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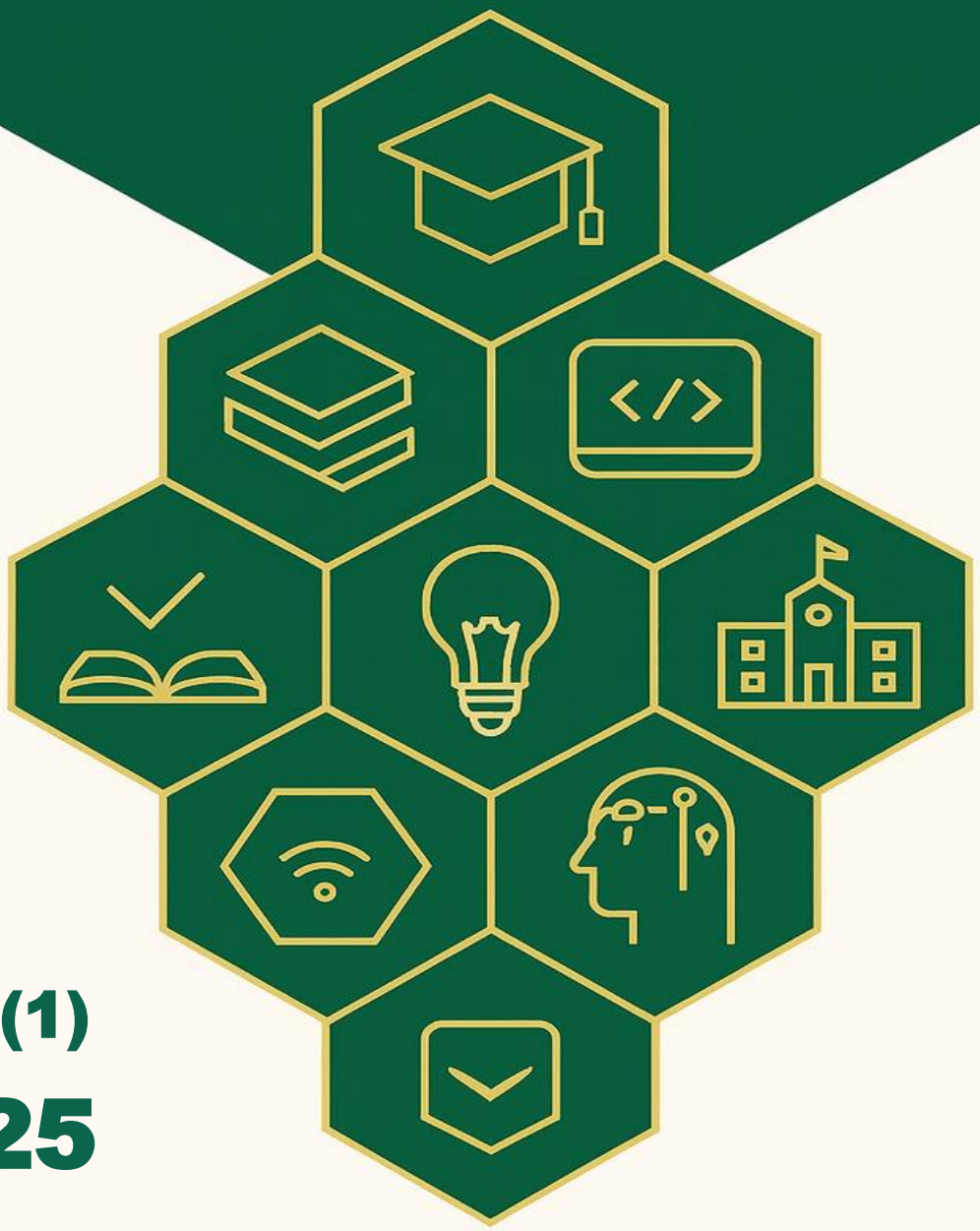

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Using the Project-Based Learning Method in the Development of Games on Unity to Develop Creative Thinking

Abstract

The article explores the development of creative thinking through the application of the project-based learning method in game development using the Unity engine. Currently, the project-based method is widely used as an effective approach that promotes motivation, teamwork, productive communication, and problem-solving abilities. Since the aim of the study was to determine its impact on creative thinking, a set of research methods was applied. The study had a quasi-experimental design. A total of 78 students participated in the pedagogical experiment: 40 were assigned to the experimental group and 38 to the control group through random assignment. The experiment was conducted based on a methodological learning system that linked the project-based method with different game genres developed in Unity. To assess the level of creative thinking, Torrance's test was administered, focusing on such parameters as fluency, originality, elaboration, and flexibility. In addition, a student survey was conducted to evaluate their satisfaction with the learning process and to identify the main benefits and drawbacks of implementing the project-based method. The results were positive, confirming the effectiveness of the project-based approach in fostering creative skills.

Keywords: project-based method, game development, creative thinking.

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Introduction

Nowadays, the problems arising in the sphere of education require innovative, original and modern solutions. This undoubtedly makes the development of creative thinking skills particularly relevant. In digital education, especially in the context of teaching media and STEM disciplines, there is a growing demand for pedagogical methods aimed at developing creativity. In this context, the project-based learning method is an effective way to develop students' responsibility, critical and creative thinking by applying their ideas to real-world problems.

Game development is interdisciplinary, so it is easy to combine with the project method. The Unity environment is a professional and widely used game engine for game development. It can be an interactive, visually rich and meaningful platform for students' creative projects.

Creative thinking is the ability to generate unique, flexible and expressive ideas. In 1966, Torrance identified the main characteristics of creative thinking: fluency, originality, elaboration, and flexibility (Kim, 2017). Creative thinking includes higher order skills such as observation, discovery, analysis, hypothesizing, testing, problem solving and communication (Buyuktaskapu, 2014). To develop these skills, the project-based learning method is particularly effective. In the process of creating a project, students interact with each other, looking for ways to solve different problems. This, in turn, gives them the opportunity to analyze existing solutions and generate new ideas. Creative thinking is one of the most important skills of the 21st century (Chien et al., 2010). In students with a high level of creative thinking, semantic memory is associated with a larger associative search and has a complex structure (Kenett, 2024).

To foster creativity in educational institutions, it is necessary to create learning environments that encourage exploration, challenge and meaningful problem solving.

Unity is a 2D and 3D game development platform that supports C# scripting (Unity Technologies, 2023). Its visual editor and developed community allow integrating different resources and using them for educational purposes. Unity is an excellent environment for creative projects, as it allows to combine technical skills (programming, physics) with artistic skills (design, animation).

Unity is a popular game development system that provides developers with fundamental features and tools for creating games and other interactive experiences. It has features such as cross-platform development, visual editor, asset management, scripting, physics, scripting, graphics and rendering, animation, audio, artificial intelligence and navigation, multi-platform support, physics-based shaders, analytics, monetization solutions, cloud services, etc. (Parikshith, 2017).

The aim of the study is to develop creative thinking through the application of the project method in game development.

Objectives of the study:

- Using Unity game engine for game development;
- Determining the impact of the project method on the development of creative thinking.

Materials and methods

The research was conducted in several stages and was quasi-experimental in nature. It was aimed at determining the influence of project-oriented method on the development of creative thinking of students. The development of digital projects (games) using the Unity game platform was used as the basis of project activity. Before and after the implementation of the project method a comparative analysis of the results of the experimental and control groups was carried out.

The study involved third-year students of the educational program “Information Technology” at the bachelor's degree level. The total number of participants amounted to 78 people who were randomly divided into two groups. In the experimental group, 40 students were trained in the project method and developed their own games in the Unity environment. In the control group, 38 students were trained using the traditional method. All participants had previously, in previous courses, acquired basic programming skills and learned the basics of working with Unity. For 10 weeks, students worked in teams to create projects that included the following stages:

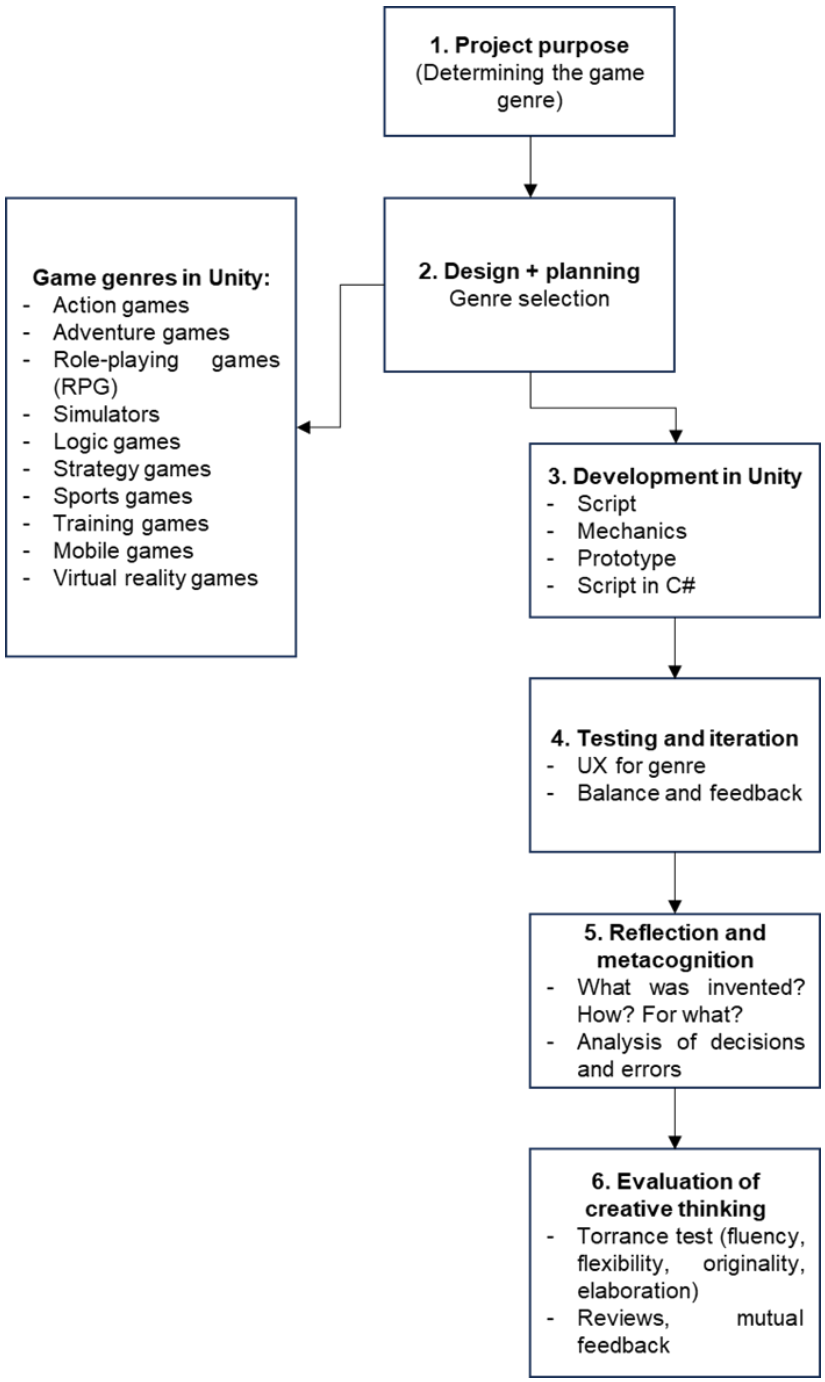
- Generating a project idea;
- Designing game mechanics;
- Creating a prototype in Unity;
- Testing and launching;
- Presentation of the developed project.

The learning process included continuous discussions, intermediate control and collective analysis of the decisions made. While the students in the control group also studied topics related to game development, they did not perform complex project assignments.

The research methods were implemented through a methodical teaching system linking the project method to the genres of games created in Unity (Figure 1).

Figure 1

A teaching methodology system linking the project method to game creation genres in Unity



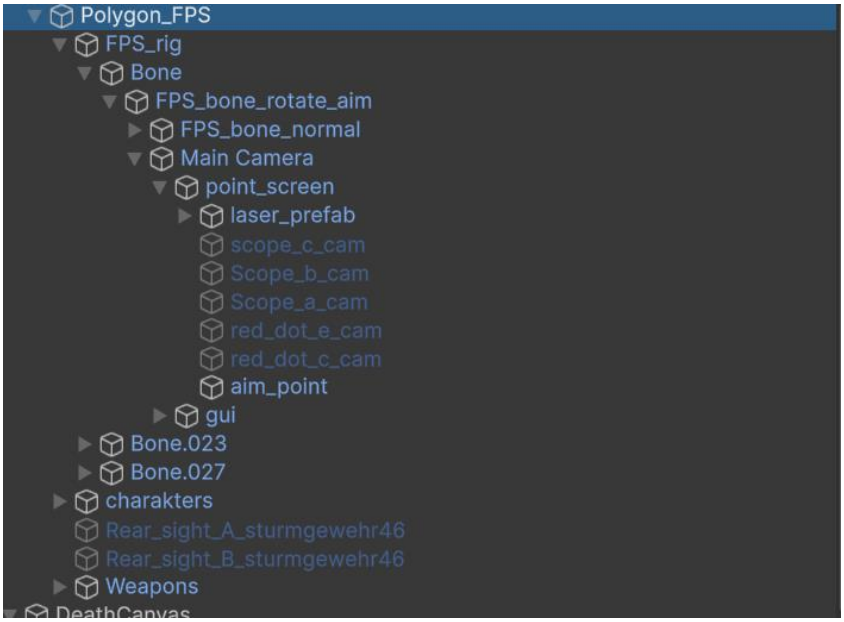
The Unity game engine helps to create games of various genres for different platforms. Notable project types include the following:

• Action games: With its robust physics engine and animation system, Unity evelopers to create games with realistic movement and interactivity. This genre includes shooters, platformers, and survival games.

- Adventure games: Unity's visual scripting system and resource storage capabilities make it easy to create compelling story-driven adventure games. Developers can create interactive worlds, NPC characters, sprites, and puzzles, engaging players in an interesting story.
- Role-playing games (RPGs): Unity's flexibility allows developers to build complex RPG systems with character customization, inventory management, and branching storylines. You can also create vast open worlds to explore.
- Simulations: The physics engine and scripting capabilities allow you to create realistic simulations. Whether it's an airplane simulator, urban planning simulator, or agriculture simulator, Unity offers the tools for an engaging and believable experience.
- Puzzles: an intuitive interface and drag-and-drop functionality make Unity convenient for developing casual puzzles. Developers can easily implement simple mechanics as well as complex logic problems, from three-in-a-row games to physics-based puzzles.
- Strategy games: Real-time multiplayer capabilities and artificial intelligence make Unity suitable for strategy games. Developers can implement games in which players compete against each other or the AI, with elements of resource management, tactical decisions, and strategic planning.
- Sports games: Unity's physics engine and animation system allow you to create realistic sports games. Whether it's soccer, basketball, tennis, or auto racing, players get a dynamic and authentic sports experience.
- Educational Games: The visual scripting system and resource storage capabilities make it easy to design educational games that entertain and educate at the same time. You can create interactive lessons, quizzes, and simulators for learning math, science, history, or languages.
- Mobile gaming: cross-platform capabilities make Unity a popular choice for mobile game development. With Unity, developers can create games for iOS and Android, reaching a wide audience.
- Virtual Reality (VR) games: Unity's support for VR makes it a great tool for developing immersive virtual reality games. Developers can utilize Unity's resources and tools to create immersive VR worlds and unique gaming experiences.

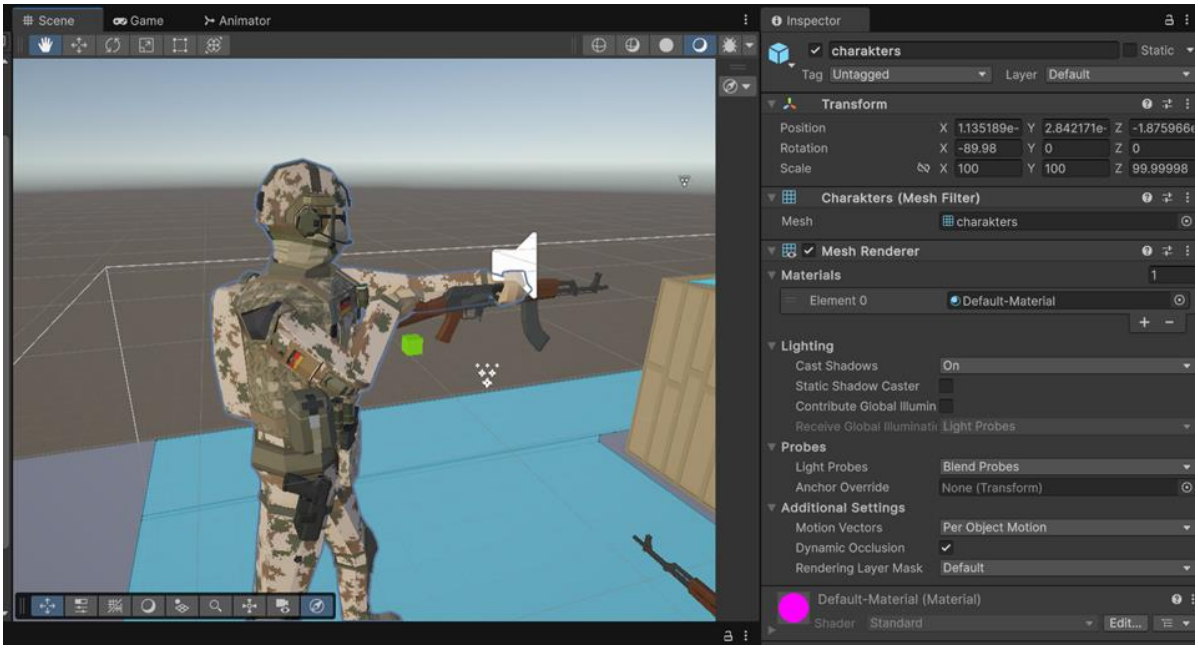
In the process of realizing the proposed projects, students added their own characters, combining model, animation, controller, and motion logic (Figure 2). For this purpose, they used sets from the Polygon collection or resources stored in the Unity Asset Store.

