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Means of gamification of learning during martial law

Ефективність використання забів гейміфікації навчання в умовах військового стану

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Abstract

The aim of the research was to investigate the impact of gamification on learning during martial law. An analysis of learning results and academic motivation of students who studied using gamification elements and the traditional "lecture-seminar" model was carried out. Academic motivation was assessed using the standard AMS-C questionnaire. It was found that the gamification of education contributed to the increase in the number of students who obtained Level B and reduction in the number of students who had Levels E and D. The use of gamification in general contributed to the strengthening of the motivation for learning, achievement and self-development. Feedback from students revealed that not all students liked the lack of correct action algorithms and the use of leader boards. It was established that the use of gamification during martial law contributed to an increase in the number of positive scores for the test exam and an enhanced intrinsic motivation. Learning motivation decreased among students who were trained with the use of gamification. Students'

Анотація

Метою дослідження стало дослідити вплив гейміфікації на навчання в умовах військового стану. Проведено аналіз результатів навчання та академічної мотивації студентів, що навчалися із застосуванням елементів гейміфікації та за традиційною моделлю «лекція-семінар». Академічну мотивацію оцінювали за стандартним опитувальником AMS-C. З'ясовано, що гейміфікація навчання дозволила збільшити кількість студентів, які отримали рівень знань B та зменшити кількість студентів, що мають рівень E та D. Застосування гейміфікації вцілому сприяло посиленню мотивації пізнання, досягнення та саморозвитку. Зворотній зв'язок від студентів дозволив виявити, що не всім студентам сподобалося відсутність правильних алгоритмів дії та застосування таблиць лідерів. Встановлено, що зовнішня мотивація студентів не зазнала змін під впливом гейміфікації навчання.

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external motivation did not change under the influence of gamification of learning.

Keywords: academic motivation, gamification, learning outcomes, martial law.

Keywords: гейміфікація, академічна мотивація, результати навчання, військовий стан

Introduction

Pedagogical science is constantly developing: new tools, methodologies, and technologies appear. The introduction of information technologies into all areas of people's lives has significantly changed the way people find and use new information (Lakhani & Wiedlitzka, 2022). The current generation of students have significant differences in learning style and requirements for it (Luke, 2020). This leads to the need to change the paradigm of the education system. The introduction of martial law as a result of Russia's military aggression against Ukraine and the transition to distance education created additional challenges in the education system.

Since February 24, 2022, Ukrainian higher educational institutions (HEIs) had to switch to distance and blended learning because of Russia's war against Ukraine. Distance learning is often asynchronous because of constant threats of shelling, communication and power outages. Studying the impact of armed conflicts on the education system and recovery after them is relevant and attracts the attention of many researchers and international organizations (for example, UNICEF, Global Coalition to Protect Education from Attack, etc.). These studies were used to develop recommendations for the implementation of the educational process in the context of armed conflicts were developed (Akresh, 2016; Leclercq et al., 2020). The recommendations emphasize that education should be continuous to prevent the worsening of the crisis in society.

During martial law, participants in the educational process may be in a depressed emotional state because of the lack of a sense of security or may not have the technical ability to join training synchronously (Akresh, 2016). Therefore, there is a need to change the traditional lecture-seminar approach to planning the educational process, since such an educational process reduces the learning motivation among students.

One of the newest pedagogical technologies is gamification in the educational process. Gamification is the use of game elements in non-game situations (Lo & Hew, 2020). Luke (2020) notes that gamification design elements are used to enhance motivation. They came to us from the world of games and are familiar to us in everyday life.

Ukraine has been implementing a number of education reforms in order to change the methodological principles of education. This is why the issue of studying the impact of gamification on education is relevant for Ukraine. Although researchers noted the overall positive impact of gamification on the educational process, the impact of gamification elements on the effectiveness of education under martial law is insufficiently studied. During the martial law, the participants of the educational process are under stressful influence, which can reflect on their performance, learning motivation and amotivation. We assume that the application of gamification elements to education can have a positive effect on academic performance, motivation and amotivation for students when studying the subject.

