

Leveraging gamification and game-based technologies for educational purposes



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Abstract The significance of the study is underscored by the continual challenges confronting contemporary educators in their quest for innovative teaching methodologies. This matter is a subject of investigation by numerous scholars and is accentuated by the evolution of information and communication technologies, the imperative rise of distance and online learning, and systemic alterations in the national educational framework. The adoption of the Conceptual Framework for Reforming Secondary Education, known as the "New Ukrainian School," endorsed by the Board of the Ministry of Education and Science of Ukraine on October 27, 2016, has intensified the exploration of modern, engaging, and efficacious teaching technologies. The heightened emphasis on the elimination of standardization within the educational process, cultivation of student interest, stimulation of motivation for academic endeavors, encouragement of collaborative learning, fostering of mutual assistance, promotion of mobility and dynamism, and the cultivation of creativity are intrinsic attributes of contemporary pedagogical approaches. These attributes align with the prevailing transformative trends in education both within Ukraine and globally. The primary objective of this study is to analyze the integration of gaming technologies within secondary school education. The employed research methodologies encompass the application of analysis, synthesis, generalization, and the systematic examination of scientific literature. The study emphasizes the process of generalization as a pivotal methodological approach. The research materials are centered on the exploration of gamification and game-based learning technologies within the pedagogical and scholarly discourse in both Ukrainian and international contexts.

Keywords: virtual communication, online interaction, adolescents, secondary school students, new Ukrainian school concept, online learning

1. Introduction

In 2018, following the timetable outlined for the implementation of the concept of the New Ukrainian School (hereinafter referred to as NUS) in 2017, the inaugural cohort of students commenced their education in a novel, Western European paradigm at the first-grade level. Presently, these students have progressed to the foundational stages of secondary education, exhibiting discerning expectations for the emerging educational milieu.

According to the NUS, its primary objective is the enhancement of overall education quality, aiming to cultivate a well-rounded individual possessing patriotic sentiments, an active civic stance, and innovativeness capable of effecting change in the global arena and thriving in the labor market. Concurrently, the proponents of the concept assert that the paramount skills requisite for the twenty-first century encompass coordination and interaction, critical thinking, diplomacy, emotional intelligence, mobility, teamwork, research acumen, perpetual learning, and the ability to dynamically adapt to contemporary challenges while aligning with the evolving needs of the labor market, as stipulated by the Ministry of Education and Science of Ukraine (MESU) in 2018.

Hence, contemporary education emphasizes systematic interaction, active collaboration, teamwork, and the pursuit of innovation. As posited by Nindur (2023), the future of education lies in learning through games. Nonetheless, game-based learning technologies cannot operate in isolation and may not achieve effectiveness independently, as traditional learning continues to serve as the foundational framework. It is only through the integration of various technologies that a transformative revolution in the future of education becomes conceivable.

The exploration of game technologies in education and the process of gamification is currently experiencing widespread dissemination. Scholars contributing to this field include Anderson, Barber, Verbakh, Verder, Dziabenko, Kademiia, Karabin, Klark, Landers, Petrenko, Pereiaslavka, Sars, Semysiuk, Smahina, Hanh, Hamari, and numerous others.



Psychologists exhibit a vested interest in the analysis of game technologies. For instance, Kuntsevskaya (2020) posits that the integration of game technologies into education necessitates the involvement of teachers and social workers in specialized courses. These courses are designed to elucidate a comprehensive perspective on game technologies, and their influence on students' personalities, and establish the groundwork for the autonomous design of game-based instructional methodologies.

Distinguished psychologists and educators from the past have additionally affirmed the positive potential of games. In the analysis of the works of Nazarchuk (2015) it has been emphasized that games serve as a primary activity for children due to their inherent clarity and appeal. Furthermore, playing games stimulates activity, initiative, and ingenuity, contributes to character formation, and facilitates both physical and mental development.

As evident, engaging in active learning through gaming technologies and integrating gamification into the educational process is a contemporary imperative and an essential component for educational institutions. It is within these settings that students acquire the requisite skills for their prospective and successful self-realization in society, family, and the professional sphere.