Figure 2
Objects integrated into a scene in Unity



The character placed on the stage is copied to the hierarchy panel as a prefab, making sure that it is positioned above the surface of the space (see Figure 3). This ensures correct operation of the controller.

Figure 3
Objects integrated into the Unity scene



Three types of enemies were developed: zombies, flying robots, and warriors (Figure 4). Each of them consists of unique models and animations. According to the game's logic, enemies patrol through specified points until they detect the player, after which they begin pursuit and open fire if necessary. Their behavior, including damage infliction and recovery, as well as defeat animations, is controlled by scripts.

Figure 4
Types of enemies in game

The next example of a project created in Unity is an animation of weather phenomena using particles: modeling rain, wind, fog, fog, lightning, and snowfall (Figure 5).

Figure 5
The weather animation

The real-time animation of dynamically changing weather conditions using the Unity game engine aimed to create a three-dimensional environment with an emphasis on environmental transitions and immersive visual storytelling.

The design goals were to understand how to model natural phenomena using particle systems and shaders, create a system capable of switching between different weather

conditions, explore time-of-day changes, skybox transitions, lighting changes, and the use of sound effects to enhance the perception of rain and other phenomena.

The Torrance methodology was used to assess changes in the learners' level of creative thinking induced by these projects. It includes four parameters: fluency, originality, elaboration, and flexibility.

The questionnaire method was used to assess subjective changes in perceptions of creativity, engagement and interest.

Teacher observation and diaries recorded cases of initiative, originality and ability for non-standard problem solving in the process of working on projects.

For data processing we used methods of statistical analysis, in particular Student's t-test for dependent and independent samples.

In qualitative analysis, content analysis of the project products (games) was conducted to identify signs of creativity, innovativeness and complexity of the implemented solutions.

Research ethics were strictly followed during the study. Participants were informed about the purpose of the study and voluntarily consented to participate. Data anonymity was guaranteed.

Results and Discussion

To evaluate the effectiveness of the project-based learning method in game development in Unity, we measured the level of creative thinking in the control and experimental groups. For this purpose, the Torrance Creative Thinking Test was used to assess the key parameters of creative thinking.

At the beginning of the experiment, there were no statistically significant differences between the control (N = 40) and experimental (N = 38) groups. The average indicators of both groups were within the norm for this age category ($p > 0.05$).

The results of the pedagogical experiment aimed at developing creative thinking skills in Unity using the project method showed a significant increase in the level of creative thinking in the experimental group. The obtained values are summarized in the table (Table 1).

Table 1

Results of Torrance test

Parameter	Control group	Experimental group	Dynamics in the Experimental group (%)
Fluency	42,3 ± 3,1	55,6 ± 3,4	+31,5%
Flexibility	38,5 ± 2,7	52,1 ± 3,0	+35,3%
Originality	40,7 ± 2,9	58,9 ± 3,2	+44,7%
Elaboration	35,1 ± 3,3	48,3 ± 3,5	+37,6%

The experimental group showed significant improvement in all four parameters. The greatest increase was noted in the indicator “Originality (non-standard solutions)” - 44.7%, which indicates the effectiveness of project-based learning for the formation of the ability to create non-standard, unique solutions in game development.

Participants noted an increase in motivation, active exchange of ideas in teams, and an increase in the ability to find multiple variants of implementing a single game mechanic.

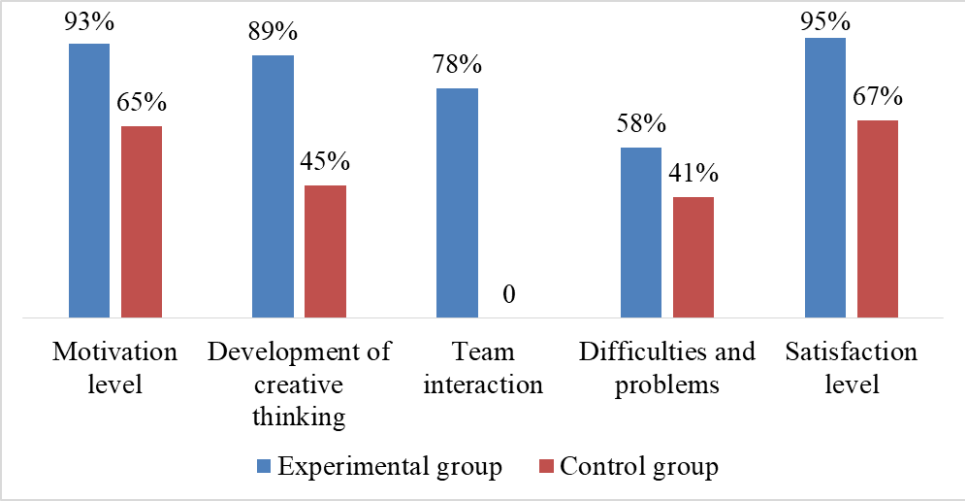
The control group also showed a slight increase in results (within 5-7%), which may be related to the general influence of the learning environment, but these differences are statistically insignificant.

Thus, the application of the project-based learning method in the process of game development in Unity contributes to the reliable growth of the main parameters of creative thinking - fluency, originality, deployment and flexibility. The obtained data confirm the effectiveness of this pedagogical model in the formation of abilities to search for new solutions, create a non-standard product and its realization within the framework of team activities.

In order to assess the subjective perception of the effectiveness of project-based learning in game development in Unity, an anonymous questionnaire was administered to the participants of the experiment. The survey was conducted at the end of the training module and included 15 questions aimed at identifying the level of students' motivation, self-esteem, development of creative thinking, quality of team interaction, complexity of tasks and understanding of their own role in the project. The purpose of the survey was to determine the degree of satisfaction with the learning process, as well as to identify the main positive and negative aspects of the implementation of the project-based learning method (Figure 6).

Figure 6

Survey result



93% of students in the experimental group noted that the project form of learning significantly increased their motivation and interest in amounted to 65%.

89% of students in the experimental group indicated that when creating a game in Unity they had to look for non-standard ways to realize ideas. 83% confirmed that the project format allowed them to reveal their creative potential. In the control group, the corresponding figures were 45% and 37%.

78% of participants in the experimental group noted the positive impact of teamwork in the project. Students emphasized that sharing ideas, joint search for solutions and team brainstorming were important factors in developing creative skills. In the control group, where learning took place individually, this aspect was not evaluated. 58% of participants in the experimental group indicated that planning and controlling time was the greatest difficulty. 41% reported difficulty in combining ideas into a workable product. In the control group, the main difficulties were identified as: lack of motivation to independently search for non-standard ideas (64%) and lack of creativity-oriented tasks (52%).

According to the level of satisfaction, 95% of students in the experimental group expressed their willingness to participate in similar projects in the future. In the control group, 67% of students stated that they would like to try the project-based learning format to increase motivation and unlock creativity.

In general, the experimental group demonstrated a significantly higher level of satisfaction with the learning process and increased motivation. The students noted that working in Unity in the format of full-fledged game creation contributes not only to the improvement of the programming level, but also to the development of the ability to search for non-trivial solutions. While the control group perceived the course formally, students from the experimental group attached importance to the meaning of the work performed.

The results of the questionnaire confirmed the effectiveness of project-based learning for the development of creative thinking when creating games in Unity. The combination of personal responsibility, joint teamwork and freedom in making design and technical decisions provides not only the growth of creative skills, but also a high level of motivation and satisfaction with the educational process.

Conclusion

In conclusion, the effectiveness of applying the project-based learning method in game development in Unity for developing learners' creative thinking was confirmed. The following results of the study provided the basis for this conclusion:

The experimental group, which worked in the project-based learning format, significantly improved performance on the key parameters of creative thinking - fluency, flexibility, originality and detailing of ideas. The greatest increase was observed in the indicator of originality, which indicates the effectiveness of the project model in forming the ability to search for non-trivial solutions. According to the results of the questionnaire,

the project-based learning format promotes sustainable motivation, active participation in the process of game creation and disclosure of personal creative potential.

The project-based learning method promotes not only the development of creative skills, but also the formation of such key competencies as critical thinking, the ability to search for optimal ways to implement ideas, planning individual learning and effective teamwork.

Further development of the project method can be associated with the integration of interdisciplinary design and the use of modern VR/AR technologies, as well as gamified educational platforms for the formation of a wide range of creative and professionally relevant competencies.

References

Buyuktaskapu, S. (2014). Scientific process skills. In B. Akman, G. Uyanik Balat, & T. Guler (Eds.), In pre-school science education (pp. 19–62). Ankara: Pegem Academy

Chien, C.-Y., & Hui, A. N. N. (2010). Creativity in early childhood education: Teachers' perceptions in three Chinese societies. Thinking Skills and Creativity, 5(2), 49–60. https://doi.org/10.1016/j.tsc.2010.02.002

Kenett, Y. N. (2024). The Role of Knowledge in Creative Thinking. Creativity Research Journal, 37(2), 242–249. https://doi.org/10.1080/10400419.2024.2322858

Kim, K. (2017). The Torrance Tests of Creative Thinking - Figural or Verbal: Which One Should We Use?. Creativity Theories – Research – Applications, 4, 302-314. https://doi.org/10.1515/ctra-2017-0015

Parikshith Reddy Baddam. (2017) Pushing the Boundaries: Advanced Game Development in Unity, International Journal of Reciprocal Symmetry and Theoretical Physics, Vol. 4, Issue 1, 2017, Pages 29-37

Unity Technologies. (2023). Unity Manual: https://docs.unity3d.com/2023.2/Documentation/Manual/UnityManual.html

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Enhancing University Teachers' Competencies in Integrating Active Methods and Digital Tools: A Pretest-Posttest Experimental Study

Abstract

The integration of active learning methodologies with digital technologies represents a critical competency for contemporary university teaching, aligning with global trends in pedagogical innovation. Nevertheless, a significant proportion of higher education instructors face challenges in effectively implementing such approaches due to insufficient training and support. This study investigated the effectiveness of a blended professional development course in enhancing university teachers' abilities to integrate Case-Based, Problem-Based, and Team-Based Learning with digital tools. Twenty-one participants completed a pretest and posttest assignment (a digital teaching guide), evaluated using standardized rubrics. Pretest scores averaged 15.6 (SD = 10.2), while posttest scores rose to 84.6 (SD = 9.9), with a statistically significant increase ($t = 35.70$, $p < .001$). Participants showed strong performance in using AI tools and lesson design, though some struggled with complex data tools like Power BI.

The results confirm that structured, hands-on training can significantly improve digital-pedagogical integration, supporting prior findings on teacher self-efficacy and blended learning. Professional development programs that integrate active learning methodologies with digital technologies have demonstrated effectiveness in enhancing instructional competencies in higher education. The findings of this study provide valuable insights for curriculum developers, university administrators, and policy-makers aiming to foster pedagogical innovation and support the digital transformation of teaching practices..

Keywords: digital pedagogy, active learning, professional development, university teachers, educational technology, teaching competencies, blended learning, PBL, CBL, TBL.

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Introduction

Developing teachers' competencies in integrating active learning methods with digital tools is a multifaceted and dynamic process that requires a solid foundation in both pedagogical knowledge and technological proficiency. Effective integration not only enhances student engagement but also improves learning outcomes by leveraging digital environments to foster interaction, creativity, and autonomy. Teachers must possess a range of key competencies to successfully implement such integrative approaches.

One fundamental competency is technological proficiency. Educators need to demonstrate a high level of digital literacy, including the ability to navigate educational platforms, utilize interactive software, and apply various ICT tools. This skill set enables them to design and deliver meaningful digital content while creating interactive and personalized learning experiences (Kiryakova & Kozhuharova, 2024; Yadav, 2024). Equally important is pedagogical knowledge, particularly regarding active learning methodologies such as Case-Based Learning (CBL), Problem-Based Learning (PBL), and Team-Based Learning (TBL). These approaches encourage critical thinking, collaboration, and reflective inquiry, and their effectiveness is significantly enhanced when coupled with appropriate digital tools (Abildinova et al., 2024; Alcántar, 2024).

In addition, content expertise plays a critical role in ensuring the relevance and adaptability of teaching materials. Teachers must be capable of designing electronic resources that address diverse learning styles and support collaborative online learning environments (Kiryakova & Kozhuharova, 2024; Svensson, 2021). To support the development of these competencies, structured professional development is essential. Ongoing training initiatives - especially those that blend workshops, collaborative projects, and self-paced modules - have demonstrated positive effects on educators' confidence and capacity to implement innovative teaching methods (Abildinova et al., 2024; Romero-García et al., 2020).

The use of digital tools such as Moodle, augmented reality applications, and interactive platforms further supports the transformation of pedagogical practices. These technologies can foster the development of soft skills, enhance student motivation, and enable the personalization of instruction (Smawati et al., 2022; Santos et al., 2024). Moreover, inter-professional collaboration within communities of practice provides a platform for exchanging experiences and pedagogical innovations, thereby reinforcing digital and didactic competencies (Svensson, 2021).

Despite these opportunities, several challenges hinder the seamless integration of digital tools and active learning methods. Limited access significant barriers. Overcoming these issues requires strategic planning, adequate funding, and leadership support (Abildinova et al., 2024; Santos et al., 2024). Furthermore, ensuring equitable access to technology and digital training is paramount, especially in contexts where disparities in infrastructure and digital literacy persist (Santos et al., 2024; Yadav, 2024).

Another critical issue is the alignment of digital tools with existing curricula. Successful integration demands thoughtful adaptation of instructional materials and outcomes to ensure cohesion with institutional goals and educational standards (Abildinova et al., 2024; Alcántar, 2024). Without such alignment, the risk of fragmented or ineffective instructional design increases.

While integrating active learning methods with digital tools holds immense potential for transforming higher education, it simultaneously introduces complex challenges that must be addressed at both the institutional and individual levels. Sustained professional development, equitable resource allocation, and a collaborative culture are essential components for fostering innovation and enhancing digital pedagogy. Addressing these dimensions enables educators to create more inclusive, interactive, and impactful learning experiences in the digital era.

Despite a growing body of literature highlighting the importance of equipping teachers with both pedagogical and technological competencies, there remains a need for empirical evidence on how structured professional development programs translate into measurable improvements in these areas. While various studies have outlined the theoretical underpinnings and strategic frameworks for integrating digital tools with active learning methodologies, fewer have examined the concrete outcomes of such integration in real instructional settings, particularly within higher education contexts.

To address this gap, the present study explores the effectiveness of a blended learning course designed to enhance university teachers' competencies in applying active teaching methods supported by digital technologies. The course was implemented within a national professional development initiative and focused on developing skills related to instructional design, digital tool usage, and case-based learning techniques.

Accordingly, this study is guided by the following research question: How does participation in a professional development course impact university teachers' competencies in integrating active learning methods (CBL, PBL, TBL) with digital tools?

Methods and materials

This study employed a pedagogical experiment aimed at enhancing university teachers' competencies in applying active learning methods.

The intervention was structured as a blended professional development course hosted on the institutional platform of Margulan University's Institute for Continuing Education (https://cabinet.ido.ppu.edu.kz/course/view.php?id=444). The course was conducted over a one-month period from April 22 to May 22, 2025, and included both asynchronous online modules and synchronous interactive components.

A total of 21 university educators voluntarily enrolled in the course. Participants came from various higher education institutions in Kazakhstan and represented diverse academic disciplines. Their participation was voluntary, and informed consent was

obtained from all individuals prior to the start of the study.

The course comprised 72 academic hours and was delivered in Russian. It was designed to improve university teachers' competencies in implementing active learning methodologies, specifically Case-Based Learning (CBL), Team-Based Learning (TBL), and Problem-Based Learning (PBL), through the effective use of digital tools. Structured into five thematic modules, the course addressed instructional design using active methods, integration of educational technologies such as Moodle, Blackboard, Mentimeter, Quizziz, Plickers, TED-Ed, Power BI, ChatGPT, Gamma, and Canva, as well as the development of pedagogical resources including case studies, educational videos, and digital surveys. Additional areas of focus included formative assessment strategies, feedback techniques, and classroom management in digitally enhanced learning environments.

To reinforce these skills, participants were engaged in a series of practical assignments aimed at evaluating their ability to combine pedagogical techniques with appropriate technologies. These included designing lessons using digital tools, developing reflective surveys, creating instructional videos, performing data visualization using Power BI, utilizing artificial intelligence tools for lesson planning, building multimedia presentations, and generating realistic educational visuals. All assignments were submitted via the Moodle platform and assessed by course instructors using standardized rubrics that considered the quality, structure, creativity, and relevance of tool application.

The course included the evaluation of several key assignments: lesson design using active methods and digital tools (task #1), creation of reflective surveys (task #2), development of instructional videos (task #3), data analysis in Power BI (task #4), AI-assisted lesson planning (task #5), ChatGPT & Grammarly Use (task #6), multimedia presentation design (task #7), the generation of realistic educational visuals (task #8), creating a methodological teaching guide that integrated active learning methods with digital tools (task #9).

To evaluate the effectiveness of the professional development course, a pretest-posttest design was employed. Participants completed an identical task before and after the course: creating a methodological teaching guide that integrated active learning methods with digital tools (task #9). This integrative task was selected as a measure of teachers' ability to apply both pedagogical and technological competencies in a coherent manner. The collected scores from the pretest and posttest phases were analyzed using a paired samples t-test, as the same group of participants completed both assessments. This statistical method was chosen to determine whether there was a statistically significant improvement in participants' competencies after completing the course, controlling for individual differences by comparing each participant's pre- and post-course performance.

Each task was assessed using standardized rubrics focusing on integration of pedagogy and technology. The assignments were evaluated by course instructors - experts

in digital pedagogy and active learning methods - using standardized assessment rubrics to ensure consistency and objectivity in scoring. Each assignment was scored on a 0–100 scale across several dimensionsи (see Appendix). Evaluation focused on the degree of method integration, appropriateness of tool selection, clarity of instructional design, and the quality of pedagogical artifacts produced. Detailed rubrics were used to ensure consistency and objectivity.

All participants involved in this study provided voluntary and informed consent prior to their inclusion. Full confidentiality, anonymity, and security of the collected data were ensured throughout the pedagogical experiment. Participation in the professional development course and related assessments was entirely voluntary, and participants were informed of their right to withdraw at any time without penalty. The research protocol was reviewed and approved by the Ethics Committee of Margulan University (Approval No. 12–EK) on March 3, 2025, in accordance with national and institutional ethical standards for research involving human participants.

