Online-Journals.org

iJIM International Journal of Interactive Mobile Technologies

iJIM | eISSN: 1865-7923 | Vol. 19 No. 15 (2025) | OPEN ACCESS

https://doi.org/10.3991/ijim.v19i15.55911

PAPER

Mobile Game Technologies and Cognitive Development in Ukrainian Preschool and Primary Education: A Correlational Study

Nataliia Bakhmat[1] (✉), Liudmyla Zahorodnia[2], Iryna Brushnevska[3], Yuliia Ribtsun[4], Tatyana Valentieva[5]

[1]Kamianets-Podilskyi Ivan Ohiienko National University, Kamianets-Podilskyi, Ukraine

[2]Oleksandr Dovzhenko Hlukhiv National Pedagogical University, Hlukhiv, Ukraine

[3]Lesya Ukrainka Volyn National University, Lutsk, Ukraine

[4]Mykola Yarmachenko Institute of Special Pedagogy and Psychology of the National Academy of Pedagogical Sciences of Ukraine, Kyiv, Ukraine

[5]T. H. Shevchenko National University "Chernihiv Colehium", Chernihiv, Ukraine

bakhmat.nataliya@kpnu.edu.ua

ABSTRACT

The current development of preschool and primary education requires the involvement of various modern technologies, among which mobile game technologies play a significant role. The purpose of this study is to determine the relationship between the use of mobile game technologies in education and the development of cognitive abilities. Purposive sampling was used to involve children (n = 58), teachers (n = 41), and parents (n = 76). The study covers children aged 5–10 years who study in preschool and primary schools in Ukraine. Several instruments were used in the study. The survey was conducted among parents and teachers. Testing, such as the Benton Visual Retention Test (BVRT) and Raven's Progressive Matrices (RPM), is used among children. The Wechsler Intelligence Scale for Children was also used. The results show that mobile game technologies are used in educational institutions daily or several times a week. The tests showed that older children who use mobile gaming technologies have higher results in both tests. The conclusions suggest a relationship between the frequency of mobile gaming technology use and cognitive skills, with a strong positive effect on general intelligence (IQ), verbal skills (VCI), logical thinking (PRI), working memory (WMI), and information processing speed (PSI).

KEYWORDS

mobile game-based learning, cognitive development, educational technologies, preschool education, primary education, interactive methodologies

1 INTRODUCTION

The active development of digital technologies and innovative approaches is transforming the field of education and child development. Consequently, gaming technologies have become an integral part of the educational process in modern kindergartens and schools.

Bakhmat, N., Zahorodnia, L., Brushnevska, I., Ribtsun, Y., Valentieva, T. (2025). Mobile Game Technologies and Cognitive Development in Ukrainian Preschool and Primary Education: A Correlational Study. *International Journal of Interactive Mobile Technologies (iJIM)*, 19(15), pp. 110–128. https://doi.org/10.3991/ijim.v19i15.55911

Article submitted 2025-04-07. Revision uploaded 2025-06-07. Final acceptance 2025-06-14.

This makes the issue of their impact on the cognitive development of preschool and primary school children more relevant.

In Ukraine, the development of interactive teaching methods utilizing mobile games is becoming increasingly prevalent in the educational system. This can be attributed to the current efforts to modernize educational approaches and enhance children's engagement in the learning process. Due to the growing accessibility of smartphones and tablets, mobile game-based learning has become a potent tool in early childhood education in recent years [1]. Mobile educational applications offer flexibility, mobility, and interactive elements that closely match the learning preferences of today's kids, in contrast to traditional desktop-based digital games [2], [3]. There are chances to improve cognitive results, increase engagement, and customize learning by incorporating mobile gaming platforms into preschool and primary education. This study focuses on how these mobile technologies affect the cognitive skill development of young Ukrainian learners.

Besides, despite the active integration of mobile gaming technologies into the educational process, there remains a lack of substantiated empirical data on their impact on children's cognitive abilities.

In particular, there is a particular lack of studies that analyze the degree of connection between the frequency of digital games in education and the level of cognitive development of preschool and primary school children.

Therefore, the scientific novelty of this work lies in conducting a detailed analysis of the impact of mobile gaming technologies on children's cognitive development within the modern Ukrainian educational system.

Unlike previous works, this study is based on a critical analysis of the relationship between the level of use of game technologies in education and the leading cognitive indicators of children.

In addition, the primary focus of the study will be to assess the use of the primary game technologies. The paper will present the main game technologies used in teaching preschoolers and primary school children in Ukraine.

The purpose of this study is to examine the relationship between the level of mobile game technology used in education and the development of cognitive abilities in preschool and primary school children in Ukraine. For this purpose, the following research questions were formed:

1. What is the frequency of using game technologies to educate and develop preschool and primary school children in Ukraine?
2. What modern game technologies are used to develop children aged 5 to 10 years old?
3. What is the impact of games on children's development, and at what level do their cognitive abilities develop?

The study also formulated several hypotheses, comprising both the null and alternative hypotheses:

1. H_0: There is no significant correlation between the use of game technologies and children's cognitive abilities.
2. H_1 (alternative hypothesis): There is a positive correlation between the use of game technologies and children's cognitive abilities.

2 LITERATURE REVIEW

The purpose of this review is to establish a conceptual framework for the application of game technologies in contemporary education systems. Additionally, this review aims to identify the primary gaps in the literature and highlight the importance of further research on the topic.

2.1 Developing cognitive skills in children

Contemporary authors have drawn attention to the peculiarities of developing cognitive skills in children, highlighting that cognitive skills play a significant role in their development, influencing their ability to learn, analyze information, and form memories [4], [5]. Modern research also indicates the significant impact of the educational environment and neuropsychological aspects on children's cognitive development.

J. Byrnes describes the features of cognitive development based on a critical analysis of Jean Piaget's views [4]. The author demonstrated that cognitive development progresses through four stages: sensorimotor, preoperational, concrete operational, and formal operational. W. Crain's study also drew attention to Piaget's views and identified their importance in child development [6].

Other researchers have emphasized the importance of social interaction in forming cognitive functions [7]. At the same time, other studies have highlighted that well-developed cognitive skills enable children to better adapt to new information and enhance their learning experience through interaction with the environment [8]. Additionally, researchers have noted that STEM methods, including science, technology, engineering, and mathematics curricula, as well as gaming technologies, can help develop memory, attention, and problem-solving skills [9], [10], [11].

Modern studies have demonstrated the importance of utilizing innovations and digital technologies in developing modern children in the digital age [12], [13], [14]. T. Zaporozhchenko et al. highlighted the importance of incorporating digital resources into the education system and emphasized their advantages, including the speed of information, adaptability, and accessibility [15]. At the same time, some authors have drawn attention to the role of virtual reality technologies and project-based methods in primary education [16], [17]. In particular, E. Demitriadou et al. highlighted their impact on enhancing student engagement in the learning process [16], [18]. This issue was also emphasized by L. López-Faican and J. Jaen, who identified the role of augmented reality in modern primary school education [19].