Hence, the study aims to analyze the incorporation of gaming technologies and gamification in education. The research objectives include the following:

- To examine diverse scientific approaches concerning the interpretation and implementation of gamification and game technologies in the field of education.
- To systematize the positive and negative effects attributed to game-based learning technologies and the integration of gamification in educational practices.
- To consolidate insights into the role of game-based collaborative approaches with students and their significance for education applicants.

2. Literature Review

Game-based learning and gamification are currently experiencing a rapid surge in popularity. This trend has been notably propelled by global circumstances such as mandatory quarantine measures amid the COVID-19 pandemic, various military conflicts and aggressions, and natural disasters. The adaptation of educators and students to online learning has become particularly pronounced, ushering in a new era of information and communication technology (ICT) utilization in education. In Ukraine, this transition is exemplified by the widespread adoption of platforms like ZOOM for seminars, Google Meet for lessons, and Google Classroom. Notably, various facets of ordinary life have undergone a virtual transformation, with game-based learning methods increasingly supplanting traditional approaches. Nevertheless, there exists a diversity of opinions concerning the gamification of the educational process and the acquisition of knowledge and competencies by students.

The experimental research conducted in the Global Gamer Study (2023) offers statistical insights. Presently, 79% of the global online population engages in video gaming, with nearly 50% of gamers utilizing multiple platforms. Additionally, 57% of players make substantial financial expenditures during gameplay. According to UNIAN (Korshunov, 2021), a notable 63% of Ukrainians actively participate in online gaming, and 80% of adolescents consistently allocate time to gaming activities. Adolescents emerge as a particularly susceptible demographic among gamers. Consequently, the integration of gaming elements into the educational process is acquiring heightened relevance and is increasingly perceived as a necessity.

Masman (2023) contends that the gamification of education represents an imperative facet of contemporary progress. While associating game-based learning technologies with this phenomenon, he delineates distinctions. According to Masman, game-based learning constitutes a secure environment for experimentation and research, offering contextual learning opportunities, fostering the development of critical thinking skills, providing immediate feedback, and enhancing collaboration skills. On the other hand, gamification in education is characterized by heightened engagement, improved comprehension and retention, stimulation of critical thinking and analysis, promotion of active learning, and cultivation of teamwork skills.

Petrenko (2018) perceives Gamification as a phenomenon within human activity capable of enhancing the manageability and organization of educational endeavors. According to the author, it serves as a method to direct attention toward the accomplishment of educational tasks, thereby contributing to a more efficient educational outcome. The researcher underscores that the incorporation of games and gaming technologies in pedagogical practice involves the establishment of specific conditions for task achievement and the modeling of a distinctive game reality with inherent internal laws. In this context, students assume roles and act based on role-specific situations rather than personal desires. Petrenko emphasizes that under these conditions of game activity, self-management of behavior is cultivated and refined. The scholar further posits that role-playing games represent the antithesis of gamification, characterized by spontaneity and the absence of a clearly defined purpose and structure. In the realm of education, gamification emerges as a unique opportunity to engage individuals accustomed to communication through messengers, chats, and social networks.

It is customary to associate game methods primarily with the education of younger students in the traditional educational process. However, a substantial number of educators, professors, and researchers today validate the efficacy of gamification in learning for both adolescents and students. The utilization of game language to discuss intricate and significant subjects is acknowledged for significantly enhancing communication between educators and students. This approach fosters positive emotions, and a sense of joy, and contributes to creating a relaxed and comfortable atmosphere for all participants in the educational gaming process.

As exemplified by Boyko (2023), a pivotal transformation wrought by digitalization is evident in communication dynamics. In this context, gamification materializes as virtual communication – an entity encompassing interactions on social networks, through gadgets, and via messengers. Virtual communication stands as an indispensable mode of interconnection integral to contemporary daily life, coexisting with face-to-face communication. In the educational domain, virtual communication extends its influence through activities such as contests, raffles, surveys, tests, and the like, facilitated within class chats and social networks.

In the context of virtual communication, the incorporation of language games serves to augment the communicative experience. These games find applicability across diverse age groups, including younger students and those in basic secondary school. Noteworthy examples of language games encompass riddles, "Guess the Word," and "Wordplay." For older students, language games may involve tasks such as text correction adhering to grammatical norms, the deduction or completion of proverbs, sayings, and phraseological units.