Results and Discussion

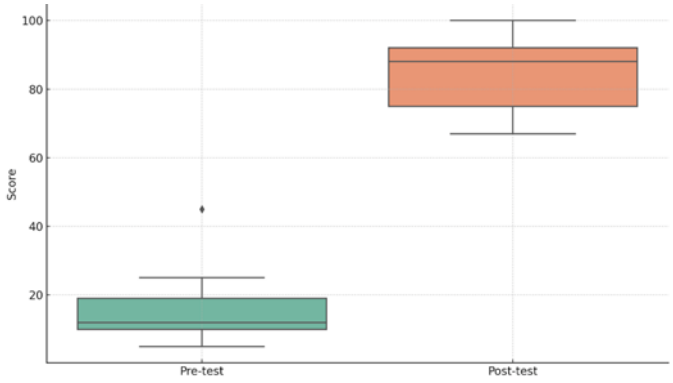
As part of the diagnostic process, participants were asked to complete Assignment 9 both before and after the course. The task required each participant to design a mini-methodological guide focused on a selected topic, explicitly integrating active learning strategies (CBL, PBL, TBL) with digital tools. A standardized template was provided to ensure comparability across responses.

Initial submissions (pre-test) revealed limited familiarity with integrating pedagogical and technological components. Most participants presented fragmented ideas, lacked structured methodology, and demonstrated minimal use of digital instruments. The average score for pre-test submissions was **15.57 out of 100**, with the lowest at **5** and only one case above **40**.

After completing the course, participants were given the **same assignment** as a post-test. The results showed dramatic improvement. Participants demonstrated an enhanced ability to structure lessons using active methods, select appropriate digital tools, and articulate pedagogical rationale. The average post-test score increased to **84.62**, with multiple participants scoring above **90** and several achieving **perfect scores (fig.2)**.

Figure 1

Comparison of Pre-test and Post-test scores



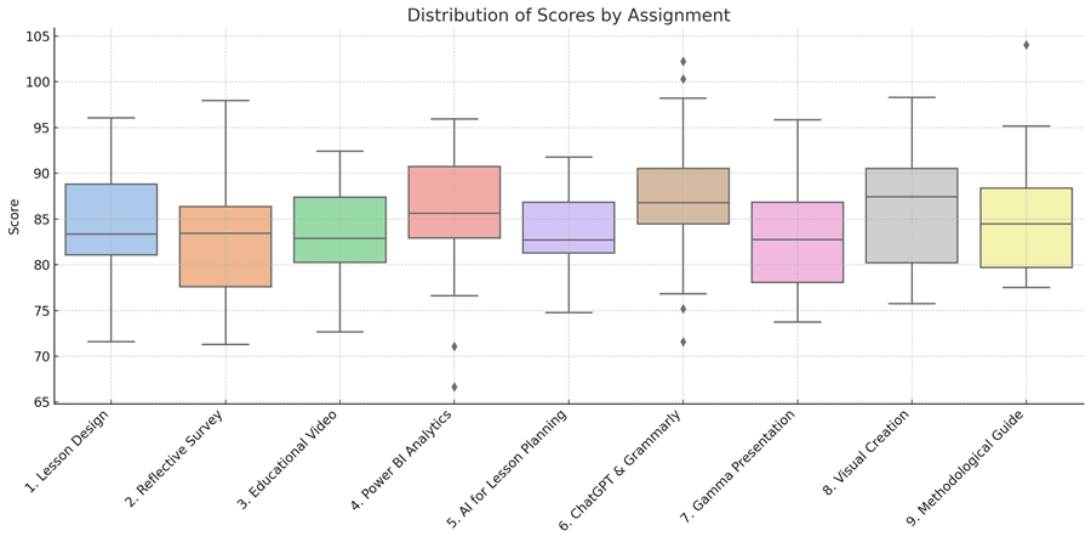
The comparison of pretest and posttest scores using a paired t-test revealed a statistically significant improvement in participants' performance. The mean score increased from 14.3 (SD = 7.2) on the pretest to 85.3 (SD = 9.9) on the posttest. The t-statistic was 35.70, and the result was highly significant ($p < .001$), indicating a strong positive effect of the course on participants' ability to integrate digital tools and active learning methods into instructional materials. This confirms the effectiveness of the professional development program in enhancing the targeted teaching competencies.

The analysis of the participants' scores across all nine assignments revealed consistently high and stable performance (fig.2). The average scores ranged from 82.2 (Task 1: lesson planning with active methodology and digital tool) to 89.3 (Task 5: using AI for lesson planning), while median scores ranged from 82.5 to 90, indicating that most participants developed strong competencies in integrating active learning methods with digital tools.

The highest performance was recorded in Tasks 5 and 9, which focused on the use of artificial intelligence and the creation of a teaching guide. These tasks not only showed the highest mean scores but also had low standard deviations (Task 5: SD = 9.37, Task 9: SD = 9.91), suggesting a relatively consistent understanding and application of these competencies across participants.

Figure 2

Distribution of Participants' Scores Across Nine Integration Assignments



Conversely, Task 4 (data analytics in Power BI) showed more variability, with a standard deviation of 15.32, indicating that while some participants excelled, others faced difficulties—likely due to the technical complexity of the tool. Despite this, the distribution of scores in most assignments was relatively symmetrical and without extreme outliers, indicating an even level of mastery across the cohort. Mode values clustered around 90 points for many tasks, with Tasks 5, 6, and 9 demonstrating the highest concentration of top performers. These findings confirm that the course was effective in developing essential skills and highlight specific areas—such as data analytics - where additional support or differentiated instruction might enhance future outcomes.

The observed patterns in performance across the assignments provide a foundation for further interpretation. The findings of this study demonstrate a significant improvement in university teachers' competencies in integrating active learning methods with digital tools following participation in a structured professional development course. The statistically significant difference between pre-test and post-test results ($t = 35.70$, $p < 0.001$) provides compelling evidence of the course's effectiveness. These results indicate not only growth in individual digital skills but also a deeper pedagogical understanding of how to embed technologies meaningfully into active instructional strategies such as CBL, PBL, and TBL.

This aligns with previous research by Abildinova et al. (2024), who emphasized the importance of blended training formats in improving teachers' digital-pedagogical integration. The marked increase in performance on integrative tasks, particularly the development of teaching materials using multiple tools, supports the view that combining

digital literacy with methodological training can have a transformative effect on instructional practice (Santos et al., 2024).

Furthermore, the variance in scores across assignments highlights the complexity of mastering multiple competencies simultaneously. While tasks such as creating surveys or working with Power BI posed initial difficulties, the final assignment - designing a teaching guide that combined all learned elements - showed that participants were able to synthesize and apply the knowledge gained. This is in line with findings by Romero-García et al. (2020), who argue that integrated, practice-based learning fosters deeper competency acquisition.

The success of the course also resonates with the concept of teacher self-efficacy in digital environments, as noted by Hamid (2020) and Blonder et al. (2013). Many participants initially lacked confidence in using AI and data visualization tools, but their ability to complete tasks involving ChatGPT, Grammarly, and Power BI by the end of the course suggests a meaningful increase in their perceived and actual capabilities.

Nevertheless, the data also reveal persistent challenges. Some participants continued to underperform on assignments requiring creative or technical synthesis, echoing concerns raised in Svensson (2021) about the variability in digital competence development in adult learners. Moreover, the success of the intervention depends on sustained institutional support and opportunities for continuous professional learning, as suggested by Yadav (2024) and Tondeur et al. (2017).

In sum, this study contributes to a growing body of evidence that strategic, hands-on professional development can foster the integration of active learning and digital tools in higher education. It underscores the importance of designing training programs that not only teach how to use technology, but also embed it within pedagogical frameworks that promote engagement, reflection, and collaboration.

This study has several limitations that should be acknowledged. First, the sample size was relatively small (n = 21), and all participants were affiliated with a single university, which may limit the generalizability of the findings to broader contexts. Second, the assessment relied primarily on performance-based tasks evaluated through standardized rubrics, which, although informative, may not fully capture participants' long-term retention or transfer of the skills acquired. Third, the absence of a control group limits the ability to attribute improvements solely to the intervention, as other contextual or motivational factors could have contributed to the observed gains. Additionally, although the assignments were designed to evaluate the integration of active methods with digital tools, variations in participants' prior experience with technology may have influenced their outcomes. Finally, the study focused on short-term gains; follow-up assessments would be needed to evaluate the sustainability of the achieved competencies over time.

Despite these limitations, the study offers valuable insights into the development of university teachers' competencies in integrating active learning methods with digital

tools. The findings highlight not only statistically significant improvements, but also practical implications for designing professional development programs in higher education. These results underscore the importance of structured, practice-oriented training that addresses both pedagogical and technological dimensions.

Conclusion

This study demonstrates that targeted professional development can significantly enhance university teachers' competencies in integrating active learning methods with digital tools. The results of the pedagogical intervention revealed substantial growth in participants' ability to design and implement instruction that combines Case-Based Learning (CBL), Problem-Based Learning (PBL), and Team-Based Learning (TBL) with digital technologies. The statistically significant improvements observed between the pretest and posttest scores support the effectiveness of the training course in fostering practical, applicable skills among educators.

The study contributes to the broader understanding of how blended, hands-on professional development can be structured to yield measurable outcomes in digital pedagogy. By emphasizing real-world assignments and providing structured feedback, the course helped participants translate theoretical knowledge into educational practice. Furthermore, the findings align with prior research that highlights the need for pedagogically grounded approaches to digital integration in higher education.

These outcomes not only validate the chosen instructional design of the course but also suggest directions for future training programs. Continuing to invest in teacher development that focuses on both digital fluency and pedagogical innovation is essential for preparing educators to meet the demands of contemporary classrooms. Future studies may explore longitudinal impacts, disciplinary differences, and the role of institutional support in sustaining these competencies over time.

References

Abildinova, G., Abdykerimova, E., Assainova, A., Mukhtarkyzy, K., & Abykenova, D. (2024). Preparing educators for the digital age: Teacher perceptions of active teaching methods and digital integration. *Frontiers in Education*. https://doi.org/10.3389/feduc.2024.1473766

Alcántar, M. del R. C. (2024). Use of active methodologies with ICT in teacher training. *Salud, Ciencia y Tecnología - Serie de Conferencias*. https://doi.org/10.56294/sctconf2024.702

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development*, *53*(4), 25–39. https://doi.org/10.1007/BF02504683

Kiryakova, G., & Kozhuharova, D. (2024). The digital competences necessary for the successful pedagogical practice of teachers in the digital age. *Neveléstudomány*. https://doi.org/10.3390/educsci14050507

Romero-García, C., Buzón-García, O., & Paz-Lugo, P. de. (2020). Improving future teachers' digital competence using active methodologies. *Sustainability*, *12*(18), 7798. https://doi.org/10.3390/SU12187798

Santos, S. M. A. V., Tesch, A. S. S., Caetano, A. B., Silva, C. C. D., Britto, G. da S., Soeiro, J. T. P., Alencar, P. G. R. D. D., & Jesus, T. M. D. (2024). Active methodologies and digital tools: Redefining contemporary teaching. *Contribuciones a Las Ciencias Sociales*. https://doi.org/10.55905/revconv.17n.2-155

Smawati, M. A., Mohamed, A., Karim, N. S. A., Ismail, N., & Aziz, A. (2022). Redesign of active learning with using digital tools to develop student soft skills. *Studies in Educational Management*, *12*(2). https://doi.org/10.32038/sem.2022.12.02

Svensson, A. (2021). Competence development for teachers within a digital inter-professional community. In *Digital Professionalism in Health and Care: Developing the Workforce, Building the Future* (pp. 125–138). https://doi.org/10.1007/978-3-030-47539-0_8

Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence. *Educational Technology Research and Development*, *65*, 555–575. https://doi.org/10.1007/S11423-016-9481-2

Yadav, S. (2024). Enhancing digital competencies of teachers. In *Advances in Educational Marketing, Administration, and Leadership Book Series*. https://doi.org/10.4018/979-8-3373-1692-5.ch005

Appendix

Assessment Checklist

Assignment for Module 1: Lesson Design Using an Active Method and a Digital Tool

1. Task Execution

0 - 20 points: The method was not applied or was applied incorrectly.

21 - 40 points: The method was partially applied, but key aspects were missing.

41 - 60 points: The method was applied correctly, but lacked a clear connection to the lesson.

61 - 80 points: The method was applied appropriately with good connection to the instructional process, though minor flaws were present.

81 - 100 points: The method was fully and correctly integrated into the lesson with

effective use of digital tools.

Experience Description

0 - 20 points: Description is missing or highly unstructured.

21 - 40 points: The description is incomplete or lacks sufficient detail.

41 - 60 points: The experience is described well, but some aspects are not fully explained.

61 - 80 points: Detailed and coherent description, with minor flaws.

81 - 100 points: Comprehensive, logical, and clear explanation with analysis of all experience aspects.

Practical Assignment 2.2.1: Reflective Survey Based on an Active Learning Method

2. Survey Quality

0 - 20 points: Survey does not meet requirements or has serious errors.

21 - 40 points: Survey has structural issues or lacks alignment with the method.

41 - 60 points: Survey is mostly correct but needs improvement.

61 - 80 points: Well-developed survey meeting basic standards.

81 - 100 points: Excellent survey, fully aligned with CBL/PBL/TBL and thoughtfully designed questions.

Use of Digital Tool

0 - 20 points: Tool not used or used incorrectly.

21 - 40 points: Tool used with configuration issues.

41 - 60 points: Tool used appropriately with minor problems.

61 - 80 points: Good use of tool with minimal errors.

81 - 100 points: Excellent tool usage with proper configuration and application.

3 Practical Assignment 2.2.3: Creation of an Educational Video in TED-Ed or YouTube

3.1. Video Quality

0 - 20 points: No video or very poor quality.

21 - 40 points: Video contains content or format errors.

41 - 60 points: Good video with some presentation flaws.

61 - 80 points: Clear and effective video.

81 - 100 points: High-quality video with excellent presentation and tool use.

Questions and Feedback

0 - 20 points: Questions missing or irrelevant.

21 - 40 points: Questions poorly structured.

41 - 60 points: Well-written but could be more diverse.

61 - 80 points: Thought-provoking and well-selected questions.

81 - 100 points: Logical, diverse, and fully aligned with learning objectives.

Practical Assignment 2.2.6: Data Analytics in Power BI

4.1. Analytics Structure and Content

0 - 20 points: Analytics missing or seriously flawed.
21 - 40 points: Present but needs major improvement.
41 - 60 points: Adequate but underdeveloped.
61 - 80 points: Well-structured with minor issues.
81 - 100 points: Excellent analytics with in-depth data analysis.
Use of Power BI
0 - 20 points: Not used or used incorrectly.
21 - 40 points: Tool used with setup errors.
41 - 60 points: Correct use with small issues.
61 - 80 points: Good use with proper visuals.
81 - 100 points: Excellent use with clear and informative visualizations.
Practical Assignment 2.2.7: Use of AI for Lesson Planning
5.1. AI Application
0 - 20 points: AI not used or misused.
21 - 40 points: Used with setup errors.
41 - 60 points: Applied correctly but needs refinement.
61 - 80 points: Good application with useful results.
81 - 100 points: Excellent application with relevant outcomes.
Assignment 4.4: Working with ChatGPT and Grammarly
6.1. ChatGPT Usage
0 - 20 points: Not used or used incorrectly.
21 - 40 points: Used but with unsatisfactory results.
41 - 60 points: Used appropriately with room for improvement.
61 - 80 points: Good usage with relevant outcomes.
81 - 100 points: Excellent use of ChatGPT with high-quality results.
Grammarly Usage
0 - 20 points: Not used or misused.
21 - 40 points: Used with many errors.
41 - 60 points: Used properly but some flaws.
61 - 80 points: Good use with minor issues.
81 - 100 points: Excellent analysis and error detection.
Assignment 4.5: Presentation Design in Gamma
7.1. Presentation Quality
0 - 20 points: Missing or poorly done.
21 - 40 points: Completed but with flaws.
41 - 60 points: Good but needs improvements.
61 - 80 points: Clear and effective presentation.
81 - 100 points: Excellent presentation with professional design.
Assignment 4.6: Creation of Realistic Visuals

8.1. Visual Quality
0 - 20 points: Missing or poorly created.
21 - 40 points: Completed but needs refinement.
41 - 60 points: Acceptable but can be improved.
61 - 80 points: Good visuals with detail.
81 - 100 points: Realistic and high-quality visuals.

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Engagement Of Kazakhstani Youth In Video Games

Abstract

The widespread use of video games as one of the key forms of leisure underscores the importance of studying their impact on young people, as this phenomenon has a significant effect on their psycho-emotional state, social adaptation, and behavior. This paper examines the engagement of Kazakhstani youth in video games, as well as the relationships and differences between gaming habits, demographic characteristics, forms of addictive behavior, and other behavioral aspects. The study involved 105 people aged 18 to 35 years (including 44 men and 61 women) who completed an online survey. The main hypotheses concerned gender differences in engagement in video games, the influence of religiosity, as well as the relationship between gaming activity and financial expenses, and the perception of the harm of video games. Data analysis was carried out using descriptive statistics, correlation analysis, Mann-Whitney, and Kruskal-Wallis criteria. The results showed that men are more actively engaged in video games, more often participate in online games, and have a positive attitude towards the gaming process. Women use social networks more and demonstrate stress eating. Religious respondents showed less engagement in video games. Differences were identified between groups of respondents based on their level of engagement in video games and their perception of the associated harm. The correlation analysis revealed a relationship between gaming activity, financial costs, and perception of video games. The results can be useful for further research in the field of digital culture and the prevention of addictive behavior. The practical significance of the study lies in the possibility of using the presented results to develop effective programs aimed at minimizing the risk of developing gaming addiction and other related problems among young people..

Keywords: video games, gaming addiction, addictive behavior, youth, online games.

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Introduction

In recent decades, video games have become a widespread form of entertainment, attracting individuals of various ages and genders (Burris & Dow, 2015). Statistics indicate that the number of people playing video games has been growing rapidly: in 2014, there were 1.8 billion users, and six years later, that number had increased to 2 billion (WHO, 2019). This suggests that video games are capable of fulfilling certain human needs.

