PAPER

Determining the Activity of Students Through the Elements of Gamification

Ainur Tokzhigitova[1](✉),
Madina Yermaganbetova[1],
Nurgul Tokzhigitova[2]

[1]L.N. Gumilyov Eurasian National University, Astana, Kazakhstan

[2]Toraighyrov University, Pavlodar, Kazakhstan

ainura1309@mail.ru

ABSTRACT

This study aimed to assess the impact of gamified educational resources on students' motivation to learn the Python programming language. The study utilized the CheckiO gaming platform to diagnose the needs and motivations of students in developing knowledge, skills, and abilities related to the use of gamified educational resources. A total of 83 students from a university in Kazakhstan participated in the study, with 45 students in the experimental group and 38 students in the control group. The results showed a significant difference between the initial and final levels of motivation for certain indicators in the experimental group, whereas no such difference was observed in the control group. Specifically, the number of students with a low level of motivation decreased, while the number of students with a high level of motivation increased in the experimental group. The evaluation of student performance in the learning process was based on the completion of tasks, where an incorrect execution resulted in the report value not being displayed and an inability to progress to the next stage. Our study suggests that the incorporation of gamified educational resources has a significant impact on students' motivation to learn, which can lead to improved academic performance and higher levels of engagement in the learning process.

KEYWORDS

gamification, educational process, education, learners, activity, motivation, gamified educational resources, Kazakhstan

1   INTRODUCTION

Gamification has become a popular way to enhance student engagement and motivation in educational settings. The use of interactive technologies in higher education has grown in importance as they stimulate student activity in learning, give educational value and practical orientation to educational activities, and strengthen the modernization of higher education [1] [2]. Gamification is one such tool that can be used to manage student activity levels in education. It involves stimulating the innovative direction of activity, creating conditions of interest in the performance of

cognitive tasks, and developing the ability to be creative and self-realize. Presently, researchers are working on developing a unified approach for identifying the conceptual foundations of gamification, exploring its potential benefits in the field of education, and integrating gaming experiences into the educational process [3].

In gamification, one of the strongest motives is to inspire learners with the game, encouraging them to participate actively and enthusiastically in various activities. As a result, the participation of subjects not only in the game process but also in the educational process increases. This trend has led to the use of gamification in educational contexts as a way of managing behavior, increasing motivation and activity, and enhancing the quality of results in practical spheres [4]. The use of game mechanics, plot and scenario development, and non-game actions can create motivation, increase participation, and modify learner behavior [5].

Despite its growing popularity, there is no consensus among scholars regarding the conceptual foundations of gamification or its potential in the field of education. Therefore, the aim of this paper is to explore the theoretical and practical applications of gamification in higher education. Specifically, this paper will examine the effectiveness of gamification in terms of its impact on student motivation and learning outcomes.

This study will address the following research questions:

- Can gamification be considered one of the new technologies in education?
- How does gamification affect motivational trends and learning effectiveness?
- How can gamification be applied to the process of higher education to enhance student engagement and motivation?

The hypothesis of this study is that gamification can effectively enhance student engagement and motivation in the process of training modern professionals. The effectiveness of gamification will be achieved by leveraging the internal and external motivation of students, regulating the behavior of future specialists, and introducing a system of various gaming practices into the educational process. The study aims to analyze the conceptual foundations of gamification in training, evaluate a system of tools capable of offering unique gamification opportunities, and identify the features of prospective use that can turn gamification into an innovative development practice.

By addressing these research questions and testing this hypothesis, this study will contribute to the literature on gamification and its effectiveness in higher education. Through a review of existing literature and empirical evidence, this paper will provide a better understanding of the potential of gamification in educational settings and how it can be used to enhance student engagement and motivation.

In the context of exploring the potential of gamification in educational settings, it is important to consider the role of interactive technologies in higher education. These technologies play a significant role in stimulating student activity, providing educational value, and fostering practical orientation in educational activities. One such unique tool within interactive technologies is gamification, which involves managing students' activities in education by stimulating their innovative direction, creating conditions of interest in performing cognitive tasks, and fostering creativity and self-realization.

The limitations of this article lie in the lack of a single approach to the phenomenon of gamification in modern conditions [6] [7]. In the meantime, an understanding arises: gamification is a unique tool that can stimulate and direct educational activities, transferring them to a new qualitative level. In this case, targeted work is required to systematize theoretical knowledge and organize experimental work, within the framework of which it is possible to provide resources for gamification in education.