The prevalence of game technologies is notable in the realm of studying mathematical disciplines. Bryukhovych (2023) underscores that games play a significant role in fostering the development of a crucial skill – logical thinking. Goryainova (2023) extends this application by transitioning conventional board games into virtual spaces or adapting them for incorporation into mathematics lessons, with examples including Sudoku, chess, and Monopoly, among others.

Developers affiliated with the United Nations introduce innovative methodologies for training, as highlighted by the Regional Information Center for Western Europe (2023). A recent example is the "Appolo's Edition," a novel game technology designed specifically for teenagers. This free online educational resource targets individuals aged 13 to 18 years, focusing on themes related to environmental conservation, ecological issues, and climate change. In addition to the game technology, scientists provide complimentary resources such as a free phone application, online workbooks, and programs.

Cambridge English (2023) provides complimentary digital games designed for English language learning. The platform features corporate business games tailored for English language acquisition, accompanied by guidance on effective learning strategies, speaking and listening skills enhancement, customization of games, and, significantly, a comprehensive test or examination upon the completion of the course.

Albano (2022) directs attention to the efficacy of game-based learning methods within instructional settings. The researcher contends that games grant access to a realm characterized by freedom and control, uncovering new emotions that were previously inaccessible. Additionally, Albano suggests that games often serve as a means for students to momentarily disengage from stress, contributing to the normalization of their mental and physical well-being. When crafting game materials for educational purposes, it becomes imperative to consider various factors, including the age and physiological characteristics of students, the comprehensibility of the game's target language to all participants, its rules, assessment mechanisms, and the stage of learning (whether it involves teaching, repetition, or assessment). According to the scholar, the preference lies in engaging students in team or group games rather than individual ones. Moreover, the researcher emphasizes that the formation of groups or pairs should not be arbitrary; instead, factors such as the level of friendship, trust among students, their academic achievements, and receptiveness to progress and learning must be considered. It is incumbent upon the teacher to exercise continuous control over the gaming process, overseeing the emotional states of the participants and fostering reflective practices. The aim is to maintain an equitable level among all groups or pairs, ideally avoiding a competitive dynamic with clear winners or losers. Additionally, the teacher should strategically calculate rewards to ensure equitable distribution among all participating students.

The aforementioned rules are suitable for implementation when engaging younger students, middle-basic school students, and high school students. The age characteristics of these students necessitate a sensory and empathetic approach, fostering a friendly demeanor, and promoting respect for their mental states and emotions.

The initiation of an engaging learning process commences with the integration of gaming technologies in education, as suggested by Team (2022). The recommendation is to employ game-based learning methods during independent work within the classroom. The incorporation of gamification in learning is seen to foster the enhancement of students' skills and abilities. When educators utilize educational games, particularly within adolescent groups, they play a role in aiding adolescents in constructing positive communication patterns, adopting appropriate relationship strategies, and imbuing the team atmosphere with positive emotions. Gaming technology is identified as a premier simulator for the development of logical thinking.

According to Birt (2023), game-based learning serves not only to facilitate adolescents in establishing a shared language and fostering unity among students but also to enhance communication between the teacher and the adolescent cohort. A teacher who enriches the curriculum with pertinent and engaging game exercises also incorporates a variety of contests, tests, raffles, and lotteries, and discusses the utility of online communication, along with the advantages of online interaction, establishes a foundation for a friendly reception by the student group. The utilization of games in the classroom proves beneficial, particularly when new students integrate into the group. This practice enables the assessment of the level of camaraderie among students and their preparedness to welcome a new group member. Game-based forms of collaboration are equally effective in the context of career guidance. Additionally, games foster team spirit, stimulate creative expression, aid in students' adjustment to the team, and predispose them to interactive participation.

Puzan (2019) underscores the efficacy of game-based learning strategies, attributing their success to the central role of active participation and interaction. This perspective signals a departure from the perceived ineffectiveness of traditional teaching methods. Furthermore, the utilization of collaborative role-playing games provides students with an opportunity to

apply acquired knowledge and skills in practical scenarios. The gamified environment offers a platform where real-world challenges become more manageable, allowing students to gain experiential insights.