2.2 The role of games in the development of cognitive skills

The authors drew attention to the fact that modern interactive games and digital resources enable the development of basic cognitive skills [20], [21]. H. Byhar et al. proved the role of gaming technologies in improving students' motivation to learn [22]. Additionally, Y. Chuchalina found that gamification enhances primary school students' performance and increases their interest in learning [23].

According to K. Dimitra et al. modern games have significant potential and value in the educational sphere because they attract children's attention [24]. The authors determined that games can serve as valuable research tools.

At the same time, modern games enable the identification of several cognitive and affective skills related to learning, including self-efficacy, self-esteem, and personality differences. Gamification is an important learning method that should be implemented, according to P. Halachev [25]. After critically analyzing the literature, the author determined the primary advantages of implementing a gamified learning environment [25].

The use of digital learning games to help kids acquire their digital abilities was highlighted by M. Hussein et al. [26]. I. Huszti et al. provided a comparative description of digital and non-digital games [27]. The authors also emphasized the need for teachers to possess various skills so that children can actively develop cognitive skills. Research by Koval et al. addressed this issue and concluded that teacher preparation should include gamification components [28].

The study by O. Vilkhova and O. Hryshko [29] provides a detailed description of the primary pedagogical conditions for employing didactic games. I. Pukas et al. also addressed this issue [30]. Furthermore, according to the study by A. Zourmpakis et al. future teachers should have additional training to employ adaptive gaming technology [31].

As a result, contemporary writers have highlighted specific pedagogical needs while simultaneously stressing the need to integrate game technologies into preschool and primary education. Additionally, research has demonstrated that games can enhance memory and attention while promoting spatial thinking [32].

Over the past decade, the role of mobile game technology in education has garnered considerable scholarly interest. Research has indicated that tablet-based apps and mobile learning activities can enhance early learners' working memory, attention, and logical thinking [33].

In contrast to traditional teaching techniques, mobile apps frequently incorporate gamification, interactive feedback, and visual stimuli to improve cognitive engagement. Children can continue to receive cognitive stimulation outside of the classroom thanks to mobile technologies that facilitate ubiquitous learning [34].

S. Papadakis described the importance of mobile applications for developing computational thinking and programming skills in preschool children. The author identified the main available educational applications designed according to children's age characteristics and indicated the criteria for assessing their effectiveness [35]. Other studies have indicated the patterns of use of mobile devices among preschool children [36]. These studies also indicated the importance of parental digital literacy, control of screen time, and the impact on children's behavior [36], [37].

Compared to traditional games, mobile games have several key characteristics that make them potentially more effective in cognitive development in preschool and early school-age children. First of all, the adaptability of mobile games lies in the ability to automatically change the difficulty of tasks according to the child's capabilities, which contributes to more effective training of working memory (Working Memory Index (WMI)).

For example, many mobile applications for teaching mathematics or language skills provide adaptive modeling of tasks that stimulate the storing and manipulating of information in short-term memory. In addition, the high level of interactivity inherent in mobile games ensures the child's continuous involvement in the learning process: sensory interaction, instant feedback, dynamic visual effects, and audio reinforcement improve the focus of attention, which is critically essential for the development of information processing speed (Processing Speed Index (PSI)).

The regular training of rapid response to visual and sound stimuli in mobile games can influence the ability to recognize, sort, and evaluate information quickly. Also important is the portability of mobile devices, which allows children to access educational games at any time and place—at home, on the go, or during leisure time.

Such accessibility contributes to a more frequent and regular impact on cognitive functions and the formation of more stable neural connections in repetitive learning. All this creates the conditions for ubiquitous learning—a concept that involves expanding the educational environment beyond the classroom.

Given the above, it can be argued that the combination of adaptability, interactivity, and portability of mobile games creates unique opportunities for a comprehensive impact on children's cognitive development. Unlike board or stationary computer games, mobile applications are more dynamic, personalized, and integrated into a child's daily life, making them an up-and-coming tool for the targeted development of cognitive indicators such as WMI and PSI. Research on the precise effects of mobile game-based learning in post-Soviet educational systems, like Ukraine, is still lacking, even though most studies concentrate on Western contexts.

However, without detracting from the results of other authors, it is essential to determine the role of game technologies in developing cognitive skills through correlational studies. As evident from the literature review, there is a significant lack of such studies in the current scientific discourse, and authors have been reluctant to prove the relationship between gaming technologies and skills.

This study aims to fill this gap and investigate the relationship between the level of game technology used in education and the development of cognitive skills in preschool and primary school children in Ukraine.

3 MATERIALS AND METHODS

3.1 Research design

This study employs a correlational design to investigate the association between the cognitive abilities of preschool and primary school students and the amount of digital and mobile game technologies used in the classroom. This strategy was selected to ensure ecological validity by permitting observation in a natural learning environment without changing variables. To prevent contrived settings, data were gathered in universities where game-based learning is already integrated. The study was conducted from October to December 2024.

Theoretical evidence that mobile educational games can improve critical cognitive skills supports the design choice. These include processing speed, working memory, logical reasoning, and problem-solving skills. These games include kids in interactive activities that promote cognitive growth related to early education.

3.2 Sample and participants

The study employed a purposive sampling method, which involved identifying study participants through personal contacts and sending letters inviting them to participate in the study.

The study aims to encompass children aged 5–10 who attend preschools and primary schools in Ukraine. Teachers and parents will also take part in the study. Such a sample group will help ensure a systematic approach to analyzing the impact of gaming technologies on children's cognitive development.

The inclusion criteria were developed separately for each of the three categories. Specifically, children were selected to be between the ages of five and 10 and to attend preschool or primary schools in Ukraine. An important criterion was obtaining informed parental consent for their child to participate in the study.

The most important criterion for teachers was at least two years of experience working with preschool or primary school children. Teachers should also be familiar with and use essential game technologies in education. A key criterion was their willingness to participate in the study and complete the questionnaires actively. For parents, the inclusion criteria included their willingness to provide accurate information about the use of game technologies and to provide informed consent for themselves and their children. Table 1 shows the main inclusion criteria for all three groups.

Table 1. Inclusion criteria for the study

Criteria	Description
For children	Age from 5 to 10 years; Attendance at preschool or primary educational institutions in Ukraine; No serious cognitive impairment; Parental consent to the child's participation in the study.
For teachers and carers	At least 2 years of experience working with preschool or primary school children; Understanding of essential game technologies; Use of game technologies in the educational process; Willingness to actively participate in the study.
For parents	Parents or legal guardians of the child; Willingness to provide information about the use of gaming technologies; Providing informed consent to participate in the study.

