interests and individual abilities over merely fulfilling program requirements. The use of digital educational technologies broadens students' worldview, unveils novel prospects for acquiring knowledge in a structured and comprehensible format. Future primary school teachers should possess a set of skills geared towards enhancing primary school learners' information literacy and digital competence while carefully considering their developmental dispositions and natural inclinations.

The acquisition of these competencies is stipulated in contemporary educational papers, not only within Ukraine but also abroad. The teacher's task is to make the learning process interesting, accessible and understandable. Younger learners spend a lot of time playing computer games, sharing information on social networks, or watching cartoons and videos on a variety of topics in social networks. Therefore, the teacher should create an environment that addresses computer dependency, while simultaneously aligning video games with educational objectives.

The significance of the selected subject matter is further underscored by the recent proliferation of distance and blended learning, necessitating a high level of digital proficiency among educators who

must adeptly navigate contemporary computer technologies to develop educational software.

Active use of the Kahoot! interactive platform in teacher training contributes to the understanding of the need to use gamified content when working with children. Quizzes, Discussions, Surveys and other tasks done with the help of Kahoot! will create a proper psychological atmosphere during training sessions, contribute to educational material consolidation and motivation to attend classes, independent research.

Evaluating outcomes from the pedagogical experiment validated the efficacy of utilizing the interactive platform Kahoot! as a means to enhance digital proficiency among prospective primary school teachers.

Utilizing the interactive educational platform Kahoot! in the educational process promotes individualization and personality-oriented orientation. The use of this platform minimizes paperwork, simplifies teaching activities and activates student learning. In addition, Kahoot! fosters students' practical skills and brings learning to a qualitatively new level through digital technologies. Its interactive format allows to effectively engage students and promotes an active learning process, meeting modern educational requirements.

Promising areas for further research are the study of prospective teachers' readiness to create multimedia products using modern programs iClone Pro, Toon Boom Harmony, Anime Studio Pro, etc. Thus, enriching contemporary teaching methodologies with interactive didactic materials engenders curiosity among students and prompts them towards active cognitive engagement.

Limitations of the Study

The principal limiting factors of the study are that the study was conducted on the basis of one university, and the experiment was conducted during one semester.

Recommendations

To further elaborate the development of future teachers' digital competence, we recommend conducting a study that would include the respondents of other pedagogical specialties.

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