In Kazakhstan, precise data on the video game market is not available. However, according to *Newzoo's Global Games Market Report* for 2020, the country ranked 44th in the global gaming industry and was among the top five countries in Eastern Europe in terms of revenue. Kazakhstani gamers spent approximately $183 million. Moreover, according to the Kazakhstan Cybersport Federation, more than 5 million Kazakhstani citizens play computer and mobile games (Turkayev, 2022).

Along with the growing popularity of video games, concerns about their potential negative consequences have also increased (Erevik et al., 2023). Video game addiction, also known as gaming disorder, is characterized by persistent and compulsive engagement in gaming activities, which can lead to significant impairments in various areas of an individual's life, including social, occupational, academic, and psychological functioning. In 2010, the American Psychiatric Association included Internet Gaming Disorder (IGD) in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) as a condition warranting further research (Holden, 2010).

The World Health Organization officially recognized gaming disorder as a mental health condition in its International Classification of Diseases (ICD-11), categorizing it under "Disorders due to addictive behaviors," thereby emphasizing the need for further research and intervention in this area (WHO, 2019).

However, there is still a noticeable lack of research in Kazakhstani academic literature regarding the prevalence, patterns, and determinants of video game addiction among the country's youth.

This study aims to examine the engagement of Kazakhstani youth in video games and to identify the relationships and differences between gaming habits, demographic characteristics, forms of addictive behavior, and other behavioral aspects. The research addresses various dimensions such as interest in video and online games, time spent playing, genre preferences, and the inclination to make in-game purchases.

The article proceeds with a literature review that explores both the positive effects of video games and the issues related to gaming addiction and addictive behaviors, which in turn form the basis for research hypotheses. The methodology section describes the research tools and methods used, followed by the presentation of results that highlight predictors contributing to the development of gaming addiction among youth, and discusses their

correlations with the likelihood of engaging in addictive behavior. The conclusion summarizes the main findings of the study and highlights their practical implications.

Thus, the study investigates the impact of demographic and psychological factors such as age, gender, anxiety levels, and social isolation on the susceptibility to gaming addiction.

Literature review

Positive effects of video games

The usefulness of video games in enhancing human abilities can be traced back over 30 years, when researchers first employed them to train children in communication and spatial skills (Horn et al., 1991). The broad potential for content customization and interactive features makes video games a unique tool when used for educational purposes. This approach, known as "game-based learning" or "gamification," has been actively explored and applied in various educational contexts, ranging from primary schools to universities (Adžić et al., 2023; Aarseth, 2003; Susi et al., 2007). Game developers can integrate learning content into gameplay and provide immediate rewards when learners complete required tasks. These features, from the perspective of self-determination theory, have been shown to support users' needs for autonomy and competence, promote critical thinking, and ultimately enhance motivation for continued engagement (Iacovides & Mekler, 2019).

Some researchers have found that video games help improve performance in a variety of visual and spatial tasks (Adžić et al., 2023). Positive effects on visuospatial skills have been observed in both correlational and experimental studies (Wolinsky et al., 2013; Tanaka et al., 2010; Beaumont et al., 2021).

Video games may also help individuals cope with stressful life events, such as job loss or bereavement (Massimi et al., 2012; Sun et al., 2008). McGonigal (2011) emphasizes the role of video games as a tool for relaxation and stress reduction. Carter and colleagues (2018) examine the potential of advanced technologies such as virtual reality (VR) and biofeedback interfaces in managing stress through gaming. VR immerses players in a virtual environment where they can interact with their surroundings. Studies suggest that VR can be an effective medium for creating immersive experiences that help reduce stress and anxiety.

Gameplay often involves the simulation of stressful situations, such as solving complex tasks within a limited time frame, which can enhance players' stress responses and their ability to function effectively under pressure (Cheng & Kramer, 2014; Adachi et al., 2016).

In addition, video games have been found to increase users' social activity. This social engagement may involve interactions with characters controlled by other real players or with non-playable characters (NPCs), which are programmed virtual agents

within the game. Laboratory studies have shown that prosocial video games can reduce aggressive thoughts, emotions, and behaviors, while also promoting prosocial thinking, empathy, and a willingness to help others (Burke & Kraut, 2001; Adachi et al., 2015; Adachi et al., 2016; von der Heiden et al., 2019). Several studies have confirmed that the long-term effects of such games include increased cooperation, knowledge sharing, empathy, and helpfulness among adolescents, as well as enhanced prosocial behavior in children (Brezinka, 2008).

Despite the positive influences of video games on users, a substantial body of research addresses the potential risks and negative consequences associated with excessive video game use, which requires a more detailed consideration of the most significant issues.

Negative effects of video games

The growing popularity of video games across various age groups has drawn the attention of researchers to their potential impact on players' psychological well-being. Studies on prolonged engagement with video games have revealed that gaming addiction may be associated with increased levels of depression and anxiety, particularly among adolescents and young adults. It has also been noted that games containing violent and aggressive content may exacerbate these psychological issues (Anderson & Bushman, 2001).

A study conducted in Pakistan investigated the causes of increased aggression and cognitive impairments among university students who play video games. The research involved surveys of 200 gamers and 198 non-gamers from the Islamia University of Bahawalpur. The findings indicated that gamers exhibited significantly higher levels of aggression and cognitive impairments compared to their non-gaming peers (Karim & Chaudhri, 2012).

Research into the behavioral characteristics of adolescents who are enthusiastic about video games revealed instances of physical and verbal aggression, irritability, and a higher incidence of various forms of deviant behavior. These included smoking, rudeness, violations of school rules, and other disruptive behaviors. Notably, full-blown gaming addiction was not found among most adolescents. However, many of them demonstrated elevated levels of aggression and anxiety. Furthermore, adolescents engaged in gaming showed reduced ability to manage emotional states in stressful social situations (Wan et al., 2007; Pantling, 2020).

Social isolation is also a significant psychological consequence of excessive engagement with video games.

Research has shown that prolonged gaming sessions may lead to detachment from the real world and a reduction in social activity. This can negatively impact the development of healthy interpersonal relationships and hinder social adaptation (Wan & Chiou, 2006). A meta-analysis conducted in 2001 revealed that playing violent video

games is not only associated with aggressive behavior and affect but also induces heightened physiological arousal in players (Rosendo-Rios et al., 2022).

In a study by Schmitt and Livingston (2015), the correlation between video game addiction and various aspects of college engagement and academic success was examined among first-year students at a liberal arts college. The results indicated that higher levels of video game addiction were associated with lower expectations regarding academic involvement and lower academic performance, as evidenced by reduced first-year GPA. Surprisingly, higher levels of gaming addiction correlated with fewer reported incidents of drug and alcohol violations on campus.

Based on the analysis of existing literature, it can be assumed that video games may serve as an important risk factor in the development of addictive behaviors among youth, especially under conditions of social isolation and elevated anxiety levels. The main challenge lies in the insufficient understanding of which specific aspects of gaming behaviors, such as game genres or players' personality traits, contribute to the emergence of gaming addiction.

Study materials and methods

Study hypotheses

H_1 Engagement in video games is higher among males than females, as reflected in gaming frequency and the amount of time spent playing.

H_2 More frequent gaming activity is associated with a more positive attitude toward video games and a lower perception of their potential harm.

H_3 Active gamers are more likely to spend money on in-game purchases than those who play less frequently or have never played.

H_4 Religious individuals are less engaged in video gaming.

H_5 There are statistically significant differences in the perception of video game harm between groups with different levels of gaming engagement.

Study participants

The study sample consisted of 105 individuals residing in Kazakhstan, aged between 18 and 35 years, ensuring demographic diversity among young adults. The sample included 44 males and 61 females, with a mean age of 22 years. Participants were recruited from various sources, including university networks, workplaces, and social media platforms, which contributed to the representativeness of different social strata. The sample comprised working individuals, students, as well as those who both study and work. Participants' professional backgrounds included fields such as IT, physical education and sports, marketing, management, social sciences, accounting, auditing, and others (see Table 1).

Table 1

Demographic Characteristics of Study Participants

Variable	*Number*	*Percentage, %*
Gender		
Male	44	42
Female	51	58
Social Status		
Students	78	74
Employed	24	23
Both studying and working	3	3
Field of Specialization		
Education	22	21
Natural Sciences	6	6
Social Sciences	47	45
Engineering	15	14
Finance and Economics	20	19

Note: compiled by the authors.

Ethical standards

The study was conducted in accordance with ethical standards. Prior to participation, each respondent was provided with an informed consent form outlining the purpose of the study, the voluntary nature of participation, and assurances of confidentiality. Participants were required to agree to the terms of participation presented at the beginning of the survey in order to proceed with answering the questions.

Data collection

Data collection was carried out using a structured online survey specifically developed for this study. Participants completed a questionnaire that included items addressing various aspects of their demographic characteristics, video gaming habits, and forms of addictive behavior. Data was collected over a two-month period through multiple distribution channels, including universities, social media platforms, and email.

Participants completed the questionnaire at their convenience. The survey consisted of closed-ended questions with predefined response options, as well as several open-ended questions that allowed respondents to express their opinions about video games. The average completion time for the survey was approximately 15 minutes.

Instruments and Measures

The survey instrument included five sections:

1. Demographic information: gender, age, social status (student, employed, unemployed, other), and field of study.

2. Video game engagement and experience: whether participants had ever played video games, devices used for gaming (computer, console, mobile device), gaming frequency over the past year (daily, several times a week, several times a month), average daily gaming time, preferred genres, and participation in online games.

3. Financial aspects: questions about spending on video games, including in-game purchases and the amounts spent.

4. Assessment of addictive behaviors: engagement in video games, smoking, alcohol consumption, social media usage, and emotional eating measured on a scale from 1 to 10.

5. Religiosity.

Data analysis

The statistical software SPSS version 26.0 was used to analyze the collected data.

Results and discussion

Descriptive statistics

The descriptive statistics are based on a sample of 105 participants and include variables such as the mean, standard deviation, median, minimum, maximum, kurtosis, and skewness. The descriptive statistics for the survey items are presented in Table 2.

Table 2

Descriptive statistics of survey items (n = 105)

Survey Item	*M*	*Std.Dev.*	*Медиана*	*Min*	*Max*	*Kurtosis*	*Skewness*
Have you ever played video games?	2.28	0.66	2.00	1.00	3.00	0.23	-0.73
What devices do you use to play video games?	2.78	2.05	2.00	1.00	8.00	0.24	0.64
How often have you played video games in the past year?	2.00	1.16	2.00	1.00	4.00	0.24	-1.09
How much time do you usually spend on video games?	1.47	0.56	1.00	1.00	3.00	0.24	-0.65
What types of games do you play?	7.34	6.38	6.00	1.00	27.00	0.24	2.11
Do you play online video games?	1.42	0.50	1.00	1.00	2.00	0.24	-1.93
Have you ever spent money on video games or in-game purchases?	1.29	0.45	1.00	1.00	2.00	0.24	-1.10
What is the maximum amount you have spent at one time on in-game purchases?	1.59	0.93	1.00	1.00	5.00	0.24	1.60
What is your attitude toward video games?	3.44	0.85	3.00	1.00	5.00	0.24	-0.10
Do you believe video games can be harmful?	1.29	0.45	1.00	1.00	2.00	0.24	-1.10
Rate your engagement in video games on a scale from 1 to 10.	3.02	3.05	1.00	1.00	10.00	0.24	0.05

Rate the frequency of your smoking (cigarettes, vapes, etc.) on a scale from 1 to 10	4.14	2.84	4.00	1.00	10.00	0.24	-1.10
Rate the frequency of your alcohol consumption on a scale from 1 to 10	2.30	1.74	2.00	1.00	10.00	0.24	2.82
Rate how often you use social media on a scale from 1 to 10	6.97	2.67	7.00	1.00	10.00	0.24	-0.60
Rate how often you eat in response to stress on a scale from 1 to 10	4.71	2.62	5.00	1.00	10.00	0.24	-1.04
Rate your level of religiosity on a scale from 1 to 10	3.90	2.65	3.00	1.00	10.00	0.24	-0.77

Note: M – Mean; Std. Dev. – Standard Deviation

* compiled by the authors.

The results of the Shapiro–Wilk test indicated that the data did not follow a normal distribution. This conclusion is supported by the skewness and kurtosis values presented in the initial descriptive statistics table. Consequently, the use of non-parametric methods of analysis, such as the Mann–Whitney U test and the Kruskal–Wallis test, was considered appropriate.

The descriptive statistics allow for several observations. Specifically, the mean, median, skewness, and kurtosis suggest that most respondents have prior gaming experience; play video games with moderate frequency (less than daily); typically spend 1–2 hours on gaming, though the majority play less; there is considerable variation in genre preferences; offline games are favored; spending on video games is minimal; few respondents are willing to spend significant amounts on in-game purchases; overall attitudes toward video games are positive; respondents generally do not consider video games to be harmful; they demonstrate moderate engagement; high levels of smoking and low levels of alcohol use are recorded; social media usage is notably frequent; many respondents report emotional eating in stressful situations; and the average level of religiosity is moderate, although there is a presence of more religious individuals.

Mann–Whitney U test

The Mann–Whitney U test was used to compare two independent groups — males and females. The results of the pairwise comparison are presented in Table 3.

Table 3

Significant results of survey item comparisons using the Mann–Whitney U test

Survey Item	Rank Sum (Females, n = 61)	Rank Sum (Males, n = 44)	U-value	Z-score	p-value	U
How often have you played in the past year?	2867	2698	976	-2.37	0.017	0.017
Do you play online video games?	2784	2782	893	-2.91	0.003	0.003
What is your attitude toward video games?	2925	2640	1034	-1.99	0.045	0.045
Rate your engagement in video games on a scale from 1 to 10	2916	2650	1024.5	-2.05	0.039	0.039
Rate the frequency of your social media use on a scale from 1 to 10	3639	1927	936.5	2.63	0.008	0.008
Rate how often you eat in response to stress on a scale from 1 to 10	3667	1899	908.5	2.81	0.004	0.005

The results of the Mann–Whitney U test revealed significant gender differences in several areas related to video gaming behavior, social media use, and stress responses.

Statistical analysis indicates that males play video games significantly more frequently over the course of a year ($p = 0.017$). Additionally, the frequency of participation in online games is significantly higher among males ($p = 0.003$). These findings suggest a greater tendency among men to engage in online formats that require interaction with other players. Males also demonstrate higher levels of engagement in video games ($p = 0.039$) and exhibit a more positive attitude toward video games ($p = 0.045$).

In contrast, when it comes to social media use and stress-related behaviors, the results were reversed. Females report significantly higher levels of social media use compared to males ($p = 0.008$), reflecting gender-based differences in leisure preferences and modes of virtual interaction. Moreover, females are more likely to engage in emotional eating under stress than males ($p = 0.004$), indicating different coping mechanisms between genders.

Correlation analysis

Correlation analysis was conducted using Pearson's correlation coefficient, which measures the degree of linear relationship between pairs of variables (Appendix A).

Negative correlations were observed between gender and the frequency of social media use ($r = -0.234$, $p = 0.016$), participation in online gaming ($r = -0.334$, $p = 0.000$), attitude toward video games ($r = -0.198$, $p = 0.043$), and video game engagement ($r = -0.196$, $p = 0.045$). In contrast, positive correlations were found between gender and both social media use ($r = 0.274$, $p = 0.005$) and eating in response to stress ($r = 0.269$, $p = 0.005$). These associations reinforce earlier findings on gender-based differences in modes of virtual interaction.

A strong positive correlation between social status and age ($r = 0.582$, $p = 0.000$) suggests that social status tends to increase with age, likely due to career progression. A positive correlation between social status and access to gaming devices ($r = 0.379$, $p = 0.000$) indicates that individuals with higher status may have access to a greater number of devices. Moreover, a correlation between social status and video game preferences ($r = 0.275$, $p = 0.005$) implies that individuals with higher status may prefer more complex or expensive games. On the other hand, social status negatively correlates with the frequency of social media use ($r = -0.204$, $p = 0.036$) and eating in response to stress ($r = -0.310$, $p = 0.001$), which may indicate the use of alternative stress management strategies among higher-status individuals.

Strong correlations were also observed between prior gaming experience and current gaming activity. For example, the frequency of gaming over the past year ($r = 0.752$, $p = 0.000$) and time spent on gaming ($r = 0.549$, $p = 0.000$) show that those who have previously played continue to do so actively. Additionally, a positive correlation was found between time spent gaming and genre preferences ($r = 0.263$, $p = 0.007$), as well as with online gaming ($r = 0.511$, $p = 0.000$). Spending on in-game purchases is also correlated with previous gaming experience ($r = 0.398$, $p = 0.000$), and the amount of money spent shows a correlation with video game engagement ($r = 0.338$, $p = 0.000$).

A positive correlation was found between attitude toward video games and time spent playing ($r = 0.508$, $p = 0.000$), as well as between time spent gaming and willingness to spend money on in-game purchases ($r = 0.504$, $p = 0.000$). These findings suggest that the more time individuals spend playing games, the more engaged they become and the more willing they are to invest financially in the activity. At the same time, perception of harm from video games ($r = 0.302$, $p = 0.002$) indicates that those who are more active gamers are also aware of the potential negative consequences, even though their overall attitude toward games remains positive.

The correlation between smoking and alcohol consumption ($r = 0.376$, $p < 0.001$) reflects a predisposition to these behaviors, which may be influenced by both social and individual factors.

A positive correlation between stress-related overeating and social media use ($r = 0.394$, $p < 0.001$) may be interpreted as a coping strategy mechanism, whereby social media is used for distraction from stress, potentially contributing to emotional eating.

Negative correlations were observed between religiosity and video game engagement ($r = -0.203$, $p < 0.05$), frequency of gaming over the past year ($r = -0.200$, $p < 0.05$), spending on video games ($r = -0.328$, $p < 0.001$), and attitude toward video games ($r = -0.227$, $p < 0.05$). These correlations highlight the importance of considering religious beliefs and values when studying gaming behavior.

Kruskal–Wallis H Test

The results of the Kruskal–Wallis H test revealed significant differences between the respondent groups. The analysis was based on the distribution of ranks across three groups: individuals who have never played video games (Group 1), those who have played in the past (Group 2), and active players (Group 3) (Table 4).