Source: Author's development.

Using these inclusion criteria, a total of 175 participants were recruited for the study, comprising 58 children aged five to 10 years, 41 educators, and 76 parents. The study involved 58 kids between the ages of preschool and elementary school.

The study's characteristics, including qualitative observation of the effects of digital and mobile gaming technologies on children's cognitive development in actual educational contexts, were considered when choosing this sample size.

In addition to providing us with enough detailed empirical data to examine the dynamics of changes in cognitive processes, the sample guarantees representativeness within the target group. The study also employed techniques sensitive to individual differences to compensate for the comparatively limited sample size.

Table 2 shows the general demographic data of all participants.

Table 2. General demographic data of all participants

Category	N	Mean Age (M ± SD)	Gender (M/F)	Level of Use of Gaming Technology (Low/Medium/High)	Education (for Teachers and Parents)
Children	58	7.2 ± 1.8	30/28	12/27/19	–
Educators	41	36.5 ± 5.4	1/41	2/18/20	Higher – 39, Secondary special – 2
Parents	76	34.8 ± 4.9	28/48	19/34/23	Higher – 54, Secondary special – 22

Source: Author's development.

3.3 Tools and procedure

Several tools were used in the study, including surveys and testing.

The survey for parents and teachers aimed to determine the frequency of gaming technology use in the educational process and identify the primary gaming technologies.

Table 3 presents the main sections of the survey.

Table 3. Questionnaire for parents and teachers

Section	Question
Status Definition	Please indicate your status: teacher or parent
Frequency of Use	How often are gaming technologies used in your child's learning process?
Key Gaming Technologies	Which game technologies are used most often? **1.** Role-playing games **2.** Constructors and role-playing games **3.** Video games **4.** Interactive learning programs **5.** Quest games
Efficiency	How do you assess the effectiveness of using game technologies?
Further Development	Do you think it is worthwhile to increase the use of game technologies in the educational process?

Source: Author's development.

Key cognitive indicators in children were evaluated using a variety of tests specifically chosen to support the investigation's goals in relation to the effects of digital and mobile gaming technologies on early cognitive development. The Benton Visual Retention Test (BVRT) is a basic psychological instrument to assess visuoconstructive skills, visual memory, and perception. This test assesses a child's ability to retain and accurately repeat geometric designs after brief exposure in educational activities involving visual-spatial skills, pattern replication, or short-term visual recall.

The Wechsler Intelligence Scale for Children (WISC), which thoroughly evaluates general intellectual functioning in children aged 5 to 16, also became indispensable. The WISC comprises several subtests that assess verbal comprehension, working memory, processing speed, and perceptual reasoning–all cognitive domains often triggered by learning contexts involving games. For instance, interactive storytelling games use verbal subtests to assess language acquisition, while timed gaming tasks frequently examine cognitive speed. This scale enables the assessment of intellectual abilities in children aged five to 16. WISC consists of several main sections.

1. Verbal Scale. Assesses the child's language abilities, understanding, and use of essential words.
2. Performance Scale. The scale makes it possible to assess the child's ability to perform tasks, solve puzzles, and build models from geometric shapes.
3. Verbal Comprehension Index. The scale lets you assess the child's ability to process and comprehend verbal information.
4. Perceptual Reasoning Index. The scale enables the determination of a child's ability to solve problems that require spatial and abstract thinking.
5. Working Memory Index. This measure assesses the child's ability to store and utilize information.
6. Processing Speed Index. Determines the speed with which the child can carry out tasks that require attention and reaction.

3.4 Data analysis

Thematic analysis was employed to analyze the data, enabling the processing of answers to open-ended questions from surveys completed by parents and teachers. For this purpose, Excel software generated basic tables with the principal codes. The study by V. Clarke and V. Braun identifies six key stages of analysis, which were used in this study [33]. The first stage involved data reading (careful examination of the responses), coding (highlighting significant fragments), and forming codes, including the frequency of game methods and technologies, identification of primary game technologies, the most common game technologies, and difficulties encountered in use. After that, the primary codes were grouped into themes, and the general structure of the themes was established: frequency of technology use, leading game technologies, effectiveness, and further use.

As a result, each theme was interpreted. The coefficient κ (Cohen's Kappa) was used to conduct a precise consistency check of this analysis. This coefficient allowed us to measure the level of consistency between the data coding.

In general, a value of $\kappa \geq 0.7$ was obtained, indicating substantial agreement between the codes. Once the basic data were obtained, they were compared with data from other studies. Correlation analysis investigated the relationships between key cognitive indices obtained from standardized testing. Pearson's correlation coefficient (r) was used to assess linear associations between the primary subscales of the WISC, including the Verbal Comprehension Index (VCI), Perceptual Index (PRI), WMI, and PSI.

Before calculation, all cognitive data were tested for normality using the Shapiro-Wilk test ($p > 0.05$), confirming the validity of the Pearson method. The obtained correlation coefficients ranged from $r = 0.96$ to 0.99, particularly between WMI and PSI, and between PRI and VCI. Two key factors can explain these high values. First, the conceptual interdependence of the WISC subscales, which often measure overlapping cognitive functions, is notable. On the other hand, the limited variance within a relatively small and demographically homogeneous sample ($N = 58$) is notable.

Although strong correlations suggest internal consistency in models of cognitive development, they should be interpreted with caution because of limited generalizability. However, such high correlations are found in other studies, which indicates general scientific acceptability.

3.5 Ethical approval statement

The study was approved by the Ethical Committees of educational institutions that employed the article's authors. All study procedures involving children were conducted in accordance with institutional ethical guidelines, with prior informed consent obtained from the parents or legal guardians of all participants. The study adhered to the principles of the Declaration of Helsinki.

The Commission approved the study on Ethics of Pedagogical Research at the leading Institute of Postgraduate Pedagogical Education of Taras Shevchenko National University, protocol No. 04/2024 of April 12, 2024.

4 RESULTS

Current educational standards require the development of a well-rounded personality that should possess communication skills, mathematical literacy, information and digital competence, and the ability to learn throughout life, among other qualities [38].

The definition of child development suggests that children develop mental processes more effectively through play than in other activities, making game methods a crucial tool for child development.

The use of various game technologies in the educational process is also justified from a psychological perspective, as taking on specific game roles enables a child to create themselves as the essential subject of a particular activity.

In modern Ukrainian schools and preschools, gaming technologies are frequently used. Specifically, the parents and teachers surveyed reported that games are used with children aged five to 10 years, with most learning through game-based methods several times a week, at a rate of 44.44%.