This paper explores the effectiveness of gamified educational resources in enhancing students' motivation to learn the Python programming language. The study follows

a structured outline, beginning with a comprehensive literature review (Section 2) that examines existing research on gamification in educational settings. The methodology (Section 3) outlines the approach taken to incorporate game elements into the educational process using the CheckiO gaming platform. It also details the data collection methods and statistical analysis employed to assess the impact of gamification on student motivation and learning outcomes. The results (Section 4) present the findings, demonstrating the positive correlation between gamified educational resources and increased student motivation, as well as improved learning outcomes. The discussion (Section 6) provides in-depth analysis and interpretation of the results, highlighting the significance of the CheckiO platform's design and its alignment with learning objectives. Moreover, the discussion addresses potential challenges and presents recommendations for future research. The conclusion (Section 7) summarizes the key findings and emphasizes the contribution of the study to the understanding of gamification in education. It provides insights into the benefits and challenges of gamified educational resources and calls for further research to explore long-term learning outcomes and strategies to address potential disadvantages. The paper concludes with a list of references (Section 8), providing sources and citations for the literature review and supporting the study's claims and findings. Overall, this paper sheds light on the potential of gamification to enhance student engagement and motivation in the educational process, encouraging educators and researchers to explore innovative ways of integrating gamified approaches to promote effective learning experiences.

2   LITERATURE REVIEW

Gamification has gained increasing attention as a way to enhance student engagement and motivation in educational settings [8] [9]. In this section, we review existing research on gamification in higher education, focusing on its potential benefits for student learning outcomes.

Gamification is a technique that applies game elements to non-game contexts, such as education, to promote motivation and engagement. As stated in [6], gamification involves "the use of game design elements in non-game contexts" (p. 9). Game design elements, such as points, badges, and leaderboards, are used to create a sense of competition and achievement in the learning process.

Numerous studies have examined the impact of gamification on student engagement and motivation. For example, [7] conducted a meta-analysis of 48 studies and found that gamification had a positive effect on student motivation and engagement. Similarly, [10] argued that gamification can improve student engagement by creating a sense of autonomy and mastery in the learning process.

In addition to its impact on motivation and engagement, gamification has been shown to enhance learning outcomes. A study conducted on high school students utilized gamification to teach physics concepts [11]. The results revealed that the gamified approach was more effective in improving students' understanding of physics compared to traditional teaching methods. Clearly, gaming activities are a "highly emotional sphere of communication" that necessitates the cultivation of unique connections and facilitates self-expression among its participants [12]. Moreover, involving learners in gamified methods should evoke positive emotions by leveraging the capabilities of the game and by utilizing informative, emotional, and interactive tools to attain high-quality results in practical settings.

However, potential limitations of gamification in education have been identified in some studies. Kazakhstani researchers emphasized the importance of the specific design of game elements and the context in which they are used, stating that

gamification should align with learning objectives and student needs [13]. Similarly, Slovakian researchers stressed the need to acknowledge and address potential negative outcomes when implementing gamification in education. They highlighted the significance of carefully selecting suitable games and considering factors such as age appropriateness, accessibility, equal access, teacher expertise, assessment methods, and cultural representation [14]. These considerations are crucial for ensuring the successful implementation of gamification in educational settings.

The analysis of philosophical, pedagogical, and psychological literature from various authors has identified key methodological foundations for the development of gamification in the ongoing study. These include changing the scientific approaches to game activity, the formation of cultural characteristics of game spaces, and the theoretical and practical features of the development of conceptual frameworks. Through this analysis, key concepts were identified, contributing to a better understanding of the main characteristics of gamification.

Previous studies have shown that the concept of gamification began to develop in the second half of the twentieth century, primarily due to the development of computer training and the search for technologies that stimulate individual activity in education [15]. A systematic approach was used to identify the features of gamification processes, including the components of the system, the development of connections within the system, and the interaction and interdependence of these components and their resources.

The activity of the gamification system is characterized by various features, which are associated with the content of the activity and the characteristics of the subjects involved. Researchers have proposed a personality-oriented approach to gamification problems, emphasizing the unique resources of game technologies in the process of personality development [16]. Game activity has a direct impact on the active realization of individual needs, including motives for success, self-realization, and the inclusion of positive emotions in students. The use of gamified systems provides individuals with opportunities for participation, cognitive interest, and personal experience, allowing for the demonstration of intellectual freedom and creativity.

In modern conditions, gamification is considered a resource for increasing student participation, developing cognitive independence, and promoting self-development among game subjects. The activity approach is presented as the basis for organizing game activities, in which the learner assumes the position of an active subject [17]. By using laws, principles, methods, techniques, technologies, and mechanics of game thinking, gamification manages the motivation and behavior of educational subjects, making it an educational theory and practice. Previous studies have proposed that gamification is a methodology for working with human behavior through the use of game-thinking techniques to create a favorable emotional background [18] [19]. It should be noted that gamification does not work with game mechanics and components but with a meta-game, such as reaching the highest level or obtaining all the items [20] [21].