Churock and Shamonya (2022) delineate several functions fulfilled by game technologies in education, including educational and cognitive, research, developmental, professional adaptation, and control functions. Notably, they place specific emphasis on computer games as a prominent manifestation of gamification within the contemporary educational landscape. As per the researchers, computer games are interactive applications crafted through the utilization of information technology, specialized software, or online services. These applications aid students in acquiring a more comprehensive understanding of educational material or assessing their knowledge through gameplay on a computer. Prominent gaming platforms highlighted by the researchers include Duolingo, MinecraftEdu, and Scratch.

The insights shared by Pirs (2023), as documented on the Teaching Time blog and focusing on the gamification of education, offer an intriguing perspective. The researcher advocates for the active engagement of students in game-based learning methods from an early age, emphasizing the continuity of such approaches throughout their entire educational journey.

Aligned with Onyshchenko (2021), we posit the significance of emphasizing the preparation of future educators for leveraging game-based learning technologies in their interactions with students. The researcher contends that acquiring proficiency in game technologies during the teaching process in a student classroom presents new avenues for teachers to achieve professional self-realization and optimize their utilization in practical engagement with students. Strategies such as online quests, addressing professional dilemmas, problem-solving approaches, virtual travel, role-playing games, and similar methodologies can be effectively employed in student interactions (Imanbazar & KimYe, 2023).

In unanimous consensus, scholars acknowledge that game-based learning technologies serve as motivational tools for students, fostering engagement in work, acquisition of knowledge, skills, and abilities, exploration of new phenomena, and the cultivation of independent viewpoints without fear of expression. It is crucial, however, to exercise caution against an excessive embrace of gamification in learning. The systematic development of ratings, conducting surveys, and constructing diagrams may inadvertently shift the focus for students toward winning the game, potentially overshadowing the primary goals of knowledge acquisition and enjoyment of the learning process.

3. Methods

Throughout the study, various methods were employed, including analysis, synthesis, and the systematization of scientific literature, particularly when working with literary sources and scientific research. Additionally, the method of generalization was utilized for the examination of the distinctive features associated with game technologies in education.

To conduct research on the impact of gamification on the educational process, we focused on the processing of statistical data and received reports of educational institutions regarding the implementation of modern digital technologies. Using Classcraft, Socrative, Moodle, and Quizizz platforms as tools for implementing gamified elements into the educational process, changes in student engagement and academic performance were analyzed, both based on own observations and conducted surveys.

For this, quantitative methods of analysis were applied, including statistical processing of data on student interest and their evaluations before and after the implementation of gamification. The analysis was carried out by comparing the development of digital technologies in different regions of the world, studying using interactive methods and the share of students who continued their education in the traditional way (Semenets-Orlova et al., 2022).

The appropriate methodology made it possible to assess the impact of gamification on students' motivation and their academic growth. The study is based on scientific data, which used as t-test for independent samples and analysis of student performance in different regions of the world. During the analysis, it was determined that gamification has a significant impact on the motivation of students in the educational process, stimulating their active participation in the educational process. The analysis showed that the introduction of game elements in the form of points, levels, awards and the presence of elements of competition helps to increase students' interest in subjects and improve their academic achievements.

Taking into account the available statistical data, the methodology provides a number of recommendations for educational institutions to optimize the use of gamification in educational programs. The recommendations are aimed at increasing student motivation and creating a dynamic and interactive learning environment that meets the needs of the modern educational process. This approach provided a comprehensive understanding of the impact of gamification on the educational process, demonstrating its potential to improve the quality of education and the effectiveness of learning.

4. Results

The examination of relevant research, and literature, and the monitoring of websites providing online games for learning gamification, along with game-based training simulators, enables us to assert the effectiveness of game technologies in education. This is particularly evident in the development of teamwork skills, fostering friendships, encouraging healthy competition, and enhancing teacher-student interaction. However, it is essential to acknowledge that the educational process enriched with gaming technologies may also introduce potential negative effects. A detailed exploration of these effects is provided in the table titled "Positive and Negative Effects of Game-Based Learning Technologies and Gamification in Education" (Table 1).

Table 1 Positive and negative effects of game-based learning technologies and gamification in education.