At the same time, 39.32% indicated that game technologies are used in every lesson. Only 8.55% indicated that they are used once a week (see Figure 1).

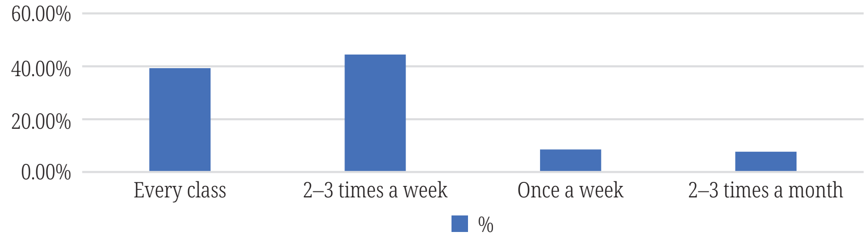

Fig. 1. Frequency of using game technologies

Source: Author's development.

Modern game technologies are highly diverse in content, nature, and organization. In the modern learning, role-playing games are the most popular game technology. They were mentioned 72 times among the respondents. Interactive learning programs were chosen 61 times. At the same time, construction sets and board games have become popular technologies, with 53 parents and teachers choosing them. Quest games and video games were less prevalent (see Figure 2). This study also analyzed the results of 58 children aged five to 10 years who initially took two tests: BVRT and RPM.

The first test is designed to assess visual memory and the ability to reproduce visual information. At the same time, the RPM measures logical thinking and abstract intelligence. The primary purpose of these tests is to determine how children's cognitive skills change with age and whether there is a correlation between the two tests.

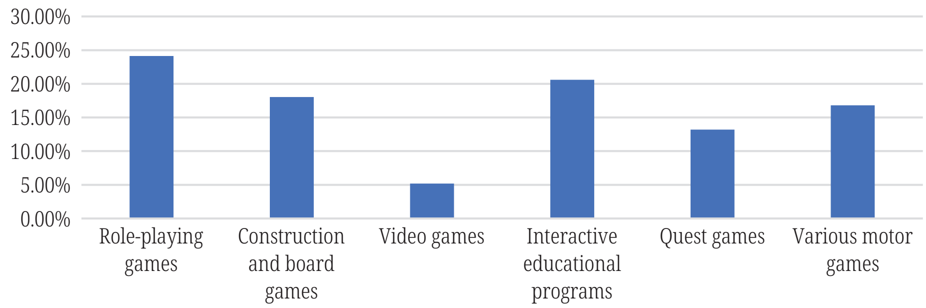

Fig. 2. Use of different game technologies

Source: Author's development.

Table 4 presents the data from the statistical analysis of these tests.

Table 4. Indicators from testing

Indicators\Age		5	6	7	8	9	10
BVRT	**mean**	15.08	16.65	18.71	22.05	23.18	24.20
	S/D	1.71	2.33	1.94	1.53	1.83	1.13
	min	13.13	12.91	15.87	19.31	19.85	21.98
	max	18.28	20.59	21.47	25.00	25.00	25.00
RPM	**mean**	19.50	23.81	24.75	29.41	30.62	33.72
	S/D	2.45	3.14	3.18	1.67	3.32	1.27
	min	16.94	19.25	19.73	26.48	24.50	31.84
	max	24.44	29.48	29.20	32.70	35.00	35.00

Source: Author's development.

As shown in Table 4, there is a noticeable increase in scores with age. Older children who use gaming technologies have higher scores on both tests. The spread of values is also noticeable.

This means that the standard deviation is highest for children aged 6–7, indicating that their results vary the most. At the same time, 10-year-olds have the lowest scatter of results. This shows that this category of children has more stable cognitive abilities. Accordingly, children aged 9–10 have the highest test scores.

The study also conducted a correlation analysis between the tests, yielding an indicator of $r = 0.58$. This result indicates a moderately positive correlation between the outcomes of the two tests, suggesting that children who perform better on the BVRT tend to achieve better results on the RPM.

The p-value of less than 0.001 indicates that the relationship is statistically significant and unlikely to be due to chance. Therefore, BVRT and RPM testing are interrelated; children with higher BVRT scores tend to have better RPM scores. In general, this shows additional consistency in cognitive performance.

It is also important to note that in the modern educational environment, mobile technologies have become a key tool for combining game elements and features of the learning process. Due to the proliferation of smartphones and tablets, mobile applications have become highly accessible, so their educational potential warrants further research. The study used both mobile and non-mobile tools to develop cognitive skills. Mobile tools included platforms such as Kahoot!, Quizlet, Duolingo, and ClassDojo, with dedicated mobile apps for smartphones and tablets.

Using these platforms allowed children to complete educational games and tasks within the educational institution and at home, contributing to more regular cognitive stimulation. The results showed that children who actively used mobile platforms tended to have higher scores on WMI (working memory) and PSI (processing speed) indices than those who used traditional or non-mobile digital tools. This may indicate a positive impact of mobile accessibility and interactivity on developing these cognitive functions.

Developers of mobile platforms are considering opportunities for integration with interactive educational games, also known as "edutainment." First, it is essential to note tools such as Kahoot!, Quizlet, Duolingo, and ClassDojo. Their use is a rather illustrative example of combining effective mobile learning and game motivation. Such conclusions have a detailed theoretical justification [29], [31] (Table 5).

Table 5. Characteristics of used mobile and non-mobile gaming platforms and average results of cognitive indices

Tool	Mobile/ Non-Mobile	Primary Device	Average WMI	Average PSI	Comment
Kahoot!	Mobile	Smartphone and tablet	105	102	Highly interactive
Duolingo	Mobile	Smartphone and tablet	107	104	Continuous learning at home
Quizlet	Mobile	Smartphone and tablet	104	100	Mobile adaptability
ClassDojo	Mobile	Smartphone and tablet	103	99	Parental engagement
Traditional games	Nonmobile	PC	98	95	Classroom use

Source: Author's development.

At the same time, the cognitive development of the selected 58 children was shaped not just by traditional teaching methods but also through interactive games, educational applications, and gamified tasks.

These gaming technologies have influenced various indicators on the Wechsler Intelligence Scale for Children, including verbal comprehension (VCI), productive thinking (PRI), working memory (WMI), and processing speed (PSI). In particular, riddles and puzzles help improve vocabulary and language skills, affecting the VCI score.

At the same time, logic games and tasks contribute to developing spatial and analytical thinking, influencing the formation of productive thinking. Interactive tasks that require memorization affect memory. Dynamic or movement games enable children to perceive new information and respond to changes more quickly, which generally affects PSI.

The children who were tested on the Wechsler Intelligence Scale for Children generally had an average IQ (87–113), with 66% of the respondents falling within this range. They also had average levels of cognitive development.