Table 4

Comparison of the three groups using the Kruskal–Wallis H Test (n = 105)

Variable	*Group (1-3)*	*Sum of Ranks*	*Mean Rank*
Frequency of gaming over the past year	Group 1	926.0	26.5
	Group 2	1255.5	35.87
	Group 3	2850.5	81.37
Time spent playing video games	Group 1	1050.0	30.0
	Group 2	1501.5	42.9
	Group 3	2823.5	71.83
Type of games	Group 1	898.0	25.63
	Group 2	1262.5	49.29
	Group 3	2284.5	65.32
Experience with online games	Group 1	1085.5	31.0
	Group 2	1528.5	45.41
	Group 3	2621.5	68.5
Spending on video games and in-game purchases	Group 1	940.0	38.0
	Group 2	1322.5	47.26
	Group 3	2248.5	64.25
Attitude toward video games	Group 1	850.5	31.92
	Group 2	1468.5	42.73
	Group 3	2515.0	71.5
Perceived harm of video games	Group 1	926.5	38.0
	Group 2	1385.5	50.35
	Group 3	2158.5	60.5
Self-reported gaming engagement (scale 1–10)	Group 1	1103.5	23.54
	Group 2	1327.5	42.51
	Group 3	2515.0	74.15

Note: *$p < 0.05$

*compiled by the authors

According to the results presented in the table, active players differ significantly from those who have played in the past or never played, across a number of variables related to gaming frequency, time spent on video games, attitudes toward gaming, and willingness to spend money on in-game purchases. These differences are particularly pronounced in self-reported gaming engagement and the perception of video games as a less harmful activity among active players.

Discussion

The aim of the present study was to examine attitudes toward and engagement with video games among Kazakhstani youth, as well as to identify relationships and differences between gaming habits, demographic characteristics, forms of addictive behavior, and other behavioral aspects.

According to the results obtained, males were more engaged in video gaming, including gaming frequency, preference for online games, and in-game spending. This supports Hypothesis H1 and aligns with the findings of previous studies (Adžić et al., 2023; López Fernández et al., 2020). In contrast, females were found to use social media more frequently (Ye et al., 2023; Irawati et al., 2024) and were more likely to engage in stress-related eating behaviors (Fu, 2024; Degroote et al., 2023).

Correlation analysis revealed positive associations between gaming activity, a more favorable attitude toward video games, and reduced perceptions of their harm. This indicates that active players may consider video games as a meaningful aspect of life, a source of entertainment, and a means of self-fulfillment. These findings support Hypothesis H2.

The observed relationship between gaming engagement and willingness to make in-game purchases confirmed Hypothesis H3, suggesting that active players are more inclined to spend money on such purchases. This may reflect their perception of in-game spending as a way to enhance gameplay or achieve specific goals within games.

A negative correlation between religiosity and gaming engagement confirmed Hypothesis H4 (Braun et al., 2016; Buja et al., 2024; Burris & Dow, 2015; Ghaffari et al., 2024). It is possible that religious beliefs and values promote more limited participation in entertainment-oriented leisure activities such as video gaming.

A significant association between smoking and alcohol use was identified (Green et al., 2022; Tsygankova et al., 2022; Wycoff et al., 2022). Interestingly, this behavioral synergy did not show significant correlations with video game engagement, suggesting that these forms of addictive behavior may operate independently of gaming experience and virtual engagement. This finding highlights the need for further investigation into this dimension.

A positive correlation between stress-induced overeating and social media use underscores the importance of examining the relationship between digital habits and stress management strategies, as well as their potential impact on physical and mental health.

Finally, differences in harm perception across groups with varying levels of gaming engagement confirmed Hypothesis H5. Individuals with lower engagement tended to be more critical of the potential harm of video games, possibly due to lower personal interest or limited gaming experience.

Limitations and directions for future research

The present study has several limitations that require further investigation. Since the research was conducted exclusively in Kazakhstan, the generalizability of the findings is limited. Therefore, future studies should include international samples to enable cross-cultural comparisons of attitudes toward video games and behavioral habits. The relatively small sample size may also reduce the overall representativeness of the results. Expanding the sample would help to better capture the characteristics of different social groups.

An interesting direction for future research could involve examining the relationship between gaming behavior and professional activity, educational level, and family dynamics. It would also be valuable to investigate the influence of cultural norms and values on gaming behavior in order to identify both universal patterns and culture-specific traits. Moreover, it is essential to explore effective behavioral management strategies and develop evidence-based recommendations for the prevention of gaming addiction among young people.

Conclusion

Despite existing limitations and the need for further research, the findings of this study contribute to a better understanding of the nature of video game engagement among Kazakhstani youth. The study expands the existing body of knowledge by highlighting the importance of considering demographic, cultural, and individual factors when analyzing gaming behavior. The results may be valuable for the development of preventive measures and strategies aimed at promoting healthy habits and minimizing the risks associated with gaming and other forms of addictive behavior.

References

Aarseth, E. (2003). Playing research: Methodological approaches to game analysis. *In DiGRA 2003 Level Up Conference. Utrecht: University of Utrecht.*

Adachi, P. J., Hodson, G., Willoughby, T., & Zanette, S. (2015). Brothers and sisters in arms: Intergroup cooperation in a violent shooter game can reduce intergroup bias. *Psychology of Violence, 5,* 455–462. https://doi.org/10.1037/a0037407

Adachi, P. J., Hodson, G., Willoughby, T., Blank, C., & Ha, A. (2016). From outgroups to allied forces: Effect of intergroup cooperation in violent and nonviolent video games on boosting favorable outgroup attitudes. *Journal of Experimental Psychology: General, 145,* 259–265. https://doi.org/10.1037/xge0000145

Adžić, Slobodan & Savic-Tot, Tijana & Savić, Verica & P, Marija & Tot, Vilmos. (2023). *Student Achievement in Relation to Time Spent Studying and Playing Video Games: A Gender Perspective. 12.* 832-839. 10.18421/TEM122-28.

Anderson, C. A., & Bushman, B. J. (2001). Effects of violent video games on aggressive behavior, aggressive cognition, aggressive affect, physiological arousal, and prosocial behavior: A meta-analytic review of the scientific literature. *Psychological Science, 12,* 353-359.

Beaumont, R., Walker, H., Weiss, J., & Sofronoff, K. (2021). Randomized controlled trial of a video gaming-based social skills program for children on the autism spectrum. *Journal of Autism and Developmental Disorders, 51(10),* 3637–3650. https://doi.org/10.1007/s10803-020-04801-z

Braun, B., Kornhuber, J., Lenz, B. et al. Gaming and Religion: The Impact of Spirituality and Denomination. *J Relig Health* ***55***, 1464–1471 (2016). https://doi.org/10.1007/s10943-015-0152-0

Brezinka, V. (2008). Treasure hunt - a serious game to support psychotherapeutic treatment of children. *Studies in Health Technology and Informatics, 136, 71.* https://doi.org/10.1007/978-3-540-76805-0_30

Buja, Alessandra & Montecchio, Laura & Dossi, Francesca. (2024). Association Between Religiosity and Spirituality and Cocaine Use: A Systematic Review. *Journal of Religion and Health. 63.* 3532-3579. 10.1007/s10943-024-02069-6.

Burke, M., & Kraut, R. (2013). Using Facebook after losing a job: Differential benefits of strong and weak ties. *Proceedings of the 2013 Conference on Computer Supported Cooperative Work,* 1419–1430. https://doi.org/10.1145/2441776.2441936

Burris, C. T., & Dow, T. (2015). Lost in the Myst?: Narrative video gaming decreases self-reported propensity for spiritual/religious experience. *International Journal for the Psychology of Religion, 25(1),* 18–28. https://doi.org/10.1080/10508619.2014.884393

Carter, J. A., et al. (2018). The Impact of Virtual Reality on Chronic Pain. *PLoS ONE, 13(9), e0200987.*

Cheng, M., & Kramer, K. (2014). Gaming Well: Links Between Videogames and Flourishing Mental Health. *Frontiers in Psychology, 5,* 260.

Degroote, Cathy & Renner, Britta & Wickl, Julia & Leven, Anika & Wirtz, Petra. (2023). Eating After Acute Psychosocial Stress in Healthy Men and Women: Gender Differences and Endocrine Mechanisms. *The Journal of Clinical Endocrinology & Metabolism. Volume 109, Issue 2, February 2024,* Pages e543–e551, https://doi.org/10.1210/clinem/dgad578

Erevik, E. K., Landrø, H., Mattson, Å. L., Kristensen, J. H., Kaur, P., & Pallesen, S. (2022). Problem gaming and suicidality: A systematic literature review. *Addictive behaviors reports, 15, 100419.*

Fu, Jingxuan. (2024). The Role of Stress and Relevant Social Factors in Food Addiction. *Communications in Humanities Research. 46.* None-None. 10.54254/2753-7064/46/20242332.

Ghaffari, A. S., Iqbal, K., Bibi, S., Khalid, A., & Nadeem, B. (2024). Cognitive Failure as a Consequence of Video Games, Developing Risk of Disruptive Behaviors among Students. Al-Qanṭara. *Retrieved from* https://alqantarajournal.com/index.php/Journal/article/view/463

Green, ReJoyce & Montoya, Amanda & Ray, Lara. (2022). The Relationship Between Drinking and Smoking in a Clinical Trial for Smoking Cessation and Drinking Reduction. *Experimental and Clinical Psychopharmacology. Vol 30(6), Dec 2022,* 873-883 10.1037/pha0000536.

Holden, C. (2010). Psychiatry. Behavioral addictions debut in proposed DSM-V. *Science (New York, NY), 327(5968),* 935. https://doi.org/10.1126/science.327.5968.935

World Health Organization. (2019). *ICD-11 for mortality and morbidity statistics. Retrieved on 18 September 2021 from* https://icd.who.int/browse 11/l-m/en

Horn, E., Jones, H. A., & Hamlett, C. (1991). An investigation of the feasibility of a video game system for developing scanning and selection skills. *Journal of the Association for Persons with Severe Handicaps, 16(2),* 108–115. https://doi.org/10.1177/154079699101600205

Iacovides, I., & Mekler, E. D. (2019). The role of gaming during difficult life experiences. *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems,* 1–12. https://doi.org/10.1145/3290605.3300453

Irawati, Irawati & Hasgimianti, Hasgimianti & Raja, Rahima & Fitra, Herlinda. (2024). Women on social media: A representation of self-actualization and social embarrassment. *Gender Equality: International Journal of Child and Gender Studies.* 10. 41. 10.22373/equality.v10i1.20720.

Karim, R., & Chaudhri, P. (2012). Behavioral addictions: An overview. *Journal of Psychoactive Drugs, 44(1),* 5–17. https://doi.org/10.1080/02791072.2012.662859

López Fernández, Francisco & Mezquita, Laura & Griffiths, Mark & Ortet-Fabregat, Generós & Ibáñez, Manuel. (2020). El papel de la personalidad en el juego

problemático y en las preferencias de géneros de videojuegos en adolescentes. *Adicciones.* 10.20882/adicciones.1370.

Massimi, M., Dimond, J. P., & Le Dantec, C. A. (2012). Finding a new normal: The role of technology in life disruptions. *Proceedings of the ACM 2012 Conference on Computer Supported Cooperative Work*, 719–728. https://doi.org/10.1145/2145204.2145314

McGonigal, J. (2011). Reality Is Broken: Why Games Make Us Better and How They Can Change the World. *Penguin Books.*

Pantling, A. (2020). Gaming usage up 75 percent amid coronavirus outbreak. Verizon Report. *Retrieved on 28 September 2021 from* https://www.hollywoodreporter.com/news/gaming-usage-up-75-percent-coronavirus-outbreak-verizon-reports-1285140

Rosendo-Rios, V., Trott, S., & Shukla, P. (2022). Systematic literature review online gaming addiction among children and young adults: A framework and research agenda. *Addictive Behaviors*, 129, 107238.

Schmitt, Z. L., & Livingston, M. G. (2015). Video game addiction and college performance among males: Results from a one-year longitudinal study. *Cyberpsychology, Behavior, and Social Networking, 18(1),* 25-29. https://doi.org/10.1089/cyber.2014.0403

Sun, D. L., Ma, N., Bao, M., Chen, X. C., & Zhang, D. R. (2008). Computer games: A double-edged sword? *Cyberpsychology & Behavior*, *11(5),* 545–548.

Susi, T., Johannesson, M., & Backlund, P. (2007). Serious Games: An overview. *Available online at:* https://www.diva-portal.org/smash/get/diva2:2416/FULLTEXT01.pdf (Accessed May 22, 2023)

Tanaka, J. W., Wolf, J. M., Klaiman, C., Koenig, K., Cockburn, J., Herlihy, L., et al. (2010). Using computerized games to teach face recognition skills to children with autism spectrum disorder: The let's face it! program. *Journal of Child Psychology and Psychiatry*, *51(8)*, 944–952. https://doi.org/10.1111/j.1469-7610.2010.02258

Tsygankova, Daria & Bazdyrev, Evgeny & Nakhratova, O.V. & Agienko, A.S. & Indukaeva, E. & Artamonova, G.V. & Barbarash, O.L.. (2022). Combined consumption of alcohol and tobacco and their relationship with risk factors for cardiovascular diseases. *Social Aspects of Population Health. 68. 15*. 10.21045/2071-5021-2022-68-1-15.

von der Heiden, J. M., Braun, B., Müller, K. W., & Egloff, B. (2019). The association between video gaming and psychological functioning. *Frontiers in Psychology, 10, 1731*.
https://doi.org/10.3389/fpsyg.2019.01731

Wan Rozali, W. A., Hamid, X. H. A., & Sabri, M. I. M. (2007). Video games: Issues and problems. *Proceedings of the 5th International Conference on Information and Communications Technology*, 217-222.

Wan, C. S., & Chiou, W. B. (2006). Why are adolescents addicted to online gaming? An interview study in Taiwan. *Cyberpsychology & Behavior, 9(6),* 762–766.

Wolinsky, F. D., Vander Weg, M. W., Howren, M. B., Jones, M. P., & Dotson, M. M. (2013). A randomized controlled trial of cognitive training using a visual speed of processing intervention in middle aged and older adults. *PloS ONE, 8(5),* 1-11.

World Health Organization. (2019). ICD-11 for mortality and morbidity statistics. *Retrieved on 18 September 2021 from* https://icd.who.int/browse 11/l-m/en

Wycoff, A. M., Motschman, C. A., Griffin, S. A., Helle, A. C., Piasecki, T. M., & Trull, T. J. (2022). Simultaneous use of alcohol and cigarettes in a mixed psychiatric sample: Daily-life associations with smoking motives, craving, stimulation, sedation, and affect. *Psychology of Addictive Behaviors, 36(8),* 942–954. https://doi.org/10.1037/adb0000790

Ye, L., Chen, Y., Cai, Y., Kao, Y. W., Wang, Y., Chen, M., … Qin, L. (2023). Gender Differences in the Nonspecific and Health-Specific Use of Social Media Before and During the COVID-19 Pandemic: Trend Analysis Using HINTS 2017-2020 Data. *Journal of Health Communication, 28(4),* 231–240. https://doi.org/10.1080/10810730.2023.2193151

Turkaev, A. (2022, Noyabr' 17). Istorii | *Gazeta Kursiv №45. Kuda dvizhetsya industriya videoigr v Kazahstane. Gazeta Kursiv. (In Russian).*

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Appendix A

*Results of the correlation analysis (*p < 0.05, **p < 0.01, ***p < 0.001)*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Gender	1.0																			
2. Age		1.0																		
3. Social status		.582***	1.0																	
4. Specialization		.263**		1.0																
5. Have you ever played video games?					1.0															
6. На каких устройствах Вы играете в видеоигры?			.379***			1.0														
7. How often have you played video games in the past year?	-.234**				.752***		1.0													
8. How much time do you usually spend on video games?					.549***		.477***	1.0												
9. What types of games do you play?			.275**		.263**	.421***	.193*		1.0											
10. Do you play online video games?	-.334***				.511***		.501***	.504***		1.0										
11. Have you ever spent money on video games or in-game purchases?					.398***		.456***	.419***	.198*	.317***	1.0									
12. What is the maximum amount you have spent at one time on in-game purchases?					.338***		.366***	.326***		.218*	.675***	1.0								
13. What is your attitude toward video games?	-.198*				.508***		.504***	.395***	.244*	.357***	.368***	.367***	1.0							
14. Do you believe video games can be harmful?					.302***		.200*	.343***	.214*				.343***	1.0						

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Using ThingsBoard as a tool in teaching IoT to Computer Science students

Abstract

Internet of Things (IoT) is expanding extremely fast in various areas, in particular in education sector. Computer science education nowadays requires practical learning environments. However, limited access to physical hardware can impede students from understanding and applying IoT concepts effectively. This study explores the use of ThingsBoard, an open-source IoT platform, as a virtual tool for teaching IoT to undergraduate computer science students. Students participated in a series of guided activities that involved simulating sensor data using Python, transmitting telemetry to ThingsBoard via HTTP, and visualizing the data through interactive dashboards. Pre- and post-tests were administered to assess students' theoretical understanding and practical skills. Results indicated a significant improvement in students' ability to understand IoT architecture, data flow, and cloud integration. Student feedback also highlighted the platform's advantages, engagement, and effectiveness in realization of real-world IoT scenarios. The study concludes that ThingsBoard provides a scalable and accessible solution for improving IoT education and recommends its integration into computer science curricula.

Keywords: IoT, ThingsBoard, platform, IoT scenarios, Computer Science.

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Introduction

The Internet of Things (IoT) is a network that allow devices interact, communicate, and generate data in real-time. The demand for IoT solutions continues to grow among various industries, accordingly computer science students must obtain not only theoretical knowledge but also practical competencies to develop and manage IoT systems. In order to reach effective IoT education, access to physical sensors, microcontrollers, and communication networks is required, while the resources may be limited in many educational institutions.

Traditional IoT lab setups require significant investment such as microcontrollers, sensors, actuators, and networked environments causing difficulties for many institutions to provide stable practical experience to all students (Domínguez-Bolaño et al., 2024). This leads to a remarkable gap between what is taught and what is expected in the job market, where experimental knowledge and system integration skills are highly valued.