Game-based learning technologies in education, gamification	
Positive effects	Negative effects
Healthy competition, contesting	Rivalry
Free choice of the proposed roles, freedom of choice, and opinion	Possible loss of control of the teacher
Formation of emotional intelligence	Excessive enthusiasm for gaming techniques has the potential to result in a loss of control, disruption of the learning process, and diminished interaction, consequently leading to a decline in student achievement.
Development of mobility, activity, dynamism, and ability to make responsible decisions and choices quickly	In the absence of reflective practices on the part of the teacher, certain participants may disproportionately dominate others, underscoring the significance of purposeful division into pairs and groups.
Emotions of joy and fun, positive comradely climate in the classroom	In the context of online game-based learning, the absence of "live" communication results in a diminished opportunity for socialization.
Improving memory, improving physiological and psychological state	
Assimilation of knowledge without coercion	
Stimulation of mental activity, development of logical thinking	
Motivation to study	

The examination of the characteristics outlined in the table indicates a notably reduced negative aspect of game-based learning. Considering the contemporary shift towards digitization and virtualization, encompassing familiar processes through games, an adjustment to new formats of knowledge acquisition and utilization becomes imperative.

When delving into discussions surrounding gamification and gaming technologies, it is imperative to emphasize that these terms are not synonymous and are often employed within a broader context. As articulated by Bullock (2023):

Gamification refers to the application of game mechanics in non-game settings to motivate learners. This involves the incorporation of elements such as rewards, achievements, and badges. Gamification allows learners to personalize the learning process, utilizing experience points and levels instead of conventional grades. It serves the purpose of tracking progress and performance on a larger scale.

Game-based technologies involve the utilization of games to align with specific learning outcomes. Learners engage in learning through gameplay, leveraging educational games and simulations to enhance knowledge retention. The focus is on the development of specific skills while engaging in designated tasks. Growth Rate of Game-based learning Systems can be calculated in Figure 1.

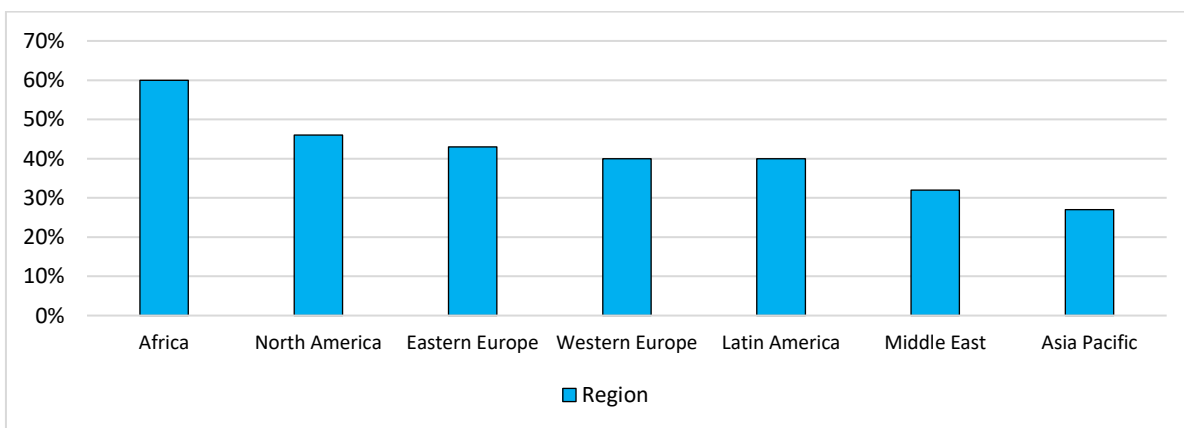


Figure 1 Projected 5 Year Growth Rate of Game-based learning Systems by Region.

Source: Growthengineering (2023).

The development of gamification in Europe, America and Africa shows unique trajectories according to regional characteristics, cultural preferences and the degree of technological progress. In Europe, with its developed digital technology market and strong data protection regulations, gamification is focused on creating value for users with an emphasis on educational and social programs and learning.



In America, entrepreneurship and innovation are culturally pervasive, so gamification is being used as a means to increase customer engagement and sales in a variety of sectors, including retail, marketing and education, using advanced technologies such as artificial intelligence and virtual reality (Yuldashev et al., 2022).