This demonstrates that gaming technologies do not contribute to the emergence of cognitive disorders and instead support the harmonious development of basic skills (refer to Table 6).

Table 6. Wechsler intelligence scale for children

Criteria	Min. (from 100 – 2SD)	Max. (from 100 + 2SD)	Range (mean ± 1SD)	Number of Children (Approximate)
IQ	72	128	87–113	66% children (38 children)
VCI	75	132	90–118	60% children (41 children)
PRI	71	129	85–114	67% children (39 children)
WMI	71	129	85–114	67% children (39 children)
PSI	65	124	80–108	60% children (35 children)

Source: Author's development.

As shown in Table 6, the VCI yields more comprehensive results than the general IQ. Specifically, 70% of children fell within the middle range (90–118). Thus, these verbal skills are well-developed.

Skills such as text analysis, logical reasoning, and communication skills are well-developed. This can be attributed to game-based learning technologies, which stimulate speech through interactive exercises and promote effective communication.

The PRI score is somewhat lower (85–114) than the VCI, indicating that some children have difficulty solving spatial problems and performing logical analysis. The WMI index has also been developed, indicating that most children do not have significant problems memorizing and processing information.

However, the PSI indicates that not all children can process information quickly, suggesting that some children struggle with the speed of cognitive tasks. Next, we used Pearson's correlation coefficient to determine the correlation between the frequency of gaming technology use and the development of a specific indicator. Pearson correlation coefficients ranged from 0.58 to 0.70, indicating a moderate to strong positive relationship.

This confirms that frequent gaming technology use is associated with better development of cognitive skills, including working memory, verbal comprehension, productive thinking, and information processing speed. All correlations were statistically significant ($p < 0.01$).

Table 7 presents the indicators along with their calculated correlations. Thus, modern gaming technologies significantly impact the development of critical cognitive skills. This is also evidenced by the surveys of parents and teachers, among whom 40% indicated that gaming technologies are very effective (48 people).

Table 7. Correlation with the frequency of gaming technology use

Cognitive Index	Correlation	Analysis
IQ	0.60	There is a positive connection. Frequent use of gaming technology is associated with higher IQ.
VCI	0.65	There is a moderate positive relationship between children who play games and their development of verbal skills.
PRI	0.58	Moderate correlation; games contribute to productive thinking.
WMI	0.70	Stronger positive correlation with working memory enhancement.
PSI	0.68	Moderate to strong correlation with processing speed improvement.

Source: Author's development.

At the same time, 35% of respondents indicated these technologies are generally effective (41 people). Another 15% indicated that these technologies are not very effective. However, despite this, 75% of respondents indicated that the use of gaming technologies in the educational process should be increased.

5 DISCUSSION

The results of this study demonstrate how mobile game technologies, especially tablet-based apps and interactive learning games, can help foster the growth of cognitive abilities, including abstract reasoning, pattern recognition, and memory retention. There may be a connection between mobile interaction and cognitive development, as children who played in structured mobile game environments performed better on assessments such as Raven's Matrices and BVRT.

These findings are consistent with earlier studies, showing that mobile platforms offer special affordances that promote deeper cognitive engagement, specifically adjustable difficulty and rapid feedback [38], [39].

Future research should continue examining how mobile-specific design elements affect various cognitive domains in early learners, given the increasing prevalence of mobile devices in Ukrainian educational settings.

The primary research question was to determine the relationship between the use of game-based learning technologies and the development of cognitive abilities in preschool and early school-age children. Accordingly, the first research question was to determine the frequency of use of game technologies for the education and development of preschool and primary school children in Ukraine.

It was found that children mostly learn using game-based methods several times a week: 44.44% use games every lesson, 39% use games several times a week, and 32% use games once a week. At the same time, only 8.55% of users play games once a week. These figures correlate with the study by F. Fatimah et al. which shows a similar frequency [40]. These results also correlate with F. Alıncak, who found that 40 (80%) of teachers reported consistently teaching with games, and 10 (20%) reported sometimes teaching with games during their courses [41].

Thus, this confirms the widespread use of game technologies in the modern educational system. The next task was to identify the most common game technologies that impact the development of cognitive abilities. Among the most common were role-playing games and interactive learning programs. The next most popular is the use of motion and quest games. The last place is occupied by digital video games (approximately 6%). These results are somewhat consistent with those of other researchers who recognize the importance of games.

At the same time, the results do not align with the study by R. Kamilova and A. Z. Kurbanbaeva, which indicates that children frequently use digital platforms, with 86% of children using them daily [42].

This can be explained by the fact that these authors focused more on older children, while this study describes the development of preschool and early school-age children. These findings are also supported by a study by S. McKenney and J. Voogt, which found that 53% of children aged 0–6 use computers for less than one hour per day [43].

This suggests that children are actively engaged in other activities, including play, during the rest of the day. The study also shows the importance of using modern gaming applications. These results are also consistent with the opinions of other researchers [44]. Hence, the study used mobile and non-mobile learning platforms to develop children's cognitive skills.

In particular, mobile tools included Kahoot!, Duolingo, Quizlet, and ClassDojo, which have dedicated apps for smartphones and tablets. Non-mobile tools included traditional computer games and programs used in the classroom on PCs.

The results showed that children who actively used mobile platforms had higher average scores on WMI and PSI than those who used non-mobile or traditional digital tools. This indicates a possible positive effect of mobility and interactivity on the development of cognitive functions.

However, it is worth noting that the general intelligence level (IQ) and other indices (VCI, PRI) had a minor difference between the groups, indicating the complex nature of development, where mobility is only one of the factors. Specifically, the scientific literature indicates that mobile educational applications are among the modern gaming technologies that play a significant role in children's development [45].

For example, the authors note that these applications enable the implementation of various interactive lessons, including those in mathematics, reading, art, and other disciplines [46].

Furthermore, some programs use different riddles to foster logical thinking [47]. Modern scientists generally concur that gaming technologies help youngsters learn through play and influence the development of cognitive, creative, and intellectual talents [48].

This adds interest and excitement to the learning process. However, other writers have noted that the game in the classroom shouldn't be impromptu [2]. It should also be purposeful and well-organized. In addition to thoroughly understanding the game's rules and content, pupils should also be able to access its forms.

This found a substantial correlation between cognitive abilities and game usage frequency. As a result, this study demonstrated a clear link between cognitive skill development and gaming technology use, supporting the alternative hypothesis that children's cognitive abilities and gaming technology use are positively correlated.

Other research supports this finding, showing that gaming techniques enhance memory, information processing speed, and general intelligence [49], [50]. Consequently, regular use of gaming technology is associated with improved cognitive markers [51].