In order to bridge this gap, virtual platforms and cloud-based simulation tools have become known as valuable addition or alternatives to hardware-based labs (Viswanadh et al., 2024). One such tool is ThingsBoard, an open-source IoT platform that allows users to simulate data flow, process telemetry, and create real-time dashboards without the need for physical devices. It provides teachers with the comfort to build interactive assignments and projects that reflect real-world IoT use examples.

There are numerous studies related to the integration of platforms in education (Arduino, Raspberry Pi, and cloud services). However, many of these platforms require extensive setup or continuous service. They may also cause barriers for beginners due to programming complexity or infrastructure limitations, which can interfere initial engagement. Furthermore, commercial solutions often include hidden costs or have limited educational licenses, reducing their sustainability in long-term curriculum planning. ThingsBoard, instead, offers a web-based environment with built-in telemetry simulation, rule engines, device provisioning, and customizable visual interfaces, making it especially suitable for classroom use (Bestari & Wibowo, 2023).

In addition, ThingsBoard supports RESTful APIs, device dashboards, asset management, and multi-user features. ThingsBoard is compatible with languages like Python, Node.js, and Java, which means it can be integrated with existing university curricula without extra teacher training.

The platform supports integration with public cloud storage, offering institutions the flexibility to configure security, access control, and data privacy based on local regulations. Instructors can pre-configure virtual devices, feed simulated data from CSVs or real-time scripts, and guide students through a structured learning path that includes basic telemetry uploads, dashboard design, rule chain development, and alert creation (Bestari & Wibowo, 2023).

This study aims to evaluate the effectiveness of ThingsBoard as a teaching tool for IoT concepts in a computer science program. It assesses how students collaborate with the

platform through simulated sensor data, cloud communication, and data visualization tasks. The research measures changes in students' knowledge and skills before and after implementation and collects qualitative feedback on their learning experience. With the assessed results of both educational outcomes and student approaches the study contributes to the current consideration on scalable, accessible IoT education for future software and systems engineers.

Literature Review

The integration of the Internet of Things (IoT) into computer science education has become increasingly important. Platforms that offer practical and cost-effective solutions are extremely necessary. To face the challenges related to expenses for physical devices like sensors, microcontrollers, educators have headed to software platforms and simulation environments that copy IoT functionalities without the need for complicated physical setups.

ThingsBoard is an open-source platform that is popular among users for its appropriateness in educational settings. It supports different IoT protocols such as MQTT and HTTP and offers opportunities like real-time data demonstration, management of various devices, and personalized dashboards. These prospects make it a satisfying tool for teaching IoT in Computer Science classes.

In a study of Sabuncu and Thornton (2022), ThingsBoard was used to provide access to remote experimentation in Mechanical Engineering education. The platform allowed students to remotely control and monitor a dehydrating cooling system. They demonstrated effectiveness of ThingsBoard in providing practical experience in a virtual environment. The experiment was held among 5 students, as a result all students were able to change the speed of the fan, calculate an efficiency value for each fan speed, some students had insignificant inconsistency due to the use of inaccurate values for the wet-bulb temperature in the efficiency equation.

Another study by Dizdarevic and Jukan (2021) demonstrated a design of an undergraduate laboratory course focusing on IoT-edge-cloud system architecture. The course teaches students about various communication protocols and system integration using open-source tools, including ThingsBoard. highlighting the platform's flexibility in educational contexts. Network-ofThings Engineering Lab (NoteLab) laboratory course combines various interfaces and communication protocols to connect IoT, edge and cloud computing systems and evaluate their performance with low-cost equipment and software.

These studies collectively suggest that ThingsBoard serves as an effective educational tool, facilitating the teaching of IoT concepts through practical, interactive, and scalable means. Its open-source nature and support for various protocols make it adaptable to different educational needs, thereby bridging the gap between theoretical knowledge and real-world application in computer science education.

In addition to ThingsBoard, several other virtual platforms have emerged as effective tools in IoT education. VIPLE (Visual IoT/Robotics Programming Language Environment), for example, offers an integrated business process composition with IoT

and robotics applications which provides an effective tool for teaching computer science concepts (De Luca et al., 2018). Cisco Packet Tracer is also often used in simulating IoT networks and their behaviors, supporting students in understanding networking concepts and IoT device interactions in a controlled, virtual environment (Abdul Rashid et al., 2019).

Moreover, the integration of cloud-based IoT simulation environments enhances scalability and remote accessibility, which are essential in modern education settings. Platforms like Microsoft Azure IoT Central and AWS IoT provide cloud infrastructures allowing students to deploy, monitor, and analyze IoT devices and data streams in real time (Domínguez-Bolaño et al., 2024). These environments also support various IoT protocols, offering a comprehensive ecosystem for practical learning.

Recent research emphasizes the pedagogical benefits of combining virtual labs with physical hardware experiments. Iqbal (2020) suggest hybrid models where virtual tools such as ThingsBoard are supplemented with low-cost IoT devices, creating a blended learning approach that improves student engagement and deepens understanding of complex IoT systems. Such approaches accommodate diverse learning preferences and bridge the gap between theoretical and hands-on experiences.

Finally, gamification has been identified as a promising technique to increase motivation and retention in IoT education. Integrating gamification that uncludes IoT technologies strengthen real-time feedback, personalized learning paths, and entire student engagement in education (Kurni & G., 2024). Applying gamification principles in platforms like ThingsBoard may further improve the effectiveness of IoT teaching in computer science curricula.

Methodology

This study used a design-based research methodology to evaluate the effectiveness of a practical, simulation-driven approach for teaching IoT concepts to undergraduate Computer Science students. The methodology combines cloud-based IoT platform (ThingsBoard) with a Telegram bot that simulate real-time device control. This construction allows students to engage with IoT architecture without requiring extra physical hardware.

Participants

The participants included 15 undergraduate Computer Science students at Eurasian National University. Students had prior experience with Python and basic networking concepts but limited interaction with IoT platforms.

Learning Environment

The learning environment was structured as a hybrid setup that includes:

- ThingsBoard Community Edition (hosted on a cloud server)
- Telegram Bot API for command-based device control
- Python-based scripting environment (PyCharm)
- Simulated virtual devices configured within ThingsBoard

Students worked in pairs to increase their collaboration, peer learning, and problem-solving. The total experiment lasted two weeks, including an introductory workshop and individual project development.

Experimental Tasks

Two experimental tasks were designed to contribute the development of main IoT competencies:

1. Virtual Telemetry Visualization

Students were provided virtual devices on ThingsBoard, sending simulated telemetry data (such as temperature and humidity) using Python scripts by the MQTT or HTTP protocol. They configured personal dashboards to visualized data in real-time, learned to use widgets for user interaction.

2. Device Control by Telegram Bot

In the second task, students developed a Telegram bot using Python (python-telegram-bot library) to remotely control virtual devices hosted on ThingsBoard. The bot was configured to receive commands (such as /fan on, /led off) and send corresponding telemetry updates to ThingsBoard. These updates reflected on the ThingsBoard dashboard, demonstrating real-time device state synchronization.

This task helped students understand concepts of device preparation, secure communication using access tokens, RESTful API integration, and real-time control flow.

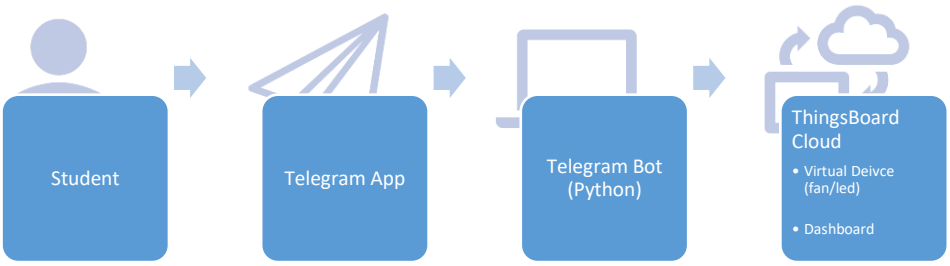
Assessment Techniques

Evaluation was conducted through both formative and summative assessments:

- Project Completion Checklists: Students submitted working Telegram bots, ThingsBoard dashboards, and integration scripts.
- Screen Recordings: Demonstrations of command-based control and dashboard updates were recorded and assessed.
- *Reflection Reports:* Each student submitted a 500-word reflective journal outlining their learning experience and technical challenges. Assessment focused on the following criteria:
  - Successful device provisioning and data visualization
  - Correct and secure integration between Telegram and ThingsBoard
  - Code readability and functionality
  - Understanding of bi-directional communication and IoT protocols

Figure 1

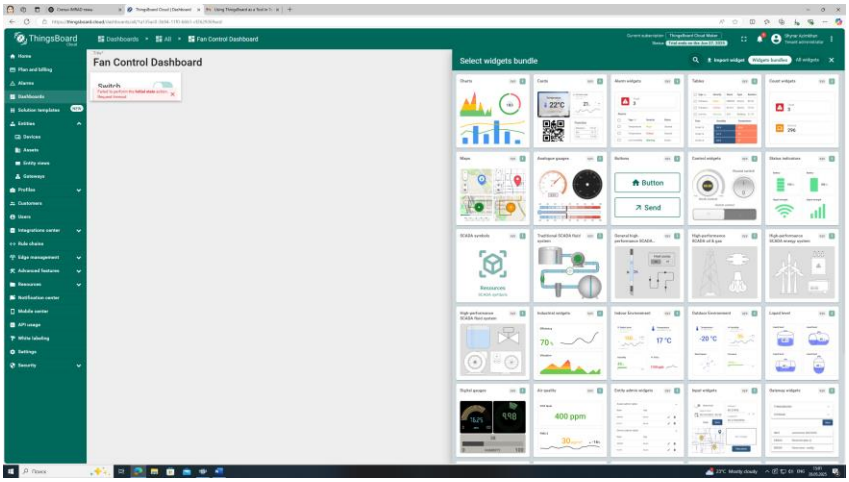
Overall architecture of Telegram-controlled IoT system using ThingsBoard.



Students were given tasks with setting up a system that simulates turning on and off a virtual fan through commands sent from Telegram to ThingsBoard. The exercise was divided into the following stages. Firstly, students created virtual devices on ThingsBoard Cloud and generated an access token. They designed dashboards using control widgets (switch, button) and telemetry charts as it is shown in Figure 2.

Figure 2

ThingsBoard Dashboard creation using dashboards



Students also registered a new bot via the **@BotFather** on Telegram, receiving a unique API token. The bot was configured using Python to handle user commands like `/fan_on`, `/fan_off`, and `/status` using the following code:

```
import requests

def update_device(state):
    url = "https://thingsboard.cloud/api/v1/DEVICE_ACCESS_TOKEN/telemetry"
    data = {"fan_status": state}
    requests.post(url, json=data)
```

Executing the Experiment

Students conducted the experiment by running the Python bot, sending messages via Telegram (/on, /off), observing real-time updates on the ThingsBoard dashboard (Switch widget toggles ON/OFF).This hands-on activity demonstrated bi-directional communication and IoT control flow without physical devices.

Ethical Considerations

Informed consent was obtained from all participants, and no personal data were collected during the experiment. The experiment involved only simulated devices, and no real-world risks were posed.

Results

The main purpose of the experimental phase was to evaluate the practical integration of cloud-based IoT platforms and messaging APIs in a digitally simulated learning environment. The core of this experiment was a Telegram-controlled virtual IoT system using the ThingsBoard cloud platform. The results are discussed under five thematic areas: system performance, student task completion, educational effectiveness, observed challenges, and future scalability.

1. System Performance and Communication Flow

The system demonstrated reliable and real-time bi-directional communication between the Telegram bot and ThingsBoard. Using a Python script, students used bots capable of sending HTTP POST requests to the ThingsBoard REST API. These requests updated a virtual device's telemetry, represented by a Boolean fan_status. Each command—such as /fan_on or /fan_off—triggered a visual change in the ThingsBoard dashboard, where a switch widget or LED indicator reflected the state change.

- Average latency: 0.8–1.2 seconds from Telegram command to dashboard update.
- System uptime during lab sessions: 100%.
- API response reliability: No reported errors due to ThingsBoard API, apart from misconfigured tokens by users.

The seamless interaction demonstrated the practcability of using Telegram as an interface for remote IoT control, offering a light and accessible alternative to more complex client-side solutions.

2. Student Completion and Engagement Metrics

Twenty students participated in the project as part of their coursework in computer networks and embedded systems. The task was broken into five distinct phases, and the completion rates were recorded in table 1:

Table 1

Competion rates for task phases

Task Phase	Completion Rate	Notes
Registration and creation of a ThingsBoard device	100%	All students completed within 10 minutes
Dashboard creation and widget setup	95%	Some confusion on widget data keys
Telegram bot setup using BotFather and Python	90%	Errors due to incorrect tokens or lack of requests installation
Command-based control (via Telegram)	100%	Highly engaging for students
Real-time state synchronization on dashboard	100%	Successfully demonstrated bi-directional communication

This experiment used cloud tools to simulate real-world IoT control systems without physical hardware, making it ideal for remote or resource-limited classrooms.

3. Learning Outcomes and Student Feedback

At the end of the session, students were surveyed to assess their comprehension and satisfaction. The survey given in the table 2 included Likert-scale questions and open comments.

Table 2
Result of the survey to scale the learning objectives

Learning Objective	Strongly Agree (5)	Agree (4)	Neutral or Below (3–1)
Understood IoT device provisioning	65%	30%	5%
Gained practical skills in REST API and HTTP communication	60%	35%	5%
Found the Telegram integration intuitive and useful	75%	20%	5%
Preferred this method to traditional console interfaces	80%	15%	5%
Felt confident to replicate the system independently	55%	40%	5%

Students expressed enthusiasm about the real-life application of messaging apps for device control. One respondent commented: “This lab was my favorite. We’re used to typing things into terminal windows—but this felt like real interaction. I can imagine controlling smart devices at home like this.” Another student wrote: “Now I finally understand what REST API really does. Seeing my command update the dashboard instantly was very satisfying.” These insights affirm that interactive and visible outcomes significantly improve student motivation and comprehension.

4. Technical Challenges and Pedagogical Implications

Despite the overall success, several issues surfaced:

- Telegram bot token confusion: students often confused the bot token (for Telegram) with the ThingsBoard access token. Some commands failed due to incorrect endpoints.

- Python environment configuration: on Windows machines, pip install requests required admin privileges or a virtual environment setup, which not all students were familiar with.

- Data Key misconfiguration: f or the widget to correctly reflect telemetry changes, the key name (fan_status) had to be typed identically—any mismatch (e.g., Fan_status) caused it to fail silently.

These issues were valuable in highlighting the importance of precision in naming conventions and configuration when working with cloud APIs.

Pedagogically, it demonstrated that low-code/no-code platforms such as ThingsBoard are highly suitable for creative learning, allowing learners to explore by doing with minimum hardware dependency.

5. Scalability and Reproducibility

The design of this experimental setup allows easy scaling and replication:

- Cloud-based: no local servers or physical devices needed.
- Low-bandwidth requirement: text commands and telemetry data are minimal.
- Cross-platform: Telegram and ThingsBoard work on any OS.
- Customizable: the fan_status key could easily be extended to multiple devices, environmental sensors, or actuators.

Discussion

The integration of a Telegram bot with the ThingsBoard IoT platform demonstrated an effective, student-centered approach to teaching fundamental concepts in Internet of Things (IoT) education. The experiment bridged the gap between theoretical learning and practical application thanks to the opportunity to enable students to interact with a cloud-based system through a familiar and intuitive interface like Telegram. Rather than simply observing pre-configured devices, students became active participants, sent real-time commands and immediately saw their impact on the system. This real-time feedback loop contributed to a deeper understanding of bi-directional data flow and reinforced the relevance of concepts such as telemetry, HTTP requests, and API interaction.

One of the most valuable aspects of this approach was the use of low-code tools within ThingsBoard. The visual dashboard and widget-based system reduced the technical barriers often encountered when working with IoT systems, allowing students from varied technical backgrounds to engage with the project. For many students, this was their first experience configuring cloud-based telemetry or working with device tokens and JSON formatting. Yet, they were able to create fully functional dashboards and successfully control virtual devices like LEDs or fans. The simplicity of the process encouraged experimentation and exploration, which are key components of effective digital learning.

In addition to technical skills, the project helped foster digital competencies aligned with modern computer science education goals. Students practiced debugging, interpreted telemetry logs, and became familiar with asynchronous communication methods. These experiences are highly important for equipping future educators and IT professionals for Industry 4.0, where skills in cloud platforms, APIs, and intelligent technologies are becoming ever more essential. In addition, the ability to design, prototype, and evaluate IoT applications without requiring physical hardware has made the process more approachable and inclusive, particularly in remote or resource-challenged educational environments.

The overall system proved highly adaptable. While the experiment focused on virtual device control, the same framework could be extended to physical hardware using platforms like Arduino or ESP32. Students expressed interest in scaling the project to create simple smart home simulations, environmental monitoring systems, or automated classroom tools. This modular design renders the method appropriate for various educational settings and fosters additional interdisciplinary inquiries in areas like environmental science, engineering, and educational technology.

Student involvement was particularly strong during the entire project. The use of a Telegram bot, a platform they already used in their daily lives, made the task feel more

authentic and motivating. Learners reported increased confidence in handling IoT-related tools and an improved understanding of how cloud platforms communicate with end devices. Their ability to finish the project from start to finish—encompassing bot setup, configuring the cloud dashboard, and achieving real-time control—provided them with a concrete feeling of achievement.

In conclusion, this experiment demonstrated the efficacy of a Telegram-operated IoT simulation in improving student comprehension, engagement, and digital skills. It provides an adaptable, accessible gateway into intricate technological ideas, establishing it as a promising framework for upcoming curriculum innovation in computer science and STEM education.

Conclusion

This study demonstrated the practicality and educational benefits of combining a Telegram bot with the ThingsBoard platform to instruct basic Internet of Things (IoT) principles in a digital, affordable, and student-oriented setting. The activity made it easier to understand the complexity of IoT system architecture by allowing learners to manage virtual devices via a messaging application, while also strengthening essential technical skills like telemetry data transmission, device provisioning, and communication based on APIs.