The aim our research is to study the impact of gamification elements on academic performance, learning motivation and amotivation of students during the educational process. The aim involved the following research objectives:

1. Analyse the learning outcomes of students who studied using gamification and those who studied according to the traditional lecture-seminar model
2. Study the impact of gamification of learning on students' intrinsic learning motivation.
3. Identify the role of gamification of learning in building students' external learning motivation and the development of amotivation.

Literature review

Learning outcomes and motivation are highly dependent on the teacher and teaching methods. The students' psychological condition is difficult in the wartime, they may not have the physical ability to complete the assignment on time. In such conditions, there is a need to use methods that enhance learning motivation and enable asynchronous distance learning. Students often

note that learning is difficult and simple memorization is boring, uninteresting and tiring. Learning outcomes can be influenced by several factors: abilities, motivation, level of anxiety and attitude towards the subject (Jati et al., 2020).

According to Shkuropat et al., (2021), the use of gamification elements in the educational process is intended to become a good monitoring tool and enhance students' learning motivation. The use of game elements in non-game situations is called gamification (Xu & Hamari, 2022). Elements of gamification are widely used in all spheres of human activity. Marketers widely use gamification, for example, "collect five stickers in a coffee shop to get the sixth coffee for free".

Modern children and teenagers are used to computer games, which have their own reward system, lack of negative attitude towards defeats, leader boards, communication through social networks, etc. (Lo & Hew, 2020). The attitude towards mistakes in games is somewhat different than in educational institutions. The educational institutions discourage mistakes, while they very rarely praise a correctly completed assignment. This is why pupils or students concentrate not on knowledge, but on obtaining grades. In computer games, a mistake is just one of the tools for achieving success. Gamification in education aims to use these elements to stimulate the desire to learn. It is very different from traditional forms of evaluation of learning outcomes. The academic literature provides data proving that the use of gamification eliminates the fear of failure and getting a bad grade (Shkuropat, 2018).

The introduction of gamification in education is related to the creation of entertainment elements and their transfer to building knowledge and skills that are components of professional training. Dalmina et al. (2019) and Matthew et al., (2022) note that gamification design elements are used to enhance motivation. They came to us from the world of games and are familiar to us in everyday life. The term "gamification" is often used to apply game elements to non-game situations to create a motivating environment and a fun learning experience (Leclercq et al., 2020). Gamification in education provides for the application of game mechanics and game elements in education in order to intensify learning and develop critical thinking, manage student behaviour and guide it in a certain direction (Toorn et al., 2022).

The term "serious games" was introduced by Abt back in 1970 to denote games that enable focusing on learning rather than entertainment. These games should appeal to students' everyday experiences (Toorn et al., 2022). According to Cruaud (2018), educational games are aimed at stimulating interest in the academic subject. Educational content in these games is presented in different ways: it can be implicit in serious games, while it is necessarily presented in educational games (Kulhanek et al., 2021). According to Schöbel et al., (2020), gamification of learning differs, as it uses elements of the game to advance towards the goal of acquiring new knowledge. For example, a student receives a badge for a correctly completed task. Although earning a badge is an element of the game, it is not tied to other elements of the game, such as levelling up. Piaget wrote in 1962 that game is a necessary prerequisite for different stages of a child's cognitive development. The child seems to go beyond the reality to an abstract level, manipulating such concepts as "acting as if". The game promotes the development of abstract thinking (Dehghanzadeh et al., 2021).

According to Suh et al., (2018), gamification is the best method to enhance learning motivation and encourage learning new material. Buckley and Doyle (2016) provide grounded evidence of the greater effectiveness of a gamified educational environment compared to a non-gamified one. The author assumes that this is connected with greater interest of students in learning, satisfaction with learning. The forms of control offered by gamification are interesting for students. These are, for example, points, badges, rankings or leader boards, virtual gifts, bonuses, etc. (Bateman, 2018). This promotes self-expression, satisfaction, and competition among students during their studies (Jati et al., 2020).