In Africa region, where technological development is rapidly increasing, gamification is experiencing a higher rate of development, thanks to the already existing experience of other regions and adaptation to local needs. Using mobile technologies that are widespread on the continent, gamification in Africa focuses on social change, education and health, providing resources and information through game engines, making it an investment target. The main difference between regions is how gamification is woven into socio-economic and cultural contexts, with Africa focusing more on solving pressing problems, Europe focusing on education and social inclusion, and America focusing on education and commercial gain (Antoshkina et al., 2023).

In the field of gamification and learning platforms, numerous technologies and platforms are used, each of which aims to improve the user experience and the effectiveness of learning. The Duolingo platform uses gamification for language learning, offering users game elements such as points, levels and virtual rewards to motivate language learning (Popovych et al., 2021).

Kahoot! another popular platform, allows you to create game quizzes for classroom and distance learning, promoting active engagement and cooperation among students. In the corporate learning sector, effective platform uses gamification to improve employee productivity by offering personalized missions and goals. Unity Technologies is behind numerous educational and gaming projects, providing a powerful game development engine used in the gamification of learning processes. Moodle, an open e-learning platform, integrates game elements through plugins to enhance student learning.

Virtual and augmented reality technologies in the form of Oculus Rift for VR experiences and Apple's ARKit for creating augmented realities are changing approaches to learning by offering interactive and immersive experiences. Available technologies and platforms together form the cutting edge of gamification and e-learning, demonstrating how game mechanics can be integrated into educational processes to increase motivation and learning effectiveness (Elbrekht et al., 2022).

The significant impact of gamification on learning methods and student engagement is evident through the innovative use of game techniques and platforms. One example is the Classcraft platform, which turns classroom and home learning into a game-based adventure, engaging students through role-playing and team interaction.

Socrative, allows teachers to create game-based quizzes and real-time polls that encourage active student participation and provide instant feedback. It is worth mentioning Quizizz, which allows you to integrate educational content into a quiz format with game elements, increasing student motivation through competitive elements and virtual rewards.

Numerous studies by leading universities in Europe and America have shown that using Classcraft can reduce the number of distractions in the classroom by 20-60%, and using Socrative and Quizizz increases active student participation by 50-70%. The platforms demonstrate how game mechanics can be adapted for a variety of educational purposes, from increasing student engagement to improving the understanding of educational materials, showing the enormous potential of gamification in education and the need for its implementation in other educational institutions.

5. Discussion

According to the results of current research and based on statistical data, it is clear that game learning technologies have been quickly integrated into the educational process, and are even more often used outside the classroom. As scientists are convinced (Kostankevych et al., 2023; Puzan, 2019), this was facilitated by the transformation processes in the education system, particularly the emergence of the concept of the New Ukrainian School. The authors' research results explain the current study's conclusions (Figure 2).

Several scientists (Kuntsevskaya, 2020; Bryukhovych, 2023; Boyko, 2023) are convinced that within the framework of the outlined concept, Ukrainian teachers, having increased their qualifications, have gained the autonomy to independently form curricula, choose methods of cooperation with students, and enrich the process of knowledge acquisition with specific materials. As a result, scientists are convinced, that a significant number of teachers, realizing the interest of students in modern technologies, introduce them into the educational process, using such platforms as communication in messengers, chats, online surveys, questionnaires, etc. However, supporters of traditional education, according to scientists (Semenets-Orlova et al., 2021; Korshunov, 2021), are not appeased, arguing that excessive enthusiasm for game-based learning methods and virtual reality does not bring benefits. They claim that such approaches are harmful and negatively affect the level of knowledge and achievements of students. Critics argue that these methods encourage the cultivation of unruly and problematic behavior, distracting students from real school life.

Controversy surrounding this issue is considerable. However, it can be argued that the modern school, being at the stage of reorganization, has ushered in a new era in which modern game, virtual, and ICT technologies coexist with traditional teaching methods. It is worth agreeing with the authors (Boremchuk & Kostankevich, 2020; Onyshchenko, 2021), who are convinced that such a combination enables significant and truly effective transformations in education, especially at its qualitative level.