The project highlighted how cloud-based simulations and user-friendly tools such as ThingsBoard and Telegram bots can effectively mimic real-world IoT scenarios in the classroom, eliminating the necessity for physical devices. Students acquired hands-on experience in setting up dashboards, managing real-time control flows, and comprehending bi-directional communication protocols—essential skills for aspiring computer science educators and developers.

The positive engagement of students and the system's adaptability indicate its significant potential for replication and growth. Upcoming efforts may entail the inclusion of actual physical devices, improving the interface with AI-driven bots, or adding sophisticated analytics to replicate intelligent environments. In general, this method provides a scalable and inclusive framework for advancing digital skills within computer science education.

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References

Abdul Rashid, N. bin, Othman, M. Z. bin, Johan, R. bin, & Sidek, S. F. bin H. (2019). Cisco Packet Tracer simulation as effective pedagogy in computer networking

course. *International Journal of Interactive Mobile Technologies (iJIM)*, 13(10), 4–18. https://doi.org/10.3991/ijim.v13i10.11283

Bestari, D. N., & Wibowo, A. . (2023). An IoT Based Real-Time Weather Monitoring System Using Telegram Bot and Thingsboard Platform. *International Journal of Interactive Mobile Technologies (iJIM)*, *17*(06), pp. 4–19. https://doi.org/10.3991/ijim.v17i06.34129

De Luca, Chen, Y., G., Li, Z., & Mian, S. (2018). Visual programming language environment for different IoT and robotics platforms in computer science education. *CAAI Transactions on Intelligence Technology*, 3(2), 65–74. https://doi.org/10.1049/trit.2018.0016

Dizdarevic, J., & Jukan, A. (2021). *Engineering an IoT-Edge-Cloud computing system architecture: Lessons learnt from an undergraduate lab course*. arXiv preprint arXiv:2103.11396. https://arxiv.org/abs/2103.11396

Domínguez-Bolaño, T., Fernández-Caramés, T. M., Fraga-Lamas, P., & Castedo, L. (2024). *Challenges and trends in the integration of the Internet of Things with Industry 4.0*. arXiv preprint arXiv:2403.15395. https://arxiv.org/abs/2403.15395

Iqbal, M. T. (2020). Design and implementation of a low-cost, open source IoT-based SCADA system using ESP32 with OLED, ThingsBoard and MQTT protocol. AIMS Electronics and Electrical Engineering. https://doi.org/10.3934/ELECTRENG.2020.1.57

Kurni, R. M., & G., M. (2024). *IoT-enabled gamification for education*. In M. K. Khan, S. Tanwar, A. Sharma, & R. Gupta (Eds.), IoT and digital technologies for sustainable development (pp. 173–192). Springer. https://doi.org/10.1007/978-3-031-67387-0_10

Sabuncu, A., & Thornton, K. (2022, June). *Leveraging ThingsBoard IoT service for remote experimentation*. In 2022 ASEE Annual Conference & Exposition. American Society for Engineering Education. https://peer.asee.org/leveraging-thingsboard-iot-service-for-remote-experimentation

Viswanadh, K. S., Sai Ram, M., Srivastava, A. K., & Murthy, M. R. K. (2024). *Design and implementation of a cost-effective IoT laboratory for developing countries*. arXiv preprint arXiv:2402.05466. https://arxiv.org/abs/2402.05466

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Education digitalization: impact on the learning quality and the participants' readiness in the educational process

Abstract

The aim of this study is to analyze the impact of digitalization on the quality of the educational process in secondary and higher education, as well as to identify the conditions conducive to successful integration of digital technologies. The theoretical base includes a review of 35 international publications covering various aspects of digital transformation in education: from digital literacy and learner motivation to management strategies and digital inequality. The empirical part is based on the results of a survey of 75 teachers and 305 students of an international school in the city of Astana. The results showed a high level of positive perception of digital tools, as well as the presence of barriers related to the choice of suitable platforms, lack of digital competences and overload of diversity of technologies. The study highlights the need for systemic support of educators and strategic digital leadership by administrations. Findings may be useful for education policy makers, managers and educators interested in sustainable digital transformation of the educational environment.

Keywords: Digitalization of education, digital literacy, motivation of students, pedagogical support, digital tools, educational transformation..

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Introduction

With the rapid development of digital technologies, the transformation of the educational environment is becoming not just a technological trend, but a necessary condition for the modernization of the education system. Digitalization affects all levels of the educational process - from the content and forms of teaching to the management of educational institutions, evaluation of learning outcomes and interaction of participants in the educational process. Contemporary challenges, including the COVID-19 pandemic, have significantly accelerated this transition by identifying both the significant potential of digital tools and vulnerabilities in the education system (Rosak-Szyrocka et al., 2024; Yang, 2024).

At the international level, there is a steady trend towards integrating online platforms, hybrid learning formats and digital feedback, visualization and collaboration (Laursen & Ryberg, 2024; Reis-Andersson, 2024). The scientific literature emphasizes that the effectiveness of digitalization depends not only on the availability of technologies, but also on the willingness of teachers, students and administrations to use them consciously (Niksiar et al., 2025; Solodovnikova & Malkova, 2025). The critical question remains: how much human, organizational and infrastructural resources are available to educational institutions for systemic digital transformation?

Despite the growing number of publications devoted to digital platforms and educational technologies, in Kazakhstan and CIS countries there are still no comprehensive studies combining theoretical analysis and empirical data on the perception of digitalization in secondary and higher education. It is particularly important to consider the views of both teachers and students, as they are the main actors in digital change.

This study aims to analyze the advantages and limitations of digital transformation of education, as well as to assess the degree of readiness and acceptance of digital practices by teachers and schoolchildren in one of the international educational institutions of the city of Astana. The article is based on a synthesis of modern scientific approaches (based on analysis of 35 international publications), as well as results of questionnaires among teachers and students in 2024-2025 school year.

The scientific novelty of research consists in an integrated approach to the study of digitalization, combining theoretical systematization of scientific sources with localized empirical analysis. The practical importance lies in identifying specific conditions and limitations that should be taken into account when developing strategies for digital development of educational institutions.

Materials and methods

General synthesis of scientific literature. Digitalization of education is a global and multidimensional process that has been actively developed since the COVID-19 pandemic. Based on the analysis of 35 international studies, several sustainable trends can be identified.

Geographical coverage and type of education. The studies cover more than 20 countries on 5 continents, including European (Spain, Germany, Lithuania, Portugal), Asian (Kazakhstan, China, South Korea, Japan), African (Mozambique), North American (USA, Canada) and Latin American (Colombia) contexts. They analyze both schools and institutions of higher education.

Table 1
Summary of the literature review

№	Authors (Year)	Method	Key findings
1	Batuchina & Melnikova, 2025	Qualitative (interview)	Digital creativity of teachers as a key factor in digital pedagogy; the importance of infrastructure and professional development
2	(Gavrus et al., 2025)	Project analysis (DoCENT)	Model of digital creativity in learning; development of digital competences through collaboration
3	(Finch et al., 2023)	Theoretical review	Rethinking creativity in the digital age, creativity as a factor of adaptation to digitalization
4	Torres A.A., Collazos C.A., Mon A.	Theoretical review	Diversity of creative approaches; emphasis on digital interaction
5	(Akim et al., 2023)	Analysis of personalization models	Highlights the need for individualization and personalisation in digital learning
6	(Reis-Andersson, 2023)	Analysis of strategic documents	Digital transformation requires changing the content of education and the role of teachers
7	(Reis-Andersson, 2024)	Qualitative (OER analysis)	Teachers are becoming active creators of digital content; importance of open resources
8	(Amdam et al., 2024)	Content analysis	Teachers use Pinterest and TPT as sources of ideas; trust issues
9	(Oluseyi-Sowunmi & Samuel, 2024)	Conceptual analysis	Definition of digital creativity: synergy between technology and imagination
10	(Tsupari et al., 2024)	Survey	Creating digital content improves the quality of education and motivates students
11	(Solodovnikova & Malkova, 2025)	Digital readiness model	Development of a model to evaluate the digital transformation of universities; importance of digital leadership
12	(Panayotova, 2024)	Scenario analysis	The future of education in a digital and uncertain environment; the importance of strategic thinking
13	(Gutu et al., 2024)	Mixed methods	Authoritarian aspects of digitalization; the risk of exclusion in digital university
14	(Rosak-Szyrocka et al., 2024)	Student survey	Link between digital literacy, motivation and support of teachers
15	(Buchmann, 2025)	Content analysis	Analysis of digital platforms and video books as tools for pedagogical reflection
16	(Göltl et al., 2024)	Case-study	Digital transformation in resource-constrained environments requires a systemic approach

17	(Filipova & Malakhova, 2024)	Survey and interview	Technological backwardness as key barrier to digitization; importance of donor support
18	(Gumaelius et al., 2023)	Case analysis	Integrating LMS and artificial intelligence into the educational process
19	(Moustakas, 2025)	Experiment	The use of digital games promotes STEM learning and sustainable thinking
20	(Hollenstein et al., 2025)	Focus group	Low digital competence of teachers as an obstacle to digitalization
21	(Ma et al., 2025)	Survey and interview	Changing roles of students in the digital educational environment; growth of autonomy and reflection
22	(Rajcsanyi-Molnar et al., 2025)	Focus group	Involving parents and teachers as the key to successful digitalization of schools
23	(Gumbi et al., 2024)	Survey and statistical analysis	Low level of teacher training; need for continuous digital training
24	(Zheng et al., 2024)	Scenario planning	Shaping digital strategies under uncertainty and TUNA paradigms
25	(Silén-Lipponen et al., 2024)	Digital software analysis	Joint digital programmes between EU universities; increased mobility and learning flexibility
26	(Zaqueu, 2024)	Case analysis	Use of digital platforms helps adapt to changing conditions
27	(Carlsson & Willermark, 2023)	Content analysis	Evaluation of distance learning platforms; impact on academic performance
28	(Laursen & Ryberg, 2024)	Mixed methods	Hybrid learning enhances student personalization and motivation
29	(De-Torres et al., 2024)	Quality interviews	Inclusive digital education is possible when platforms are adapted to local conditions
30	(Yang, 2024)	LMS data analysis	Monitoring digital activity of students allows to assess the digital competence of teachers
31	(Drljić et al., 2025)	Survey and observation	Integrating AI and VR into learning increases interest, but requires infrastructure support
32	Frolova E., Rogach O., Faizullin R	Content analysis	Digital technologies help transform engineering education
33	(Hewidy et al., 2023)	Case-study	Successful implementation of digital learning depends on a flexible curriculum
34	(Chounta et al., 2024)	Simulation	Digital readiness of universities affects academic performance and engagement
35	(Niksiar et al., 2025)	Survey and interview	Lack of digital skills among non-mathematical teachers; recommendations for vocational training

As shown in Table 1, the authors used both qualitative (interviews, focus groups, case studies) and quantitative methods (questionnaires, statistical models), as well as mixed approaches (e.g., Gutu et al., 2024; Laursen & Ryberg, 2024).

The articles raise the following key themes:

- Digital competence of teachers;
- Access to digital infrastructure;
- Motivation and involvement;

- Hybrid and mixed learning models;
- Digital justice and inclusion.

Thus, the literature reflects the multidimensionality of the process of digitalization – from technical and organizational aspects to psychological, pedagogical and cultural.

Advantages and disadvantages of digitalization in education

Digitalization benefits. One of the key advantages of introducing digital technologies into the educational process is to increase the level of involvement and motivation of students, especially in online and blended learning environments. As shown in a study by Rosak-Szyrocka et al. (2024), the perception of the digital environment as flexible, adaptive and supportive on the part of teachers has a significant influence on the involvement of students in the educational process. Digitization promotes the personalization of learning, allowing to take into account the individual characteristics of students. Research by Kim et al. (2025) has shown that hybrid learning models enhance autonomy, give students greater control over the pace and pattern of learning, and contribute to higher satisfaction with the educational process. It is emphasized that digital technologies increase access to educational resources. For example, Laursen & Ryberg (2024) points to the growing role of Open Educational Resources (OERs) and the development of competences in creating and adapting digital content among teachers. This promotes both academic freedom and the development of digital pedagogical creativity.

The literature also highlights the role of digitalization in ensuring educational resilience during crises such as the COVID-19 pandemic. In particular, post-COVID-19 architecture education has been one example of a successful transition to mixed formats where digital flexibility and scriptwriting have enhanced academic adaptation ((Hewidy et al., 2023)). For example, Panayotova (2024) describes how scenario planning has helped schools in Norway adapt to the unpredictable challenges associated with mass online adoption.

Shortcomings and challenges of digitalization. Despite the stated advantages, digitalization of education faces a number of structural, pedagogical and ethical challenges. One of the main barriers remains the lack of digital competence of teachers, especially in non-mathematical and non-humanities disciplines. (Niksiar et al. (2025) point out that teachers in Kazakh universities have low levels of ICT skills, which negatively affects the quality of teaching and limits the potential of digital platforms.

Moreover, unequal access to digital infrastructure remains a serious problem. The study by Barrera et al. (2025), conducted at universities in Mozambique, identified a severe shortage of equipment, slow internet and limited software as major barriers to digital transformation.

Another problem highlighted in a number of works is the overload of students and teachers in conditions of constant online presence. Filipova & Malakhova (2024), for example, point out that the digital environment can contribute to the authority of education by reducing student autonomy and turning the teacher into a mediator between the system and the learner.

The lack of systemic support from the education administration is also a concern. Studies by Gumbi et al. (2024) and Rajcsanyi-Molnar et al. (2025) highlight that schools where digitalization was implemented without coordination with parents and teachers were more likely to face resistance and technical failures.

Application of skills acquired through digital tools (based on cases). One of the steady trends in modern educational practice is becoming not only the integration of digital technologies, but also the formation of new forms of applied and meta-subject skills necessary for adaptation to the digital society. The studies emphasize that digital tools play an important role in the development of both academic competences and 21st century skills - critical thinking, autonomy, creativity and cooperation.

A study by Moustakas (2025) on the use of digital games in STEM education in China showed that interactive digital environments stimulate students' analytical thinking and sustainable project motivation. The use of such games promotes task comprehension, not mechanical memorization. In another example - work of Yang (2024), - the collection and analysis of student activity data on learning management platforms (LMS) allowed teachers not only to adjust courses in real time, but also to diagnose cognitive overload zones. This builds students' skills of self-reflection and digital self-assessment, allowing them to adapt to dynamically changing learning content. An article by Filipova & Malakhova (2024), based on the experience of using video blogs for educational purposes, demonstrates how digital video literacy contributes to the formation of pedagogical reflexes in future teachers. The development of educational videos requires not only mastering technical tools, but also awareness of the logic of material delivery, which is directly related to the competence «learn to learn».

In addition, the study by De-Torres et al. (2024) on digital inclusion in universities stresses that successful implementation of digital practices is only possible with locally adapted solutions that take into account the linguistic, cultural and technical characteristics of students. Here, digital tools have become not just a means of delivering content, but a platform for developing adaptive skills and critical analysis.

It is also worth noting the conclusions of Panayotova (2024), who argued that digital creativity is not only the ability to use technology, but also the ability to combine knowledge from different disciplines to create new solutions. This transdisciplinary literacy is actively developed through the participation of students in online collaborations, projects, script games and case studies.

Thus, the analysis showed that digital tools not only transform teaching forms, but also model new educational outcomes focused on practice-oriented, creative and adaptive skills of learners.

Stakeholders: students, teachers, administration

Students: a digital generation with different opportunities. Most studies highlight that students are not just the subject of digitalization, but active actors with high expectations for the digital environment. Their involvement is enhanced by the

availability of visual and multimedia content, as well as the ability to adapt the pace of learning to their needs (Laursen & Ryberg, 2024). However, as noted by Filipova & Malakhova (2024) and Drljić et al. (2025), not all students have equal access to digital devices and the internet, especially in countries with limited resources. This leads to a deepening of the digital divide and requires special attention by the education system to social inclusion.

Teachers: from resistance to professional growth. Teachers remain the central agents of digital transformation, but their level of readiness varies greatly. Similar findings are confirmed in Gumbi et al. (2024) and Ma et al. (2025), where lack of training and system support is highlighted. At the same time, many authors note a positive trend. For example, Reis-Andersson (2024) and Panayotova (2024) point out that the participation of teachers in the development and adaptation of digital content stimulates professional growth and forms a pedagogical community based on exchange of practices. Digital pedagogy becomes an area of innovation, not coercion.

Administration: driver or change barrier? The role of school and university administration in the process of digitalization is difficult to overestimate. Studies by Solodovnikova & Malkova (2025) and Zheng et al. (2024) highlight that the success of digital reforms depends directly on digital leadership at the management team level. With a clear strategy, motivational programs and infrastructure support, digitalization is implemented more consistently and systematically. However, a number of studies document the reverse cases. For example, Rajcsanyi-Molnar et al. (2025) describes a situation where administrative passivity and lack of coordination with educators lead to formal and ineffective ICT adoption. Students thus require adaptability, teachers support and development, and administration strategic leadership. Similar situation is observed in the context of Mozambique, where the lack of digital leadership and institutional strategy by the administration of educational institutions has led to a superficial introduction of technologies and increased inequality (Zaqueu, 2024). Only the collaboration of all stakeholders can ensure a sustainable and effective digital transformation in education.

Research methodology

The aim of the empirical part of the study was to identify perceptions, experiences and problems related to the use of digital tools in teaching and learning in the context of secondary school. Special attention was paid to assessing the readiness of teachers and students for digital transformation of the educational environment, as well as identifying factors that promote or hinder the effective use of digital technologies.

Study participants. The study was conducted within the framework of a pilot introduction of digital practices in one of the International schools of Astana (hereinafter - ISA). The following participated in the survey:

- 75 out of 139 teachers (54%) in various subject areas, excluding computer science;
- 305 out of 536 students in grades 6-10 (approximately 57%).

Respondents represented a diverse pedagogical and age composition, as well as a wide range of subjects and learning paths.

Data collection method. The collection of empirical data was carried out during the academic year 2024-2025 through an anonymous online survey developed specifically for this study. Google Forms were used, accessible through the personal electronic devices of the respondents. The questionnaire included both closed-ended questions with options and open for comments, which allowed to combine quantitative and qualitative approaches.