According to Dehghanzadeh et al., (2021), gamification elements such as points, leader boards, rewards, feedback, challenges are most often used in the educational process. Avatar, warning signals, virtual credits, medals, etc. are used less frequently. The elements of gamification can be divided into individual and social. Individual elements are points, virtual goods, time limit, etc. Social include interaction with other players, leader boards, rating tables, etc. (Ruggiu et al., 2022).

A study of the impact of gamification on the results of learning the basics of the taxation system, conducted by Buckley and Doyle (2016), showed a significant improvement in learning outcomes. Besides, they demonstrated that gamification of the learning process enhanced intrinsic motivation for the subject and self-

esteem motivation. In their opinion, such elements of gamification as leader boards and ratings stimulated interest in learning by stimulating gaming (Shkuropat et al., 2021).

Most researchers note that students attribute the following adjectives to the elements of gamification as "fun", "joyful", "pleasant", "interactive", "attractive", "interesting", etc. Research also shows that the use of gamification elements evoked interest, contributed to students' satisfaction and motivation. Rivera and Garden (2021) relate it to the psychological inclusion of students in the learning process, as well as having control over actions and the learning process.

Like any method, gamification in the educational process has its positive and negative features. The positive features of gamification include a web interface and asynchronous interaction of participants in the educational process. The negative ones include, for example, disconnection of the Internet and power outages during martial law.

Most researchers used surveys, focus group discussions, and student interviews to study the impact of gamification on learning. This suggests that most studies of the impact of gamification on learning are based on students' perception of the learning process. However, students' perception of learning and actual learning may not match. This necessitates a study of the impact of gamification on the effectiveness of learning, its outcomes and motivation.

Methods

Research design

We conducted an experimental study that included studying learning outcomes (academic performance of students) and students' intrinsic and extrinsic motivation, as well as amotivation to measure the impact of gamification on learning during martial law. The research covered the second semester (February 2022 – June 2022) of the 2021-2022 academic year under martial law in Ukraine. Mathematical Methods in Biology and Medicine was selected as an academic subject for the research. The students studied this subject during the second semester, once a week. This academic subject is usually difficult for students and has a low success rate.

The experimental group studied Mathematical Methods in Biology and Medicine with the involvement of gamification elements. Students were engaged in synchronous and asynchronous distance learning. Lectures were held for those students who had the opportunity to join online classes synchronously. Lecture materials were provided asynchronously for the rest of students. They could work with the leacture materials when they considered convenient. The Moodle platform was used for seminars which integrated gamification elements: digital points, badges for certain achievements, leader boards, levels with a progress indicator. All students could access the lecture material at any time. They planned their activities independently. Students could access all the lecture materials and then complete all the assignments. Another option was doing it gradually, topic by topic.

The control group studied Mathematical Methods in Biology and Medicine. The students were also engaged in distance learning synchronously and asynchronously. They studied according to the traditional lecture-seminar model. The difference was that no gamification elements were used for them on the Moodle platform, and they learned the test results from the teacher, who informed them of the results in alphabetical order.

None of the students had experience with gamified learning. Data were collected from two sources in order to assess the effect from using gamification. The first source is academic performance of students for Mathematical Methods in Biology and Medicine. Another data source was the determination of intrinsic and extrinsic learning motivation, amotivation before intervention and and after the intervention.

Methods

The analysis of academic performance of students for Mathematical Methods in Biology and Medicine, the study of academic motivation, amotivation and feedback in the form of questionnaires were used to identify the impact of gamification on learning during martial law. The students' academic performance for Mathematical Methods in Biology and Medicine were used to study the impact of the use of gamification elements on the academic performance of students for the subject. The academic performance of student were assessed in the following way. After completing the course, the students of the experimental and control groups had to pass a semester exam in the form of testing. The number of points for the test exam was summed up automatically, which

eliminated the subjectivity of assessing the impact of gamification on learning outcomes.