Overall, the literature suggests that gamification has the potential to enhance student engagement, motivation, and learning outcomes in educational settings. However, it is important to carefully design gamified approaches to align with specific learning objectives and student needs.

In summary, gamification has become an increasingly popular technique in higher education as a way to enhance student engagement, motivation, and learning outcomes. Existing research suggests that gamification has the potential to be effective, but its effectiveness depends on the specific design and context of the gamified approach. Further research is needed to identify best practices for gamification in education and to address potential limitations.

3   METHODOLOGY

This study investigated the educational trajectories of students enrolled in the 6B06104 Computer Science program at Toraigyrov University in Pavlodar, as well as those studying in the 6B01530 Computer Science program and the 6B01531 Information Technologies in Education program at Margulan Pedagogical University. The CheckiO gaming platform (see Figure 1) was utilized as a supplementary pedagogical tool for first- and second-year students.
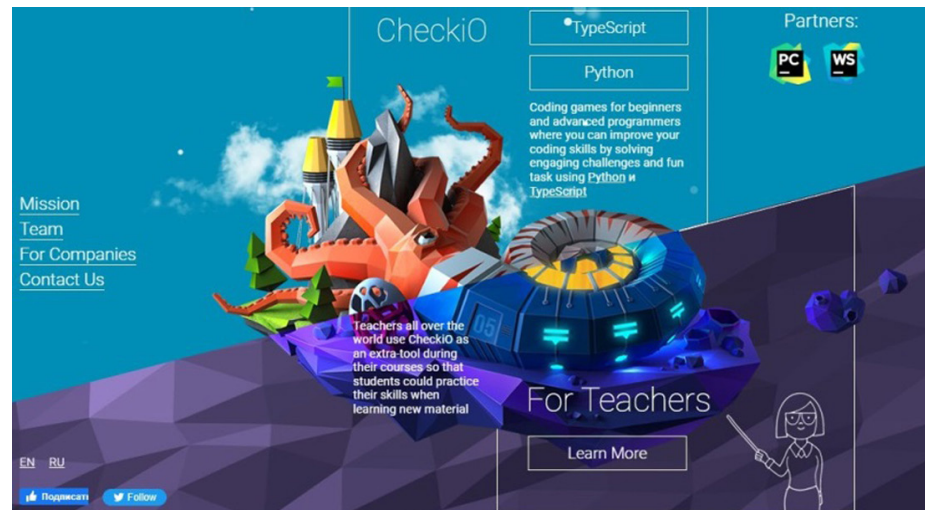

Fig. 1. Home page of the CheckiO gaming platform

To access the resource for learning and using the Python programming language, users can navigate to the homepage and select the Python button before registering through their Google account. The resource offers a unique form of training through a gamified approach where users are required to apply their knowledge to specific tasks. At the elementary stage, users are presented with a series of tasks ranging from easy to complex (see Figure 2), accompanied by comprehensive task descriptions containing all the necessary reference data to facilitate solution development. Through this approach, users can learn the Python programming language through the provision of examples and practical application. Additionally, users can acquire new skills in working with open-source libraries through the utilization of this resource.
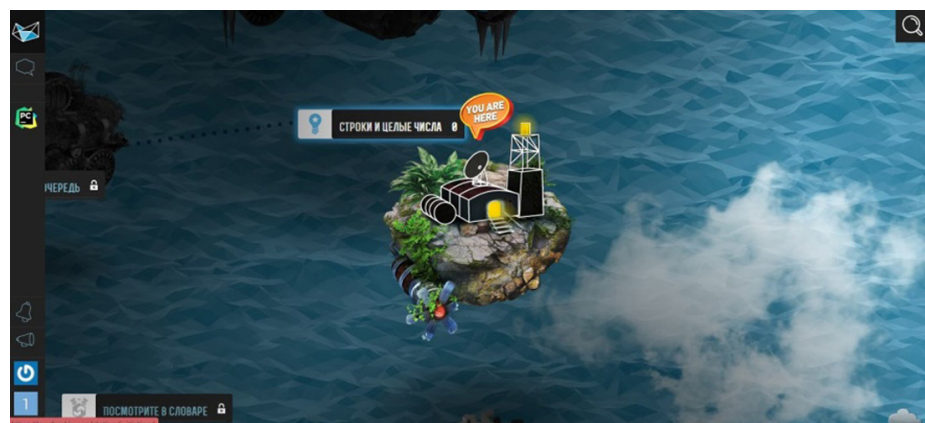