However, this study has several limitations because it primarily focuses on assessing indicators for Ukrainian children. Although triangulating data sources involving parents, teachers, and children provides a more detailed picture of the role of play technologies in early childhood education, the main quantitative sample of 58 children is a limitation.

This limited diversity may affect the generalizability of the results, as cognitive development and gaming habits may differ significantly in other population groups. The small sample size also reduces statistical power, possibly leading to overestimating or underestimating correlations. Therefore, caution should be exercised when interpreting the strength and applicability of the correlations obtained.

Future studies should consider larger and more diverse samples to test the patterns identified in this study. Hence, future research will focus on longer-term experiments and a broader range of children's participation, allowing for an analysis of the impact of the mobile games on the cognitive abilities of preschoolers and early schoolers [52].

6 CONCLUSION

The study confirms that mobile gaming techniques play an essential role in the development of cognitive abilities of preschool and primary school children. It was found that 44% of children aged five to 10 years used games several times a week. At the same time, 39.32% use gaming technologies in every lesson, while only 8.55% indicated that they use them once a week.

It identified the most common mobile game technologies that impact the development of cognitive abilities. Among the most common were role-playing games and interactive learning programs. The next most popular is the use of motion and quest games. Digital video games occupy the last place. The importance of role-playing games is demonstrated.

The study results demonstrate that using mobile learning platforms, such as Kahoot!, Duolingo, Quizlet, and ClassDojo, positively affects the development of key cognitive skills in children, particularly working memory and information processing speed. Correlation analysis confirmed a close relationship between the frequency of gaming technologies and improved intellectual development indicators.

The testing results according to the Wechsler Scale (WISC) indicate a positive effect of gaming-based learning on cognitive development. The VCI in 60% of children is within 90–118, which indicates well-developed logical thinking, text analysis, and communication skills.

Spatial thinking indicators (PRI) are lower (85–114), which may indicate the need for a special approach to developing this area. Working memory (WMI) is also well-formed in most children, while the information PSI demonstrates that not all children can quickly perform cognitive tasks. At the same time, the Information PSI shows that not all children can quickly perform cognitive tasks.

Besides, the survey confirmed the effectiveness of gaming technologies: 75% of respondents consider it advisable to implement them in education more actively. Overall, the results confirm the effectiveness of game-based learning for developing speech, logical, and memory skills. They also indicate the potential for implementing broader mobile and interactive educational technologies in the early learning system. It provides a basis for comparative analysis with other countries, where similar technologies are beginning to be implemented.

Moreover, these results have important practical implications for the educational sphere. For teachers, integrating mobile gaming platforms into the educational process can stimulate students' cognitive development and increase their motivation to learn.

Teachers are encouraged to use these tools to actively complement traditional teaching methods. For developers of educational applications, our results emphasize the importance of developing interactive, accessible, and adaptive mobile platforms that meet children's age and cognitive characteristics.

Special attention should be paid to gamification elements that increase interest and regularity in the use of applications. For policymakers and school leaders, the findings suggest that supporting integrating mobile technologies into curricula and creating conditions for their widespread access in schools is a good idea. This could include funding the purchase of mobile devices, developing internet infrastructure, and training teachers in effectively using digital tools.

However, larger studies with more diverse samples and controls for additional factors are needed to understand the impact of mobile learning further. However, it can already be argued that mobile technologies are a powerful resource for supporting modern education and developing children's cognitive abilities.

7 REFERENCES

[1] H. Annuar, E. Solihatin, and Khaerudin, "Enhancing early childhood cognitive development via mobile game-based learning applications: Insights and practical experiences," *International Journal of Interactive Mobile Technologies (iJIM)*, vol. 19, no. 4, pp. 208–229, 2025. https://doi.org/10.3991/ijim.v19i04.51897

[2] P. K. Parthasarathy, A. Mittal, and A. Aggarwal, "Literature review: Learning through game-based technology enhances cognitive skills," *International Journal of Professional Business Review*, vol. 8, no. 4, p. e01415, 2025. https://doi.org/10.26668/businessreview/2023.v8i4.1415

[3] A. I. Christou, S. Tsermentseli, and A. Drigas, "The role of mobile games and environmental factors in improving learning and metacognitive potential of young students," *International Journal of Interactive Mobile Technologies (iJIM)*, vol. 17, no. 18, pp. 67–84, 2023. https://doi.org/10.3991/ijim.v17i18.42437

[4] J. P. Byrnes, "Piaget's cognitive-developmental theory," in *Encyclopedia of Infant and Early Childhood Development*, 2020, pp. 532–539. https://doi.org/10.1016/B978-0-12-809324-5.23519-0
[5] O. Rui, "Formation of cognitive interests in children of olderpreschool age in the conditions of game activities," *Scientific Journals*, vol. 93, no. 1, pp. 186–196, 2024. https://doi.org/10.58246/k9e7zt13
[6] W. Crain, "Piaget's Cognitive-Developmental Theory," in *Theories of Development*, W. Crain, Ed., New York: Routledge, 2024, pp. 92–123. https://doi.org/10.4324/9781003315483-7
[7] I. O. Muraina, G. S. Hojapoji, and A. O. Amao, "Adoption of metacognitive approach to teaching and learning of programming language concepts to undergraduate and graduate university students," *Futurity*, vol. 3, no. 1, pp. 73–90, 2025. https://doi.org/10.57125/FS.2025.03.20.05
[8] L. Vandenbroucke, J. Spilt, K. Verschueren, C. Piccinin, and D. Baeyens, "The classroom as a developmental context for cognitive development: A meta-analysis on the importance of teacher–student interactions for children's executive functions," *Review of Educational Research*, vol. 88, no. 1, pp. 125–164, 2017. https://doi.org/10.3102/0034654317743200
[9] N. Tymoshenko, O. Osypenko, O. Smolinska, O. Ilina, and A. Romaniuk, "Integrating gamification and gaming technologies into Ukrainian education: Transforming the learning experience," *Multidisciplinary Science Journal*, vol. 6, p. 2024ss0725, 2024. https://doi.org/10.31893/multiscience.2024ss0725
[10] M. Videnovik *et al.*, "Game-based learning in computer science education: A scoping literature review," *IJ. STEM Ed.*, vol. 10, p. 54, 2023. https://doi.org/10.1186/s40594-023-00447-2
[11] O. Kasyanenko, "Directions of ICT use in Ukrainian educational institutions in the educational process with children with special educational needs: A literature review," *Scientific Bulletin of Mukachevo State University Series 'Pedagogy and Psychology*,' vol. 9, no. 3, pp. 17–26, 2023. https://doi.org/10.52534/msu-pp3.2023.17
[12] C. Bingham, "Education and artificial intelligence at the scene of writing: A derridean consideration," *Futurity Philosophy*, vol. 3, no. 4, pp. 34–46, 2024. https://doi.org/10.57125/FP.2024.12.30.03
[13] G. Abdikerimova *et al.*, "Applying textural Law's masks to images using machine learning," *International Journal of Electrical and Computer Engineering (IJECE)*, vol. 13, no. 5, pp. 5569–5575, 2023. https://doi.org/10.11591/ijece.v13i5.pp5569-5575
[14] N. Smailov, F. Uralova, R. Kadyrova, R. Magazov, and A. Sabibolda, "Optimization of machine learning methods for de-anonymization in social networks," *Informatyka, Automatyka, Pomiary w Gospodarce i Ochronie Środowiska*, vol. 15, no. 1, pp. 101–104, 2025. https://doi.org/10.35784/iapgos.7098
[15] T. Zaporozhchenko, O. Fonariuk, O. Popadych, S. Kliuieva, N. Ashikhmina, and O. Kanibolotska, "Distance education on the basis of innovative technologies. Problems of the primary school teacher training in Ukraine," *Revista Romaneasca Pentru Educatie Multidimensionala*, vol. 14, no. 2, pp. 102–117, 2022. https://doi.org/10.18662/rrem/14.2/569
[16] E. Demitriadou, K.-E. Stavroulia, and A. Lanitis, "Comparative evaluation of virtual and augmented reality for teaching mathematics in primary education," *Education and Information Technologies*, vol. 25, pp. 381–401, 2019. https://doi.org/10.1007/s10639-019-09973-5
[17] Y. Petrytsa, "Development of creative abilities of primary school students by means of project-based technologies in foreign countries," *Scientific Bulletin of Mukachevo State University Series 'Pedagogy and Psychology*,' vol. 10, no. 2, pp. 51–61, 2024. https://doi.org/10.52534/msu-pp2.2024.51