A student questionnaire (AMS-C) for determining intrinsic and external motivation and amotivation was used to determine students' academic motivation. This questionnaire proved itself reliable and has been used in about 1,000 studies of students' learning motivation. The questionnaire consists of 28 items divided into 7 subscales: three scales for intrinsic motivation, three scales for external motivation, and. one amotivation scale.

The learning motivation scale is related to the willingness to learn something new, interesting, and the satisfaction with learning something new. The achievement motivation scale reflects the desire to achieve success, to get satisfaction from solving complex problems. The self-development motivation scale reflects the desire to develop one's abilities as a result of educational activities, acquiring knowledge and competences. The self-esteem motivation scale is related to the desire to learn for the sake of self-respect and recognition, increased self-esteem, and a sense of self-importance. The motivation scale measures the willingness to learn, which is associated with a sense of shame and a sense of duty to others and oneself in case of poor learning. The external motivation scale measures the compulsion to study because of social pressure on the student. They learn because society makes certain demands on them, while their own autonomy turns out to be frustrated. This is learning for getting a good job in the future. The amotivation scale measures lack of interest in learning and understanding of the importance of learning. The survey was conducted on the same Moodle platform as learning. Surveys were conducted before and after learning.

Upon the completion of the experimental study, we additionally conducted a survey of students learning with the use of gamification in order for them to share their impressions of the learning process to get their feedback. The questionnaire included an open-ended questions: "Did you like the scoring system?", "Did you like the leader board?", "What are your general impressions of the use of gamification in education?" etc.

The experimental and control group were used for validating the results of studying the points obtained for the test exam and the points of the motivation scale.

We calculated the average statistical values of the levels of motivation and amotivation within the group. The relationship between variables was found through the Student's t-test. The indicators were compared within one group before and after the study. Group mean values between the studied groups were also compared. Two pairs of dependent samples and two independent samples were formed in connection with the set goal. There were two dependent samples. The first pair is an experimental group of students before and after the introduction of gamification elements. The second pair of dependent samples is a control group of students before and after the studies. Independent samples — comparison of the indicators of the experimental and control groups after the experiment. The Student's t-test for dependent samples was used to identify statistical significance when comparing indicators between dependent samples. The Student's t-test for independent samples was used to find out statistical significance when comparing indicators between independent samples.

The χ^2 criterion was used to study academic performance and to meaasure the statistical reliability of the distribution of knowledge levels in the studied groups of students. It enables determining the level of reliability of variables measured on a nominal scale (obtained scores) without taking into account the data distribution law.

Instruments

To find out the impact of gamification elements on students' academic performance, the final score obtained by students for the test exam in Mathematical Methods in Biology and Medicine. A student questionnaire (AMS-C) to determine students' motivation and amotivation was used in order to determine intrinsic and extrinsic motivation. The survey was conducted on the same Moodle platform as learning. Surveys were conducted before and after learning.

Sample

The study involved 60 second-year students majoring in 222: Medicine. They made up 2 academic groups. One group was experimental (n = 30), the other was control (n=30). The academic performance of students were evaluated based on the final grade they obtained for the exam. Students received a survey on academic motivation and amotivation on the Moodle platform asynchronously. The results were processed and summarized after the survey.

Ethical criteria

All students were informed about the study and gave their consent before starting the analysis of learning outcomes and academic motivation. Students' personal data were not disclosed, only summarized data were subject to discussion.

Results

A study of the impact of gamification on the educational process during martial law was conducted. Table 1 presents the academic performance of students of the experimental and control groups for Mathematical Methods in Biology and Medicine.