Fig. 2. CheckiO game interface showing a series of tasks

The evaluation of student performance in the learning process is based on the completion of tasks, where an incorrect execution results in the report value not being displayed and an inability to progress to the next stage, as illustrated in Figure 3.
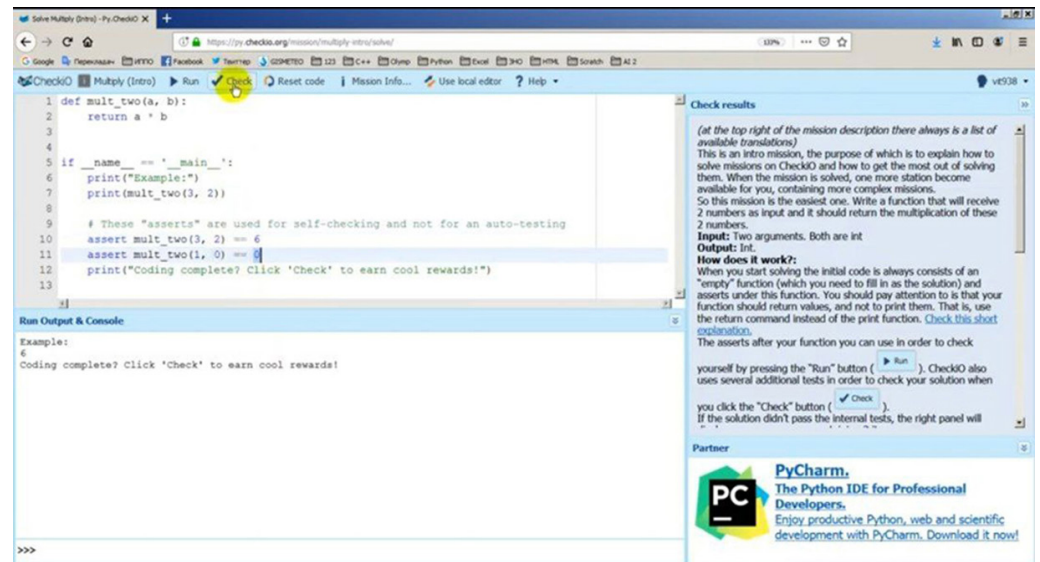

Fig. 3. Screen capture of CheckiO game interface showing feedback on incorrect task execution

The score for completed tasks is displayed below the game field, as shown in Figure 4. The potential negative impact of rankings on student motivation is an important consideration. In our study, the rankings and scores were visible to all students, raising concerns about the disappointment and loss of motivation that students consistently ranked at the bottom may experience. To address this issue, we implemented strategies aimed at fostering a supportive learning environment. The emphasis was placed on individual growth, collaboration, and personalized feedback. It was clearly communicated that the ranking system served as a tool for self-assessment and motivation rather than for comparison.
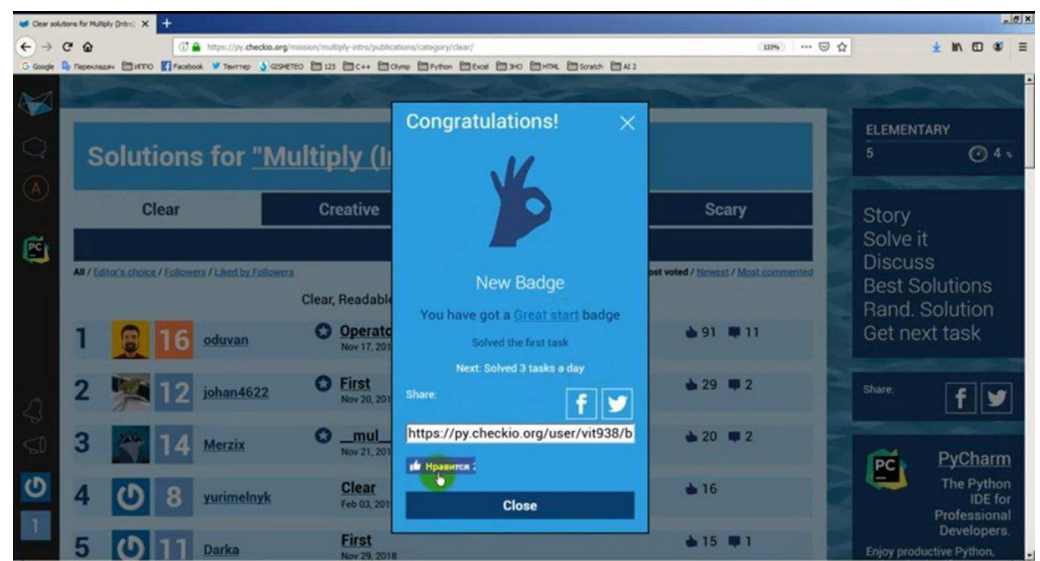