[18] Y. Tsekhmister, "War, education and development: A pedagogical response to the challenges of modernity," *Academia*, nos. 35–36, 2024. https://doi.org/10.26220/aca.4999
[19] L. López-Faican and J. Jaen, "EmoFindAR: Evaluation of a mobile multiplayer augmented reality game for primary school children," *Computers and Education*, vol. 149, p. 103814, 2020. https://doi.org/10.1016/j.compedu.2020.103814
[20] M. M. Castro-Rodríguez, "The use of community resources for the inclusion of preschool students in schools," in *Textbooks and Educational Media: Perspectives from Subject Education*, P. Bagoly-Simó and Z. Sikorová, Eds., Springer, Cham, 2021. https://doi.org/10.1007/978-3-030-80346-9_6
[21] V. M. Chaika, I. I. Kuzma, O. I. Yankovych, K. M. Binytska, O. T. Pysarchuk, and T. V. Ivanova, "Implementing media educational technology in Ukrainian preschool institutions," *Educational Technology Quarterly*, vol. 2024, no. 1, pp. 1–19, 2024. https://doi.org/10.55056/etq.57
[22] H. Byhar, I. Pits, K. Shevchuk, I. Prokop, O. Shestobuz, and S. Dariichuk, "The impact of gamification on the motivation of primary schoolers under martial law," *Amazonia Investiga*, vol. 12, no. 61, pp. 317–329, 2023. https://doi.org/10.34069/AI/2023.61.01.32
[23] Y. Chuchalina, "The effect of gamification on motivation and success in learning mathematics in primary school," *Humanities Science Current Issues*, vol. 3, no. 75, pp. 315–322, 2024. https://doi.org/10.24919/2308-4863/75-3-46
[24] K. Dimitra, K. Konstantinos, Z. Christina, and T. Katerina, "Types of game-based learning in education: A brief state of the art and the implementation in Greece," *The European Educational Researcher*, vol. 3, no. 2, pp. 87–100, 2020. https://doi.org/10.31757/euer.324
[25] P. Halachev, "Gamification as an e-learning tool: A literature review," *E-Learning Innovations Journal*, vol. 2, no. 2, pp. 4–20, 2024. https://doi.org/10.57125/ELIJ.2024.09.25.01
[26] M. H. Hussein, S. H. Ow, M. M. Elaish, and E. O. Jensen, "Digital game-based learning in K-12 mathematics education: A systematic literature review," *Education and Information Technologies*, vol 27, pp. 2859–2891, 2022. https://doi.org/10.1007/s10639-021-10721-x
[27] I. Huszti, E. Nagy-Kolozsvári, and M. Fábián, "Digital and non-digital games in young learner EFL classrooms at wartime in Ukraine," *ITLT*, vol. 103, no. 5, pp. 39–54, 2024. https://doi.org/10.33407/itlt.v103i5.5791
[28] T. Koval, N. Oliinyk, T. Kryvosheya, and A. Khilya, "Application of gamification in higher education: Training of early childhood and primary education teachers in Ukraine," *ETR*, vol. 2, pp. 183–187, 2024. https://doi.org/10.17770/etr2024vol2.8051
[29] O. Vilkhova and O. Hryshko, "Pedagogical conditions of usage didactic games for young children's sensory education," *Aesthetics and Ethics of Pedagogical Action*, vol. 25, pp. 62–72, 2022. https://doi.org/10.33989/2226-4051.2022.25.256650
[30] I. Pukas, L. Kozak, N. Tsukanova, R. Shulyhina, and L. Harashchenko, "Professional training of future teachers of preschool education institutions to implement the development of child's abilities," *Amazonia Investiga*, vol. 12, no. 62, pp. 56–65, 2023. https://doi.org/10.34069/AI/2023.62.02.4
[31] A. Zourmpakis, S. Papadakis, and M. Kalogiannakis, "Education of preschool and elementary teachers on the use of adaptive gamification in science education," *International Journal of Technology Enhanced Learning*, vol. 14, no. 1, 2022. https://doi.org/10.1504/IJTEL.2022.120556
[32] T. Vasiutina, L. Ishchenko, H. Kit, Y. Bondar, and A. Khilya, "Algorithm for implementing quest technologies in research work with preschool and primary school children," *ETR*, vol. 2, pp. 503–507, 2024. https://doi.org/10.17770/etr2024vol2.8089
[33] V. J. Clemente-Suárez *et al.*, "Digital device usage and childhood cognitive development: Exploring effects on cognitive abilities," *Children*, vol. 11, no. 11, p. 1299, 2024. https://doi.org/10.3390/children11111299

[34] N. M. Hatta, I. Ahmad, M. H. Zakaria, H. A. S. Murti, and U. C. Pendit, "The role of multiplayer online educational games in enhancing critical thinking," *International Journal of Recent Educational Research*, vol. 5, no. 6, pp. 1506–1521, 2024. https://doi.org/10.46245/ijorer.v5i6.713