Table 1.
Learning outcomes of the surveyed students in the academic subject Mathematical Methods in Biology and Medicine

ECTS level	Experimental group	Control group
FX (35-59 points)	0	0
E (60-63 points)	6.67%*	16.67%
D (64-73 points)	10% *	30%
C (74-81 points)	36.67%	26.67%
B (82-89 points)	30% *	16.67%
A (90-100 points)	16.67%	10%

Note: *-statistically significant difference between experimental and control indicators at P≤0.05

There were no students among the surveyed ones who failed the test exam (FX). That is, all students scored the required minimum of 60 points. The number of students in the experimental group who received Level E was 6.67% of the surveyed students, while the number of such students in the control group was 16.67%. That is, the number of students who received Level E in the experimental group was significantly less than the number in the control group (P≤0.05). The number of students in the experimental group with Level D for the test exam was also less than the number of students with the same level in the control group. It amounted to 10% and 30%, respectively (P≤0.05).

Comparison of the number of students of the experimental group who received Level C revealed that it was higher than the similar number of students of the control group. There were 36.67% of the surveyed students in the experimental group, and 26.67% in the control group. However, this difference did not reach statistical significance.

The number of students of the experimental group who received Level B significantly exceeded the number of students of the control group who received Level B on the test exam (P≤0.05). In the experimental group, 30% received Level B for the test exam, in the control group — 16.67%.

The number of students of the experimental group who received Level A for the test exam was 16.67%. The number of students with Level A in the control group was 10% of the surveyed students. Although the number of students in the experimental group who received Level A exceeded the number of students of the control group with the same level, this difference did not reach statistical significance.

The average score of the surveyed students (Figure 1) was calculated and showed that the surveyed students received an average of 86.87 points for the test exam. Students of the control group received 76.2 points for the test exam. We found out that students who studied with the use of gamification elements demonstrated higher average scores compared to the indicators of students in the control group (P≤0.05).

So, among the students engaged in distance learning with the application of gamification, there was a greater number of students who received Level B and a smaller number of students who received Levels D and E compared to students engaged in distance learning without the use of gamification elements.

The AMS-C questionnaire was used to determine motivation to study. Four data sets were obtained as a result of the research (Tables 2, 3). The results of the survey of the experimental and control groups before the start of the experimental study (input testing; two data sets) and the results of the survey of the experimental and control groups after the end of studies and passing the test exam (exit testing; two data sets). The questionnaire of the academic motivation scale enables evaluating the components of intrinsic and extrinsic motivation separately to

clarify the overall picture of what a student is guided by during learning, and the impact of the application of gamification of learning on individual components of academic motivation.

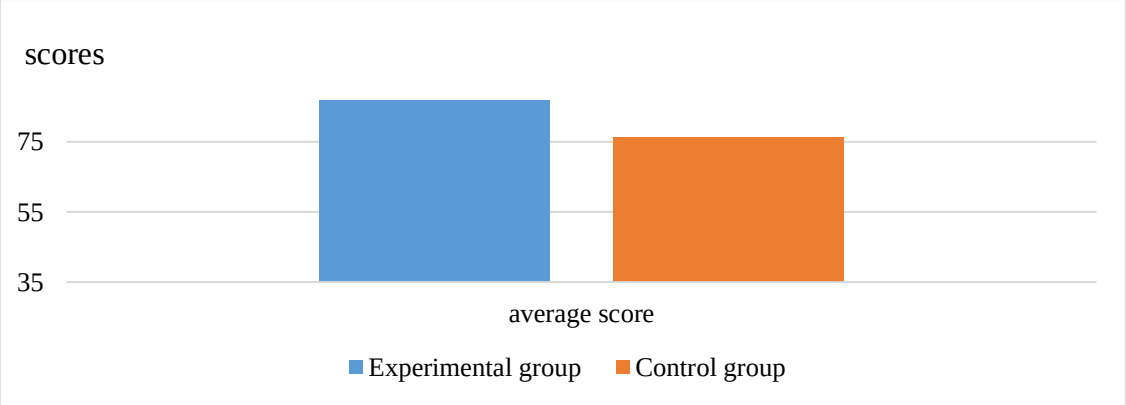

Figure 1. Average academic performance of the surveyed students
Note: *- statistically significant difference between experimental and control indicators at P≤0.05

Table 2.
An input study of the motivation of students who studied with and without the use of gamification