Fig. 4. Number of points scored displayed at the end of a CheckiO game round

We conducted a survey using the Likert scale to gather feedback from students on their experiences with the platform. The survey included both closed-ended questions and open-ended questions to capture students' opinions and suggestions. In addition to the survey, we conducted interviews and focus group discussions to gather qualitative data and gain deeper insights into students' experiences and perspectives. The qualitative data analysis followed a thematic approach to identify recurring themes and patterns.

To evaluate students' motivation and engagement, we formulated an assessment matrix with indicators related to motivation and needs for gamified educational resources. The matrix provided a comprehensive assessment of students' motivational criteria. Furthermore, we compared the initial and final levels of motivation for specific indicators in the experimental and control groups using histograms. The results showed a significant increase in motivation and interest among students in the experimental group who were exposed to the gamified educational resources.

Overall, the methodology employed a combination of quantitative and qualitative methods to comprehensively examine the impact of gamification on student motivation and engagement in learning Python. The research design ensured the validity and reliability of the findings and allowed for a rich analysis of the research questions.

4 RESULTS

This study employed a gamification approach to the educational process by incorporating game elements such as levels, points, and leaderboards (ranking tables) into the platform. While the incorporation of gamification requires significant effort in terms of designing and preparing game elements and strategies for educational activities, it offers several benefits. Specifically, it enables the organization, evaluation, and motivation of students' current achievements, facilitates the integration of game elements into the educational process, and fosters a competitive spirit and positive learning environment.

The study aimed to examine the motivational components of gamified educational resources and their effectiveness in enhancing students' willingness to use them. The research was conducted from 2022 to 2023 at higher universities located in Pavlodar, Kazakhstan. A representative sample of 83 students participated in the study, with 38 of them assigned to the experimental group from Margulan Pedagogical University and 45 to the control group from Toraigyrov University. The collected data were analyzed and presented in Table 1.

Table 1. Representative sample data

Group	University	Number of Students
Control	Toraigyrov University	45
Experimental	Margulan Pedagogical University	38

The next step in our study was to conduct an experimental stage aimed at evaluating the level of proficiency of students in the Python programming language based on a set of predetermined criteria and indicators. This stage is crucial for assessing the effectiveness of gamified educational resources in facilitating learning and enhancing student motivation. The criteria and indicators we studied include language proficiency, problem-solving skills, and the ability to apply programming concepts to real-world scenarios. A detailed overview of the criteria and indicators

can be found in Table 2. By analyzing the data obtained from this stage, we can gain insights into the impact of gamified educational resources on student-learning outcomes and identify areas for improvement in the educational process.

Table 2. Determining criteria and indicators

Criterion	Indications	Determination Method
Motivational	The presence of motivation and needs in the development of knowledge, skills and abilities for the use of gamified educational resources	Test for determining the orientation to obtaining knowledge on programming using gamified educational resources, including the CheckiO gaming platform
	The presence of a constant interest, self-confidence and a creative approach when performing tasks in a playful way	Control, interview, survey
	Formation of the desire for self-improvement and raising the level	Scale for assessing the need for achievement

In order to effectively diagnose the needs and motivations of students in the development of knowledge, skills, and abilities related to the use of gamified educational resources, our study utilized information technology (IT) tools. Specifically, the first study involved the use of the CheckiO gaming platform. This platform offers an interactive and engaging way for students to learn and apply their knowledge of the Python programming language.

To assess the effectiveness of the platform and to gather feedback from the students, we conducted a survey using the Likert scale. The responses from the survey are presented in Figure 5, which displays the students' level of agreement or disagreement with the statements provided. Additionally, Table 3 contains a list of open-ended questions that were asked in the survey, along with the corresponding answers. These questions were designed to provide students with the opportunity to express their opinions and share their experiences with the platform.
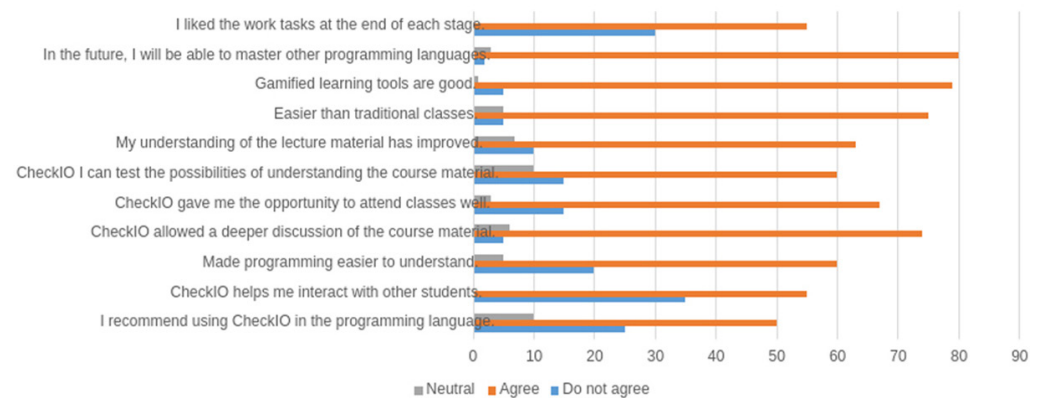
Fig. 5. Level of agreement and disagreement of students