Questionnaire structure. The questionnaire for teachers included the following blocks:

- Frequency of use of digital tools in lessons;
- Impact of digitalization on student engagement;
- List of applied platforms and technologies;
- Problems in the selection, development and application of tools;
- Assessment of the level of digital training;
- Need for methodological and administrative support.
- The student questionnaire consisted of the following components:
- Comparison of traditional and digital learning formats;
- Level of interest and comfort in the application of digital technologies;
- Availability of platforms in the off-season;
- Effectiveness of group and individual work;
- Advantages and disadvantages of digital tasks;
- Feedback to teachers in the digital environment.

Ethical aspects. All participants were informed about confidentiality and voluntary participation. The responses were collected without identification and used solely for scientific analysis. The study meets the ethical requirements of pedagogical empirical work.

Table 2

The results of the teachers survey

Category	**Number of responses (out of 75)**	**The percentage (%)**
Introducing digital tools in class	63	84
Students' interest is growing	59	79
Students actively participate in the use of DT	61	81
Have difficulty choosing tools	47	63
Limited access to platforms/resources	42	56
Lack of skills in new technologies	39	52
Need methodological support chosen by the DT	52	69

Note: DT- digital tool

Table 2 with the results of a survey among 75 teachers in Middle Years Programme (MYP). It shows the proportion of respondents who confirmed key statements, for example:

- 84% introduce digital tools in class;
- 81% report active participation of pupils in the use of digital technologies;
- 69% need methodological support in choosing digital tools.

Table 3

The results of the students survey

Category	**Number of responses (out of 305)**	**The percentage (%)**
Lessons become more understandable and interactive with DT	242	79
DTs contribute to group work	228	75
Less paper writing and more digital work	221	72
DTs allow you to make edits without stress	213	70
Tasks can be performed anytime and anywhere	234	77
CIs help kinesthetic to better perceive information	198	65
DTs provide more practice than theory	205	67
DTs promote learning differentiation	191	63
Sometimes tools are unclear and require adaptation	176	58
Some teachers are overloaded with tools	169	55
Teachers ask students for help with problems	142	47

Note: DT- digital tool

According to Table 3 with the results of a survey of 305 students in grades 6-10 of YRS, reflecting their perception of digital tools:

- 79% believe that the lessons have become more understandable and interactive;
- 77% appreciate the ability to do tasks anytime and anywhere;
- 70 percent say that digitally editing reduces stress.

Also, 58% reported that new tools needed to be adapted and 55% that some lessons were overloaded with digital platforms.

Analysis and interpretation of empirical data

1. Teachers' perspective: striving for digitalization without support. The results of the survey among 75 teachers of MYP show a high degree of desire for digitalization of the educational process: 84% of respondents adopt digital tools, and 81% noted that students' activity in class has increased. This confirms the research findings of Rosak-

Szyrocka et al. (2024) and Laursen & Ryberg (2024), which focus on increasing students' motivation and participation in digital environments.

However, about 63% of teachers have difficulties in choosing digital platforms and 69% need methodological support. These data illustrate the general lack of vocational orientation, also mentioned by Niksiar et al. (2025) and Gumbi et al. (2024): even with motivation, teachers often do not feel confident in choosing and adopting technologies.

More than half (52%) admitted that they did not have the skills to master new digital solutions on their own. Such difficulties are particularly noticeable in the context of non-mathematical disciplines, where digital integration requires adaptation of traditional methods to a multimodal environment (Reis-Andersson, 2024).

2. Students' perspective: digital technologies increase flexibility and reduce stress. Among the 305 students interviewed, there is a generally positive attitude towards digital technologies in education. 79% noted that the lessons have become more clear and interactive, and 75% are positive about the possibility of group work in a digital environment. Such findings are consistent with the work of Laursen & Ryberg (2024) and Moustakas (2025), where digital organization promotes collaborative skills and flexible thinking.

Moreover, 70% of the students stressed that digital formats allow them to edit without stress, and 77% appreciate being able to do tasks at a convenient time and place. This is consistent with the ideas of individualization of learning described in Akim et al. (2023).

It is also important to note that 67% of students believe that digitalization enhances the practical orientation of lessons, while 63% believe that it promotes differentiation. This effect is particularly valuable for kinesthetic and visual learners, as highlighted in studies by Panayotova (2024).

3. Coincidences and divergences in perception. Despite positive assessments, both participants in the educational process point to a number of problems. Students note that sometimes the platforms are not understood (58%), and some teachers overload with digital means (55%). As shown in international studies, the overload of students with digital platforms is often the result of a lack of coordinated methodological policy in schools (Silén-Lipponen et al., 2024). This confirms the conclusions of Gutu et al. (2024) on the risk of overload and fragmentation in unstructured digitalization.

An interesting aspect is that 47% of the students reported that teachers sometimes turn to them for help during technical failures, indicating a redistribution of digital competence within the class and a lack of systemic technical support (Niksiar et al., 2025).

Discussion

1. Coherence between theory and practice: confirming global trends. The results of an empirical study in schools in the city of Astana are largely consistent with the international observations presented in the literature review. In particular, the active use of digital tools by teachers (84%) and high involvement of students (81%), as well as

highlighting that the digital environment contributes to increased educational motivation, especially with interactive and visual elements.

Just as in foreign contexts, positive perception of students' flexibility, adaptability and practicality of digital learning (Hewidy et al., 2023; Moustakas, 2025) is confirmed by data in Astana: 77% of schoolchildren value the opportunity to perform assignments at a convenient time and place, a 70% say that stress is reduced because digital documents are easy to edit.

Thus, we can talk about the universality of a number of effects of digitalization, regardless of the country and level of education. This is confirmed by the results of international analysis, where it is stressed that regardless of the type of education and geographical context, digitalization reinforces both the involvement and transformation of the roles of the teacher (Torres et al., 2024)

2. Conditions for effectiveness: importance of support and coordination. Despite the clear advantages, the data confirms that the success of digitalization is not guaranteed by the fact of the introduction of technologies. The main problem is the uncertainty of the teachers - 69% of them reported a lack of methodological support, and more than half have difficulties with mastering new tools. This is in line with conclusions about the systemic deficit of digital pedagogical training and supporting infrastructure.

In addition, the lack of digital leadership and strategic approach on the part of the administration (Solodovnikova & Malkova, 2025) can lead to formal and unsustainable implementation of platforms. In the context of the study, such problems are manifested in the form of teachers turning to students for technical support (47% of students noted), which indicates insufficient institutional digital maturity.

3. Stress points: digital overload and instrumental chaos. It is interesting that, despite the predominantly positive perception, students note the overload of digital tools, as well as difficulties in adapting to new platforms when necessary (55% and 58% respectively). Such complaints confirm the concern expressed by Gutu et al. (2024) about fragmented and unstructured digitalization, in which tools are selected without regard to cognitive stress and age of students.

This conclusion highlights the importance of the didactic strategy of technology selection, as written by Akim et al. (2023): successful digitalization is impossible without the coordination of pedagogical goals with the functionality and interface of platforms. Also, the results of an analysis of engineering education show that successful digitalization requires flexibility in the choice of formats, including combinations of hybrid models, structured freedom and visual transparency of tasks (Laursen & Ryberg, 2024).

Conclusion and recommendations

Main conclusions. The results of theoretical and empirical analysis confirmed that the introduction of digital tools into educational practice has a predominantly positive impact on the involvement, motivation and quality of education in both secondary and

higher education. In this way, the most important conditions of digitalization efficiency are identified:

Trained teachers with sufficient digital literacy;

- Access to adapted infrastructure and resources;
- Management support and strategic guidance from the administration;
- Involvement of students in the process of choosing and mastering digital learning tools.

Despite a high level of enthusiasm on the part of teachers and students, digitalization faces several challenges: uncertainty in choosing suitable platforms, digital inequality, tool overload, and a fragmented approach to implementation.

Empirical data collected at the international school of the city of Astana confirmed the general international trends described in the scientific literature of researchers in the field of education, which allows to speak about the transnational nature of digital transformation of education.

Practical recommendations.

For teachers:

- Take targeted courses on digital didactics with emphasis on the choice of tools for specific purposes of the lesson;
- Use digital tools not as an end in itself, but as a means to enhance differentiation, visualization and practical orientation;
- Engage students in reflection on the convenience and effectiveness of the applied platforms.

For school and university administration:

- Shape the digital strategy of the institution, taking into account the opinions of teachers and students;
- Provide guidance and technical support to teachers, especially in non-mathematical disciplines;
- Implement common digital ecosystems to avoid overloading and duplication of functions.

For EdTech developers:

- Create adaptive, intuitive interfaces designed for different age and cognitive levels of users;
- Allow flexibility to integrate with existing LMS and other platforms;
- Develop analytical tools that allow teachers to track student progress and behavioral patterns.

Prospects for further research. Future work may be directed to:

- Comparative analysis of digital transformation in urban and rural schools;
- Research into the impact of specific digital tools on academic achievement;
- Analysis of management strategies of digitalization in regional and national education systems.

References

Akim, N. U. A., Rosli, N. M. S., & Saleh, N. N. S. (2023). Toward Digital School: The level of usage, competency and awareness for digital storage among school administrators pre to the COVID-19 era. *Journal of Advanced Research in Applied Sciences and Engineering Technology, 34(1), 249–256.* https://doi.org/10.37934/araset.34.1.249256

Amdam, S. H., Nagel, I., Njå, M. B., & Forsström, S. (2024). Self-Control or crime Control: Teachers' insights on good practices in 1:1 classrooms and implications for professional development. *Education Sciences, 14(11), 1267.* https://doi.org/10.3390/educsci14111267

Batuchina, A., & Melnikova, J. (2025). Unveiling digital creativity: enhancing teachers' capacities in the digital education landscape. *Creativity Studies, 18(1), 126–149.* https://doi.org/10.3846/cs.2025.20261

Buchmann, U. (2025). THE REPRODUCTION OF SECONDARY AUTHORITARIANISM VIA THE EDUCATION SYSTEM OR WHAT THE COVID-19 PANDEMIC HAS BROUGHT TO LIGHT REGARDING TEACHER TRAINING. *Cadernos CEDES, 45*. https://doi.org/10.1590/cc289488

Carlsson, S., & Willermark, S. (2023). Forbidden and necessary: making sense of smartphones in vocational teaching. *Journal of Workplace Learning.* https://doi.org/10.1108/jwl-03-2023-0040

Chounta, I., Ortega-Arranz, A., Daskalaki, S., Dimitriadis, Y., & Avouris, N. (2024). Toward a data-informed framework for the assessment of digital readiness of higher education institutions. *International Journal of Educational Technology in Higher Education, 21(1).* https://doi.org/10.1186/s41239-024-00491-0

De-Torres, E., Canaleta, X., Fonseca, D., & Alsina, M. (2024). Automated Monitoring of Human–Computer Interaction for assessing teachers' digital competence based on LMS data extraction. *Sensors, 24(11), 3326*. https://doi.org/10.3390/s24113326

Drljić, K., Konrad, S. Č., Rutar, S., & Štemberger, T. (2025). Digital equity and sustainability in higher education. *Sustainability, 17(5), 2011*. https://doi.org/10.3390/su17052011

Filipova, A., & Malakhova, V. (2024). Educational video blogging: search for meanings and conceptualization of concepts. *Education & Self Development, 19(4), 226–241*. https://doi.org/10.26907/esd.19.4.17

Finch, M., Bhroin, N. N., & Krüger, S. (2023). Unlearning, relearning, staying with the trouble: *Scenarios and the future of education. Prospects, 54(2), 475–482.* https://doi.org/10.1007/s11125-023-09664-7

Frolova E., Rogach O., Faizullin R. (2024). Transformation of student roles and behavior patterns in the context of digitalization. *International Journal of Media and Information Literacy, 9(2).* https://doi.org/10.13187/ijmil.2024.2.329

Gavrus, C., Petre, I. M., & Lupșa-Tătaru, D. A. (2025). The role of E-Learning Platforms in a Sustainable Higher Education: A Cross-Continental Analysis of Impact and Utility. *Sustainability, 17(7), 3032*. https://doi.org/10.3390/su17073032

Göltl, K., Ambros, R., Dolezal, D., & Motschnig, R. (2024). Pre-Service Teachers' Perceptions of Their Digital Competencies and Ways to Acquire Those through Their Studies and Self-Organized Learning. *Education Sciences, 14(9), 951*. https://doi.org/10.3390/educsci14090951

Gumaelius, L., Skogh, I., Matthíasdóttir, Á., & Pantzos, P. (2023). Engineering education in change. A case study on the impact of digital transformation on content and teaching methods in different engineering disciplines. *European Journal of Engineering Education, 49(1), 70–93.* https://doi.org/10.1080/03043797.2023.2285794

Gumbi, N. M., Sibaya, D., & Chibisa, A. (2024). Exploring Pre-Service Teachers' perspectives on the integration of digital Game-Based Learning for sustainable STEM education. *Sustainability, 16(3), 1314*. https://doi.org/10.3390/su16031314

Gutu, I., Medeleanu, C. N., & Asiminei, R. (2024). The limits of learning engagement and academic leadership within the higher education digitalization process - analysis by using PLS SEM. *PLoS ONE, 19(11), e0306079.* https://doi.org/10.1371/journal.pone.0306079

Hewidy, H., Purkarthofer, E., & Eräranta, S. (2023). A tale of four studios: Evolving planning and architecture education towards mixed modality in a post-pandemic world. *Education and Information Technologies, 29(10), 11847–11868.* https://doi.org/10.1007/s10639-023-12320-4

Hollenstein, L., Vogt, M., Benz, O., & Vogt, F. (2025). High expectations during guided pretend play in Kindergarten: a promising way to enhance agency in a digitalized society? *Education Sciences, 15(4), 399.* https://doi.org/10.3390/educsci15040399

Laursen, L. N., & Ryberg, T. (2024). Digitalisation of engineering design education: structured freedom, flipped engagement, hybridity, and transparency. *European Journal of Engineering Education, 1–20.* https://doi.org/10.1080/03043797.2024.2331257

Ma, S., Jin, X., Li, X., Dong, H., Dong, X., & Tang, B. (2025). How Epistemic Curiosity Influences Digital Literacy: Evidence from International Students in China. *Behavioral Sciences, 15(3), 286.* https://doi.org/10.3390/bs15030286

Moustakas, L. (2025). Game Changer: Harnessing artificial intelligence in sport for development. *Social Sciences, 14(3), 174*. https://doi.org/10.3390/socsci14030174

Niksiar, N., Özverir, İ., & Meghdari, A. F. (2025). The effectiveness of an authentic E-Learning environment for deaf learners. *Applied Sciences, 15(3), 1568*. https://doi.org/10.3390/app15031568

Oluseyi-Sowunmi, O. S., & Samuel, R. E. (2024). Online Learning Innovations in Accounting Education: A study of students' engagement and learning outcome. *WSEAS TRANSACTIONS ON COMPUTER RESEARCH, 13, 103–115.* https://doi.org/10.37394/232018.2025.13.11

Panayotova, N. (2024). THE FIRST STUDENTS STUDYING UNDER HIGHER EDUCATION DIGITALIZATION PROJECTS HAVE GRADUATED. *Ezikov*

Svât/Ezikov SvâT, ezs.swu.v22i2, 196–198. https://doi.org/10.37708/ezs.swu.bg.v22i2.23

Rajcsanyi-Molnar, M., Andras, I., & Czifra, S. (2025). Integrating Serious Games and Gamification for Diverse Learner Groups: Lessons from the "GeoGecko" Project. *Education Sciences, 15(4), 440.* https://doi.org/10.3390/educsci15040440

Reis-Andersson, J. (2023). Leading the digitalisation process in K–12 schools – The school leaders' perspective. *Education and Information Technologies, 29(3), 2585–2603.* https://doi.org/10.1007/s10639-023-11935-x

Reis-Andersson, J. (2024). Leaders' perceptions of digitalisation in K–12 education: influencing arrangements for leading the expansion of digital technologies. *Discover Education, 3(1).* https://doi.org/10.1007/s44217-024-00247-y

Rosak-Szyrocka, J., Apostu, S. A., & Pupp, Z. (2024). The Relationship between Technology of Higher Education in the Case of European Countries, a Panel Approach. *Polish Journal of Environmental Studies, 33(3), 2813–2821.* https://doi.org/10.15244/pjoes/173991

Silén-Lipponen, M., Piippo-Savolainen, E., Azimirad, M., & Saaranen, T. (2024). Distanced large group simulations as a learning method for interprofessional collaboration. *Nursing Reports, 14(4), 2640–2650.* https://doi.org/10.3390/nursrep14040195

Solodovnikova, O. B., & Malkova, E. E. (2025). The Changing Attitudes Towards Distance Learning: The New Demand for the Format by the Faculty [Динамика отношения к дистанционному образованию: новая востребованность формата преподавателями]. *Vysshee Obrazovanie v Rossii = Higher Education in Russia, 34(2), 72–85*. https://doi.org/10.31992/0869-3617-2025-33-2-72-85

Torres A.A., Collazos C.A., Mon A. (2024). A Review of the Literature on models or frameworks for Implementation of Digital Transformation Processes [Una Revisión de la Literatura sobre modelos o marcos de trabajo para Implementación de Procesos de Transformación Digital]. *Journal of Computer Science and Technology, 24(2), pp. 153 - 167.* https://doi.org/10.24215/16666038.24.e15

Tsupari, K., Lagstedt, A., & Kauppinen, R. (2024). Revealing the digital transformation, uncovering hidden process dimensions of education. *Business Process Management Journal, 30(8), 260–283*. https://doi.org/10.1108/bpmj-09-2023-0748

Yang, H. (2024). E-learning platforms in ideological and political education at universities: students' motivation and learning performance. *BMC Medical Education, 24(1).* https://doi.org/10.1186/s12909-024-05572-2

Zaqueu, L. (2024). Challenges and opportunities for digital transformation in Mozambique's higher education institutions [Desafíos y oportunidades para la transformación digital en las instituciones de educación superior de Mozambique]. *Revista Cientifica De Sistemas E Informatica, 4(2), e690.* https://doi.org/10.51252/rcsi.v4i2.690

Zheng, Q., Yuan, Z., & Pan, X. (2024). Examining the influencing effect of EFL students' digital literacy on their online learning power: the mediating role of perceived

teacher support. *Asia Pacific Journal of Education, 1–15.* https://doi.org/10.1080/02188791.2024.2404669

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