Academic motivation scales	Experimental group, scores	Control group	t-test when comparing experimental and control groups	p
Learning motivation	17.98	18.23	0.21	insignificant
Achievement motivation	19.01	18.96	0.1	insignificant
Self-development motivation	18.47	18.02	0.15	insignificant
Self-esteem motivation	16.47	17.11	0.43	insignificant
Introjected motivation	15.94	15.89	0.1	insignificant
Extrinsic motivation	18.23	18.41	0.17	insignificant
Amotivation	6.94	6.78	0.1	insignificant

Note: *-statistically significant difference between experimental and control indicators at P≤0.05

Table 3.
Output study of motivation of students who studied with and without gamification

Academic motivation scales	Experimental group, scores	Control group	t-test when comparing experimental and control groups	p
Learning motivation	20.67*	18.2	2.52	< 0.05
Achievement motivation	22.41*	19.17	2.87	< 0.05
Self-development motivation	21.84*	19.11	2.49	< 0.05
Self-esteem motivation	17.48	17.21	0.2	insignificant
Introjected motivation	16.28	15.97	0.37	insignificant
Extrinsic motivation	19.58	18.67	1.41	insignificant
Amotivation	4.42*	7.83	2.37	< 0.05

Note: *- statistically significant difference between experimental and control indicators at P≤0.05

Intrinsic motivation includes learning motivation, achievement motivation, and self-development motivation. There was almost no difference in the number of points scored by students of experimental and control groups on the learning motivation scale before the beginning of the experimental study. After completing the study of the academic subject Mathematical Methods in Biology and Medicine, students who studied with the use of gamification elements demonstrated an increase in learning motivation compared to the indicators before the start of the experimental study ($P \leq 0.05$). Indicators of learning motivation of students of the control group almost did not change during the study. When comparing the scores on the learning motivation scale after the experimental study of the students of the experimental and control groups, the indicators of the students of the experimental group turned out to be significantly higher than the similar indicators of the control group.

The number of points on the achievement motivation scale scored by the students of the experimental and control groups before the study did not have statistical reliability. The survey, which was conducted after the completion of the experimental study, demonstrated a statistically significant increase in the number of scores on the achievement motivation scale of the students of the experimental group. The achievement motivation of the students of the control group after the completion of the experimental study almost did not change. When comparing the indicators of achievement motivation of the two surveyed groups after completing their studies, we found a statistically significant increase in students who studied with the use of gamification elements ($P \leq 0.05$).

Studying the indicators of self-development motivation, we found out that both surveyed groups before the study of the academic subject Mathematical Methods in Biology and Medicine did not have a statistically significant difference in the scores of the relevant scale. After completing the studies, students who studied with the use of gamification demonstrated statistically significant increase in motivation for self-development, while the students of the control group only tended to increase self-development motivation. When comparing the indicators of self-development motivation between students of both groups after the experimental study, we found a statistically significant increase ($P \leq 0.05$) in the scores of the self-development motivation scale in the students of the experimental group compared to similar indicators of students of the control group.

Extrinsic motivation includes self-esteem motivation, introjected and external motivation. The number of points scored by the experimental group students on the self-esteem motivation scale did not have a statistically significant difference with the number of points scored by the control group on this scale. The output survey showed that the self-esteem motivation of students who studied with the use of gamification elements tended to increase, but did not reach statistical reliability. Indicators of self-esteem motivation of students in the control group did not change after the study was completed. The comparison of the scores of the self-esteem motivation scale of the students of the experimental and control groups after conducting the experimental study did not found a statistically significant difference. That is, the use of gamification had practically no effect on the motivation of self-esteem.The study of introjected motivation established that the experimental and control groups of students did not have significant differences in the indicators of this scale before the study. The survey conducted at the end of the study showed that the use of gamification in education in the wartime did not affect introjected motivation. The experimental group students showed almost the same result of the scale of introjected motivation as before the study. The indicators of the control group on this scale also did not undergo significant changes during the studies. No differences between the surveyed groups were found after the study.