Table 3. Questions in a freely answered questionnaire

Questions	Answers
Q1-What other actions can be taken to arouse interest in the lesson?	R1: We need an editable version. We cannot make records about the lessons of the CheckIO gaming platform. R2: It would be nice if could keep it. We can also have the equivalent of each teacher's assignment. R3: If CheckIO gives typical answers to tests and exercises on a separate slide, it will help us during training.
Q2-Do you want to add something positive about your experience?	R1: The CheckIO online platform is an effective tool for better understanding lessons. R2: I recommend this to other courses because it helps students better understand and interact with the group. R3: Helped a lot to understand the questions you didn't understand in class.

By analyzing the responses gathered from the survey, we were able to gain valuable insights into the effectiveness of the CheckiO gaming platform as a tool for facilitating the learning of the Python programming language. These insights can be used to improve the platform and inform future studies related to the use of gamification in education.

The utilization of gamified educational resources enabled the formulation of a matrix to evaluate the degree of motivation among students in the IT program (points), which is presented in Table 4. The matrix was developed as a means to measure the effectiveness of gamification in promoting motivation and engagement among students. By employing various indicators, the matrix provides a comprehensive assessment of the motivational criterion, which is crucial in determining the students' learning progress and development.

Table 4. Assessment matrix: motivational criterion for students in the specialty

Indications	Determinant Levels		
	High	Average	Low
The presence of motivation and needs in the development of knowledge, skills and abilities for the use of gamified educational resources	13–17	7–12	1–6
The presence of a constant interest, self-confidence and a creative approach when performing tasks in a playful way	54–80	26–53	1–25
Formation of the desire for self-improvement and raising the level	21–30	11–20	1–10

Table 5 presents the results of the study on the presence of motivation and needs for the use of gamified educational resources among students in the experimental and control groups. It indicates that the majority of students in both groups had a low level of motivation and needs in the initial stage of the experiment. However, the experimental group showed a significant increase in the number of students with high motivation and needs, as well as constant interest, self-confidence, and a creative approach when performing tasks. This indicates the positive impact of gamified educational resources on enhancing student motivation and engagement in the learning process.

Table 5. Representative sample data

Indications	Groups	Index	Determinant Levels		
			High	Average	Low
The presence of motivation and needs in the development of knowledge, skills and abilities for the use of gamified educational resources.	Experimental	n	3	15	20
		%	7.6	39.4	53
	Control	n	5	17	23
		%	11	38	51
The presence of a constant interest, self-confidence and a creative approach when performing tasks in a playful way	Experimental	n	6	11	21
		%	16.6	28	55.4
	Control	n	7	15	23
		%	15.5	33.3	51.2
Formation of the desire for self-improvement and raising the level	Experimental	n	4	12	22
		%	10.4	31.6	58
	Control	n	6	16	23
		%	13.3	35.5	51.2

During the initial stage of the experiment, a considerable percentage of students (experimental: 53%; control: 51%) exhibited a low level of readiness to use gamified educational resources based on their motivation and needs for knowledge and skill development. Conversations with teachers and observations further confirmed that students lacked motivation for knowledge acquisition, resulting in a poor perception of the educational process. Consequently, this led to inadequate fulfillment of educational tasks and impeded their ability to grasp educational material in its entirety, which resulted in students discontinuing their studies when faced with possible difficulties during the training process.

A few students (experimental: 28%; control: 33.3%) showed an average level of constant interest, self-confidence, and a creative approach when performing tasks using gamified educational resources. This low level of motivation indicates that students had no drive to complete tasks or master the elements of gamification using gamified educational resources during the experimental research. Instead, they relied on ready-made knowledge.