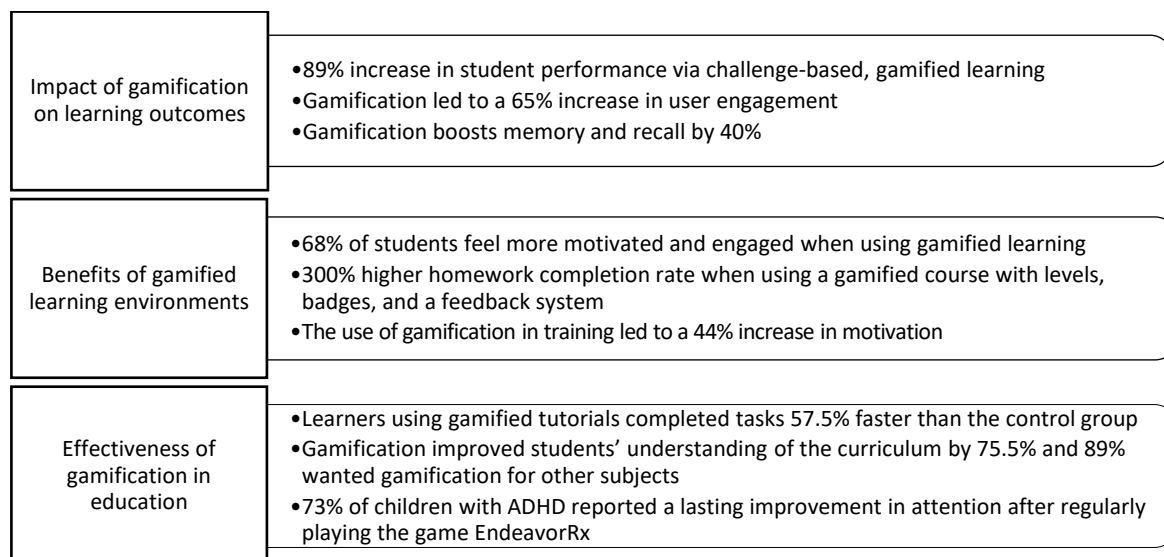


Figure 2 Gamification in Educational Achievement.

Source: Axonpark (2023).

In the studies of Birt (2023), Bullock (2023), Imanbazar & KimYe (2023), emphasis is placed on the process of generalization as a key methodological approach, studying gamification and game-based learning technologies in pedagogical and scientific discourse in both Ukrainian and international contexts. Such experience is of great value for the development of the educational environment in Ukraine, and the approach of the cited scientists corroborates the conclusions of the current study.

Several modern scientists (Masman, 2023; Nindur, 2023; Yuldashev et al., 2022) emphasize the actualization of the elimination of standardization in the educational process, the need to develop student interest, stimulate motivation for academic efforts, encourage joint learning and dynamism, as well as the development of creativity. The authors believe that the above factors are integral attributes of modern pedagogical approaches, which coincide with the prevailing transformational trends in education both in Ukraine and throughout the world.

6. Conclusions

In summarizing the study, the following observations are deemed pertinent:

1. The dynamics of modern education necessitate the incorporation of game-based learning technologies, aligning with ongoing transformation processes, the implementation of the New Ukrainian School concept, and the rapid digitalization permeating all facets of life.
2. Gamification stands as a method to foster effective interaction among students in the classroom and with the teacher.
3. Game-based learning methods contribute to the cultivation of competencies and attributes in a student's personality that are particularly relevant in contemporary times, including creativity, freedom of thought and choice, emotional intelligence, logical thinking, diplomacy, the ability to make prompt and responsible decisions, adept problem-solving, dynamic adaptation to societal demands, and open communication, among others.
4. The amalgamation of game-based learning with traditional instructional formats proves to be significantly more effective.
5. The incorporation of gamification in learning establishes conditions conducive to facilitated comprehension, cultivates motivation for learning, and nurtures a proactive inclination to engage in the learning process.
6. Game-based learning technologies assume significance for future students by affording opportunities to experiment with diverse roles, thereby mitigating the development of fear, uncertainty, and shyness.

Subsequent investigations in this domain should persist to conduct an in-depth exploration of the alterations in a student's personality throughout the integration of game technologies in the classroom. These studies should encompass the analysis of their moods and learning needs, the fostering of positive personal characteristics, and the overall provision of quality education.

Ethical considerations

Not applicable.

Conflict of Interest

The authors declare no conflicts of interest.

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