The students of the experimental group did not have a statistically significant difference with the students of the control group in terms of external motivation before the experimental study. The use of gamification in the educational process among students of the experimental group led to an insignificant increase in external motivation. Students of the control group did not change the level of external motivation during the study period. Among themselves, the studied groups did not have a statistically significant difference in the number of points of the scale of external motivation, although the students of the experimental group tended to increase the indicators compared to similar indicators of the control group.

So, students' extrinsic academic motivation was almost unchanged under the influence of gamification of learning during martial law,

although self-esteem motivation and extrinsic motivation tended to increase.

The number of points for amotivation scale scored by the experimental group students before the study did not exceed the similar indicators of the control group students before the experimental study. The use of gamification in the educational process in the experimental group students significantly decreased the number of points on the motivation scale during the input test. The control group students showed, on the contrary, a tendency to increase motivation indicators after the study period. This difference between the indicators of the input and output tests did not reach statistical significance. The amotivation indicators of the two surveyed groups after the study period had a statistically significant difference ($P \leq 0.05$): the indicators of the experimental group were lower than those of the control group.

So, students' amotivation decreased under the influence of gamification of the educational process. The survey conducted with the aim of getting feedback showed that the majority of students (67.4% of the surveyed students) were quite satisfied with the inclusion of gamification in the educational process. They noted that the accumulation of points for the assignment, the progress scale stimulated the desire to complete the task, and the leader board helped to improve the process of learning the subject.

Among the positive reviews, it was often found that studies with the use of gamification can take place completely asynchronously, which is relevant during the wartime because of frequent air-raid warnings, lack of stable communication and lack of power supply.

Students who were dissatisfied with the learning process noted that they lacked clear correct algorithms of action, in their opinion, there were too many learning vectors that students could create for themselves. In particular, when studying the academic subject Mathematical Methods in Biology and Medicine, it was not strictly regulated whether the video lecture should be watched first, and then the test, or whether it can be done simultaneously. The student could first watch all the proposed video lectures, and then complete all the assignments. Some students did not like the leader board, they noted that they were dispirited by the fact that their results were compared with others.

Discussion

Learning during martial law is significantly different from learning under normal conditions. Students are often in a depressed emotional state, have increased anxiety, neuroses and even panic attacks. Learning in such conditions requires more effort from the student than in peacetime. In addition to the mental state, the students are affected by obstacles in the technical support of the educational process: lack of stable communication, electricity supply, being constantly on the road trying to leave because of the war. In such conditions, the educational process should contribute to the relief of emotional tension, make students interested, and motivate them for further professional activity.

We established that the gamification of the educational process during martial law contributed to an increase in the number of students who had Level B, a decrease in the number of students who had Levels E and D. Gamification of the educational process had an impact on the students' academic motivation. Students' intrinsic motivation (motivation to learn, achieve, and self-develop) increased in students who studied with the use of gamification. Extrinsic motivation (self-esteem motivation, introjected and external motivation) almost did not change under the influence of gamification. The students' amotivation decreased under the influence of gamification.

Buckley and Doyle (2016) found an increased motivation, namely intrinsic motivation and self-esteem motivation, which is a type of external self-esteem. In our study, only students' intrinsic motivation increased under the influence of gamification, while the extrinsic one almost did not change. All types of internal motivation are related to the desire to learn something new, satisfaction from solving complex problems, and the desire to build one's knowledge (Sotos-Martínez et al., 2022). The use of gamification stimulated such motives. This is confirmed by the study of Fernandez-Rio et al., (2020), who found that gamification caused positive emotions, the desire to learn, related to the educational process. The self-esteem motivation is related to the desire for recognition and a sense of self-importance (Shvets et al., 2020). Although studies have shown the positive influence of gamification on motivation in general and self-esteem motivation in particular (Yang et al., 2021). It is obvious that the said motives are not leading of students in the context of martial law. Besides, some students noted that they did not like the leader boards and

comparison of their results to the results of other students. This is probably caused by the increased anxiety during martial law. It increases even more because of the failure to comply with the requirements for oneself and own educational activities.