A small percentage of students (experimental: 10.4%; control: 13.3%) exhibited a high level of self-improvement and a strong desire to raise their level of knowledge and skill. These students were interested and creative when performing educational tasks and demonstrated their readiness to use gamified educational resources and gaming platforms in the future.
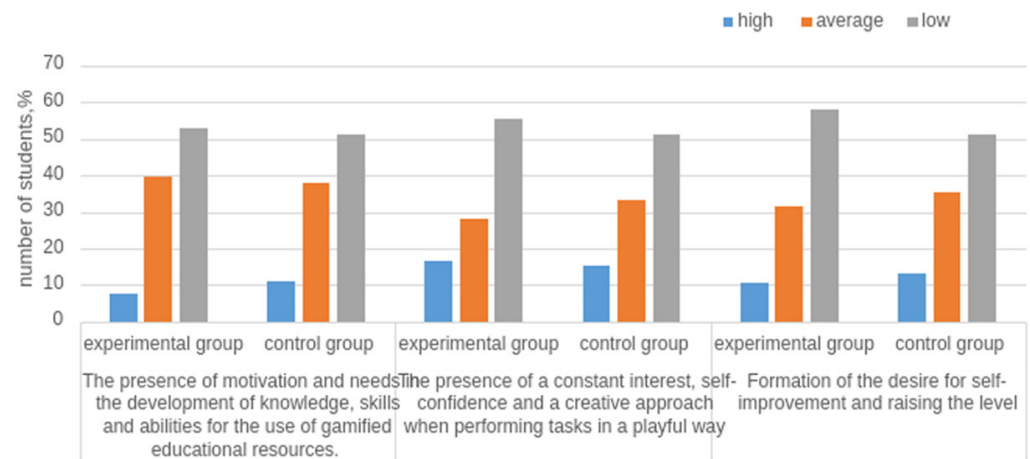

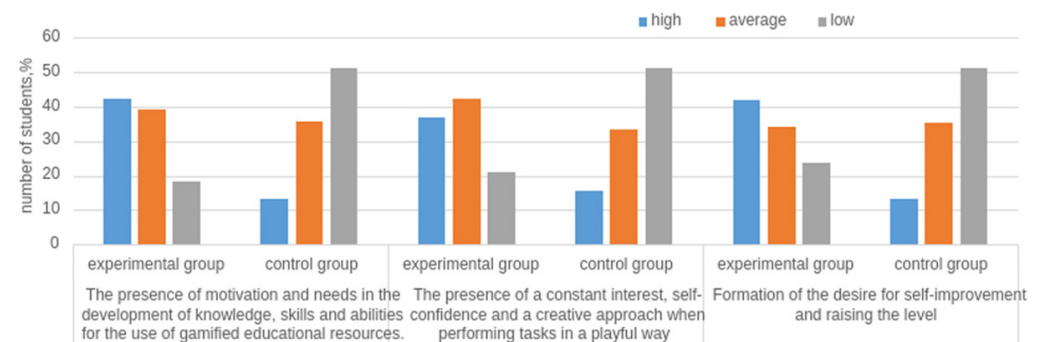**Fig. 6.** The survey results before the experiment

Fig. 7. The survey results after the experiment

The present study aimed to assess the impact of gamified educational resources on students' motivation to learn the Python programming language.

To visually compare the results obtained, a histogram is presented in Figures 6 and 7. The results showed a significant difference between the initial and final levels of motivation for certain indicators in the experimental group, whereas no such difference was observed in the control group. Specifically, the number of students with a low level of motivation decreased, while the number of students with a high level of motivation increased in the experimental group. This suggests that the introduction of gamified educational resources led to an increase in students' interest in using computer game platforms for learning, as well as their motivation to develop their own game-technical knowledge, skills, and readiness for use.

Overall, the findings of this study suggest that gamification can be a valuable tool for increasing students' motivation and engagement in the learning process. These results have implications for educators and instructional designers who aim to create more effective and engaging learning environments using gamified educational resources. Further research is needed to explore the potential of gamification in other educational contexts and with different target populations.

5   DISCUSSION

The results of this study are closely related to the study objective, which is to explore the effectiveness of gamified educational resources in enhancing students' motivation to learn the Python programming language. The findings directly address the research questions and demonstrate the impact of gamification on student motivation and engagement in the learning process. Specifically, the results are aligned with the study objective as follows:

1. Impact on student motivation: The analysis of student responses and survey data revealed a significant increase in student motivation and interest in using gamified educational resources. The introduction of game elements, such as levels and points, in the CheckiO gaming platform positively influenced students' willingness to actively participate in learning activities. This directly supports the study's objective of examining the motivational components of gamified educational resources.