[35] S. Papadakis, "Apps to promote computational thinking concepts and coding skills in children of preschool and pre-primary school age," in *Research Anthology on Computational Thinking, Programming, and Robotics in the Classroom*, IGI Global Scientific Publishing, 2022, pp. 610–630. https://doi.org/10.4018/978-1-6684-2411-7.ch028

[36] S. Papadakis, F. Alexandraki, and N. Zaranis, "Mobile device use among preschool-aged children in Greece," *Educ. Inf. Technol.*, vol. 27, pp. 2717–2750, 2022. https://doi.org/10.1007/s10639-021-10718-6

[37] M. Kalogiannakis and S. Papadakis, "The use of developmentally mobile applications for preparing pre-service teachers to promote STEM activities in preschool classrooms," in *Mobile Learning Applications in Early Childhood Education*, S. Papadakis and M. Kalogiannakis, Eds., IGI Global Scientific Publishing, 2020, pp. 82–100. https://doi.org/10.4018/978-1-7998-1486-3.ch005

[38] M. Oliveira, J. C. Silva, S. Carvalho, and J. V. Carvalho, "Mobile game for teaching and applying principles for active ageing," in *Perspectives and Trends in Education and Technology*, ICITED 2024, in Lecture Notes in Networks and Systems. Cham: Springer, 2024, vol. 859. https://doi.org/10.1007/978-3-031-78155-1_42

[39] V. Spitsyn *et al.*, "European values in the Ukrainian higher education system: Adaptation and implementation," *Journal of Curriculum and Teaching*, vol. 13, no. 3, pp. 102–114, 2024. https://doi.org/10.5430/jct.v13n3p102

[40] F. Fatimah, N. Sunardi, and S. Supriyadi, "The effect of parental attention and provision of educational game tools on the beginning reading ability of children aged 4–5 years," *International Journal of Business, Law, and Education*, vol. 6, no. 1, pp. 134–145, 2025. https://doi.org/10.56442/ijble.v6i1.988

[41] F. Alıncak, "The effect of parental attention and provision of educational game tools on the beginning reading ability of children aged 4–5 years," *European Journal of Physical Education Sport Science*, vol. 2, no. 3, pp. 81–96, 2016. https://oapub.org/edu/index.php/ejep/article/view/268/663

[42] R. T. Kamilova and A. Zh. Kurbanbaeva, "Comparative assessment of leisure time activities of children aged 11 to 17 years old who often and rarely use digital devices and the Internet," *Central Asian Journal of Medicine*, no. 1, pp. 81–90, 2025.

[43] S. McKenney and J. Voogt, "Technology and young children: How 4–7 year olds perceive their own use of computers," *Computers in Human Behavior*, vol. 26, no. 4, pp. 656–664, 2010. https://doi.org/10.1016/j.chb.2010.01.002

[44] B. Sonyel and M. Şumrut, "An evaluation of game-based education method by primary school 1st grade teachers," *International Journal of Primary Education Studies*, vol. 4, no. 3, pp. 118–137, 2023. https://doi.org/10.59062/ijpes.1359165

[45] I. Pavlenko, O. Boiko, D. Mykolaiets, O. Moskalenko, and T. Shrol, "Advancements in STEM education and the evolution of game technologies in Ukrainian educational settings," *Multidisciplinary Reviews*, vol. 7, p. 2024spe007, 2024. https://doi.org/10.31893/multirev.2024spe007

[46] K. Mereniuk and I. Parshyn, "The history of civilizations of pre-columbian America: Assessment of 7–8 grade world history textbooks for Ukrainian students," *Revista Praksis*, vol. 1, pp. 322–346, 2025. https://doi.org/10.25112/rpr.v1.3807

[47] V. Zheliaskov, V. Krasnopolskyi, T. Sharhun, V. Ihnatenko, I. Hinsirovska, and O. Tymofyeyeva, "The impact of European educational integration on the process study of foreign languages in institutions of higher education of Ukraine," *Systematic Rev. Pharmacy*, vol. 11, no. 10, pp. 147–155, 2020. https://doi.org/10.31838/srp.2020.10.25

[48] L. Savchenko, "Co-operation of prescription and primary education institutions preparing a child for a new Ukrainian school," *Pedagogy of the Formation of a Creative Person in Higher and Secondary Schools*, vol. 1, no. 68, pp. 109–113, 2020. https://doi.org/10.32840/1992-5786.2020.68-1.22

[49] V. Saienko, I. Zabiiaka, O. Potikha, O. Riabinina, and A. Mykhaliuk, "Information society: Educational trends and technical aspects of formation (EU experience)," *Journal of Higher Education Theory and Practice*, vol. 23, no. 11, 2023. https://doi.org/10.33423/jhetp.v23i11.6232

[50] O. A. Vovchenko, N. A. Lytvynova, Y. V. Tsekhmister, D. T. Hoshovska, and N. K. Vichalkovska, "Socialisation of adolescents with cognitive disorders through emotional intelligence," *Journal of Intellectual Disability – Diagnosis and Treatment*, vol. 10, no. 1, pp. 56–69, 2022. https://doi.org/10.6000/2292-2598.2022.10.01.7

[51] O. Vovchenko, I. Leonova, I. Soroka, I. Klymenko, and Y. Tsekhmister, "The impact of emotional intelligence on the academic performance of students with intellectual disabilities in inclusive education," *Journal of Intellectual Disability – Diagnosis and Treatment*, vol. 10, no. 4, pp. 187–196, 2022. https://doi.org/10.6000/2292-2598.2022.10.04.4

[52] L. Xu, M. N. A. Rahman, S. Y. Wong, and Z. Chen, 'Personalized and interactive mobile learning in early childhood education: A bibliometric study (2015–2024)," *International Journal of Interactive Mobile Technologies (iJIM)*, vol. 19, no. 10, pp. 86–111, 2025. https://doi.org/10.3991/ijim.v19i10.53587

8 AUTHORS

Nataliia Bakhmat is with the Kamianets-Podilskyi Ivan Ohiienko National University, Kamianets-Podilskyi, Ukraine (E-mail: bakhmat.nataliya@kpnu.edu.ua).

Liudmyla Zahorodnia is with the Oleksandr Dovzhenko Hlukhiv National Pedagogical University, Hlukhiv, Ukraine.

Iryna Brushnevska is with the Lesya Ukrainka Volyn National University, Lutsk, Ukraine.

Yuliia Ribtsun is with the Mykola Yarmachenko Institute of Special Pedagogy and Psychology of the National Academy of Pedagogical Sciences of Ukraine, Kyiv, Ukraine.

Tatyana Valentieva is with the T. H. Shevchenko National University "Chernihiv Colehium," Chernihiv, Ukraine.