The studies on the impact of gamification often note that it has a positive effect on learning, increases student interest, thereby improving performance (Hassan et al., 2021). Our study is fully consistent with these results. In our study, students who learned with the use of gamification noted that they liked the system of accumulating points for completed assignments and the progress scale. In our opinion, this gave students an opportunity to plan their own activities and understand to the accents to increase the number of points.

According to Domínguez et al., (2013), the educational process is associated with increased students' anxiety and, as a result, decreased interest, indifference to the educational process. The state of war intensifies these phenomena in Ukrainian students, therefore the use of methods that can improve the emotional state (Chapman & Rich, 2018), enhance the interest in learning, encourage the study of new material (Cruaud, 2018) is a necessity. As our study showed, students who studied with the use of gamification really showed decreased motivation on the academic motivation scale, while students who were engaged in distance learning using traditional lectures and seminars showed increased learning motivation.

Jati et al., (2020) noted that the improved performance during learning with the use of gamification is associated with a decreased fear of receiving an unsatisfactory grade, since the learning process is evaluated in points, which excludes such a concept as "unsatisfactory grade". Our study confirms this opinion, the majority of students in our study positively noted the absence of unsatisfactory grades, and the points and progress scales. In our opinion, the absence of unsatisfactory grades reduced students' anxiety, and the progress scale encouraged them to complete the assignment.

Most researchers of the application of gamification in the educational process note an exclusively positive impact on learning outcomes (for example, Dehghanzadeh et al., (2021)). Our study showed that it is necessary to clearly plan the educational process when applying gamification methods The reason is that a part of the students noted that it was difficult for them to choose a learning vector for themselves in the absence of a correct algorithm of educational activities. When studying the academic subject Mathematical Methods in Biology and Medicine, it was not strictly regulated whether the video lecture should be watched first and then complete the test, or it could be done simultaneously, the student could first watch all the offered video lectures and then complete all the assignment. This caused difficulties for some students. In the context of the ongoing war, these students obviously experienced difficulties in self-organization, therefore, planning their own learning vector caused them difficulties.

So, we showed that the use of gamification of the educational process during martial law had a positive effect on learning outcomes, which is consistent with other studies on gamification of the educational process. However, students' learning motivation under the influence of gamification increased only with intrinsic motivation and the use of gamification had no effect on extrinsic motivation.

Conclusions

The educational process during martial law has its specifics: depressed emotional state of the participants in the educational process, technical difficulties for timely completion of assignments and participation in traditional seminar classes. This creates the need to introduce methods that will stimulate the educational activity of students, in particular, learning motivation.

Based on the study of learning outcomes and the academic motivation scale, we established that the use of gamification in the educational process had a significant impact on intrinsic motivation, in particular, learning, achievement, and self-development motivation. Learning amotivation of students who studied with the use of gamification decreased, that is, their interest in educational activities increased. Gamification contributed to the increased number of high scores among students for the test exam. We found students who had difficulties in learning with the use of gamification. Numerous studies found that gamification enhances students' motivation and interest in learning. However, these studies do not take into account students who have problems with self-organization and time planning, who need a clear, uniform algorithm for studying and time regulations.

The obtained results of the impact of gamification on learning during martial law are intended to strengthen the teacher's arsenal with

methods that enhance intrinsic learning motivation and interest in educational material. We found out that not all students could act in the absence of a clear correct action algorithm. The obtained results will help to improve studies of such students by clearly planning the educational process with the involvement of gamification.

Research limitations

This study is aimed at contributing knowledge to the growing volume of information on the creation of educational environments, increasing the effectiveness of learning and motivation for it. However, it has a number of limitations. These include a short research period, a small sample, and the lack of division into individual elements of gamification and the study of their impact on learning outcomes and motivation.

Prospects for further research

We plan to further expand the sample size, study the impact of individual elements of gamification on learning outcomes and academic motivation. Different strategies for the application of gamification for students with different self-organization abilities and time management require further studies.

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