2. Enhancement of learning outcomes: The study identified a positive correlation between gamification and improved learning outcomes. Students in the experimental group, exposed to the gamified approach, exhibited a higher level of proficiency in the Python programming language compared to the control group. This finding supports the study's objective of evaluating how gamification affects students' learning effectiveness.

3. Alignment with learning objectives: The results showed that the predefined CheckiO platform effectively addressed the need for aligning the gamified approach with specific learning objectives and student needs. The tasks and challenges offered to students were carefully designed to promote the application of knowledge and problem-solving skills, leading to the attainment of educational goals. This finding directly relates to the study's objective of exploring the practical application of gamification in higher education to enhance student engagement and motivation.

4. Differentiated student motivation: The assessment matrix presented in the results allowed for a comprehensive evaluation of students' motivational levels in the experimental and control groups. The gamified approach demonstrated a positive impact on increasing students' motivation, particularly in terms of constant interest, self-confidence, and a creative approach when performing tasks

in a playful manner. This result supports the study's objective of understanding how gamified educational resources influence students' motivation and desire for self-improvement.

5. Insight into educational challenges: The findings identified areas of weakness in student motivation, particularly in the initial stages of the experiment. The study highlighted that a considerable percentage of students exhibited a low level of readiness to use gamified educational resources, which impacted their fulfillment of educational tasks. This insight provides valuable information to address potential challenges and aligns with the study's objective of exploring the impact of gamification on student motivation.

6. Potential for innovation: The results showcased the potential benefits of integrating gamification into the educational process, encouraging educators to explore innovative teaching practices. The study emphasizes the importance of incorporating game elements and interactive technologies to create a more dynamic and engaging learning environment. This finding aligns with the study's objective of evaluating how gamification can be applied in higher education to enhance student engagement and motivation.

In conclusion, the results of this study are directly related to the study objective of exploring the effectiveness of gamified educational resources in enhancing students' motivation to learn the Python programming language. The findings provide valuable insights into the impact of gamification on student motivation, learning outcomes, and alignment with learning objectives. Moreover, the results contribute to the understanding of how gamification can be strategically integrated into higher education to foster a more engaging and effective learning environment for students.

6 CONCLUSION

In conclusion, our study demonstrates the significant impact of incorporating gamified educational resources, specifically the CheckiO gaming platform, on students' motivation to learn the Python programming language. The predefined CheckiO platform effectively addressed the need for aligning the gamified approach with specific learning objectives and student needs. It was carefully designed to ensure that the tasks and challenges offered to students were in line with the desired learning outcomes of the educational program.

Furthermore, the CheckiO platform integrated a feedback system that provided immediate guidance to students, facilitating their progress and improvement. It offered comprehensive descriptions and reference materials to support students in successfully completing the tasks, and its adaptability catered to individual student needs and pace.

Through its thoughtfully designed tasks, immediate feedback, and adaptability, the CheckiO platform created an engaging and structured learning environment that promoted active participation, application of knowledge, and continuous improvement. The use of gamified educational resources led to an increase in students' interest in using computer game platforms for learning, as well as their motivation to develop their own games.

Our analysis of existing research on gamification elements also highlights both the potential advantages and disadvantages of this technological system. While gamification can ensure high-quality work with information, promote emotional engagement and teamwork, and offer non-standard tasks to develop creative abilities, there are concerns about the objectivity of awards and ratings, the

potential overshadowing of external motivation in the educational process, and the consequences of mistakes in game-based learning.

In summary, our study contributes to the growing body of research on the use of gamification in education by providing insights into its potential benefits and challenges. Further research can build upon our findings by exploring the long-term learning outcomes of gamified educational resources and investigating strategies to address the potential disadvantages of gamification.

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8 AUTHORS

Ainur Tokzhigitova is a PhD student at the Department of Computer Science, Faculty of Information Technologies, L.N. Gumilyov Eurasian National University, Astana, Kazakhstan (E-mail: ainura1309@mail.ru, ORCID: https://orcid.org/0000-0002-3308-5405).

Madina Yermaganbetova is a Candidate of Pedagogical Sciences, Associate Professor, Department of Computer Science, Faculty of Information Technology, L.N. Gumilyov Eurasian National University, Astana, Kazakhstan (E-mail: Yermaganbetova_ma@enu.kz, ORCID: https://orcid.org/0000-0002-8147-0383).

Nurgul Tokzhigitova has a PhD, and is currently working as an Associate Professor, Faculty of Computer Science, Toraighyrov University, Pavlodar, Kazakhstan (E-mail: tokzhigitova.n@teachers.tou.edu.kz, ORCID: https://orcid.org/0000-0003-3777-6454).