Methods of students involving in the educational process in the mathematic disciplines

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ABSTRACT

This article is concerned with several strategies that help students appeal to their personal capacities and that make the studying process more engaging. Concerning those processes that involve the studying of subjects and the completion of tasks, students often find themselves "face to face" with formal task settings and the technical aspects of problems. This is particularly true concerning mathematical disciplines and the first year of study. During this period, students have an urgent need to "ensole" the discipline they are studying; they attempt to apply the knowledge they have learned in real life examples, and receive emotional support from teachers and groupmates. The main purpose of this article is to show the possibility of improving the results of training in mathematical disciplines using development based on gamification and elaboration based on personal responsibility of training and visible results. Application of the methods presented in regard to students' involvement in the educational process, (gamification and methods of studying, based on the personal responsibility of the student) showed positive results. Accordingly, we consider experiences pertaining to the implementation of gamification to the educational sphere. In this paper, the main difficulties that face teachers when conducting gamified course are marked, and the main stages of the method's organizations and those statistical data that confirm the impact of this method are presented.

Keywords
Educational process, mathematical disciplines, personal responsibility, motivation, educational method, gamification, motivation, process of a study

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Introduction

Presently, the systems of evaluation and methods of education used by many institutions are directed toward students' constant involvement in study processes. For example, one important driving force is the gaining of study points during a study period, which influences the summary mark. Students must not only be able to rest before exams, but they must also "work" constantly, improving their knowledge they received lectures and in the process of seminars and practical lessons, in order to get high total score, because the score accumulated influences the total one. However, motivators such as these, as marks, are always a guarantee of the effectiveness of targeted work throughout all periods of study. He may be aimed only on passing the exam in this discipline. Often, student rating systems are a good stimulus, however, they are based on competition and so students do not always perceive them positively.

Many attempts have been made to distinguish directions of study motivation, the list of which is still growing. Motivation is often studied in connection with the classification of various motives among different groups, or the effectiveness of training activities, etc.

The motivational theme of an individual's behavior is interdisciplinary, and comprises philosophical, psychological, and sociological aspects. Motivation is defined as "actions made by people according to their own wishes in order to perform a specific purpose" by Koçel [1, p.619]. Ozkalp and Kırel [2, p. 315] define motivation as the "process of achieving according to an incentivizing effect of a motive". Motives are also defined as the sum of efforts made to progressively induce one or more people to-ward activation in a certain direction [3, p. 494]. Over the years, researchers have de-veloped many theories about motivation; such developments also apply to educational organizations which play an important role for development of the community.

According to the definition provided by PMBOK, motivation is "powering people to achieve high levels of performance and overcoming barriers in order to change". Psychologists have provided different definitions according to attitudes that concern the phenomenon of motivation, and these are mentioned in Tohidi [4-6]. The activities of a student, much like the activities of educational processes and life activities, concern complicated social motives. It is known that motivation is a complicated psycho-logical phenomenon.

Motivation is the force that causes movement in humans. In fact, any agent that causes an activity in a living creature, whether that activity is internal or external, is considered to be a kind of motivation [7, 4-6].

Recently, many authors turn to the issue of student motivation. Do motivational regulation strategies contribute to university students' academic success? Olena Kryshko O., Jens Fleischer and et al. [8] noted, that motivational regulation strategies relate to university students' academic success.

It should be noted that all course material, laboratory papers, control tests, and home assignment writing are included in a student's work when that student is personally responsible. These criteria of evaluation starts during a student's school years, and so is not viewed as a strong motivator; more likely, they are perceived as school working days before becoming part of a students' life especially in the disciplines of the natural sciences and technical sciences. Students in

their first year of study in particular pose questions such as "Why do we need it?", "Why are these limits needed?", "Why should we calculate integrals?", and "How we can implement this theorem in life?"

The specific kind of motivation that is studied within the specialized setting of education differs qualitatively from more general forms of motivation as studied by psychologists in other fields [6,9]. Much attention is paid to gamification in the context of how the latest technology can help the modern education system. For a long time it was believed that gaming technology was generally a distraction from learning. Accordingly, the following question arises: "Is it possible to implement games as instruments for increasing study effectiveness?" [10,11]

Gamification is the use of game elements, methods, and play in contexts in which games are not usually provided; it concerns the implementation of approaches typical for computer games in non-game processes in order to attract users, to increase their involvement in applied tasks and their solutions, or to increase customer utilization of products and services. The basis of gamification is the analysis of an individual in regard to the methodology of correct motivation, which itself is grounded on the analysis of that individual's behavior.

What is the essence of gamification? The main goal is to attract trainees' attention and increase their interest in solving learning problems and further applying their acquired knowledge. Gamification is described as the use of game design for non-game content [12], and can be defined as the transference process of the three elements (dynamics, mechanics, and components) in harmony to non-game contexts . The main reasons why it is worth to imply the gamification if not in the entire course, then at least in the part of it.

Reason 1. Make studying more motivating. This can be achieved through competition in the "game" process , and by taking into consideration the student's personal interest.

Reason 2. Make studying more innovative. For many students, university appears as a kind of system with outdated studying systems. This perception is typical among students studying fundamental mathematical disciplines, especially in the first year. If modern trends appear in the study process then learning among young people will typically become successful.

Reason 3. Make learning more functional. Gamification helps to force "players", and in the case of training in "high school" players of "students", to act.

Reason 4. Make learning more interesting and enjoyable. Gamification started in reality and was only subsequently transposed into electronic environments and online learning. The origin of gaming itself can be found in the childhood of man. A game is a natural condition; everyone has a different need when playing a game, but everyone shares the need itself. There are players on the stock exchange, and players we call "actors" in real life. If one is to successfully and correctly "switch on" the "child" in every student-player who loves the game then, as a result, one is able to get that "child" to indulge in the game, and they will forget everything except the game itself.

After educational attainments (i.e., objectives) have been determined, the next step is to integrate the gamification procedure into the teaching process, which includes the effective use of dynamics, mechanics, and components [13]. Determining the place of gamification regarding the development of the course is crucial to realizing this aim.

According to Maroney [14], games can be defined as "a form of play with goals and structure", while Grünberg [15] maintains that game mechanics comprise agents, objects, elements, and the relationship among these within games. Gamification can be defined as the "use of game design elements to motivate user behavior in non-game contexts" [12]. Gamification, as a technic of behavioral change, appeared long ago, and the origin gamification as a term can be found within the sphere of marketing, where it is used to increase customers' interrelations with brands.

Some authors note that gamification can increase student learning performance (effect size of 0.504) [16].

As noted by Urh M., Goran Vukovic and et al. [17] there are many possibilities of using the gamification model in practical that affect the dynamics of the students.

Digital transformation in education improves the results of traditional methodologies.

As noted in the study by Díaz-Ramírez J. [18] gamification, recently considered as a science, takes advantage of the benefits of games to induce desirable behaviors in a given "normal" activity. Application of gamification in education to motivate and engage students in their learning process present positive effects [18].

Jeferson Arango-López and et al. [19] noted that pervasive games generate a positive impact on the learning process of students and the use of new technologies in education increases students' motivation to acquire new knowledge.

It is noted [20], that the empirical results demonstrate that educational community could do a great deal to enhance a student's intention to use gamification strategies leading to the greater application of innovative technological, educational tools in tourism face-to-face learning . Authors' findings also evidence that students' attitude towards learning as well as to innovation has a positive and significant role.

Gamification had a positive impact on learning [21], namely, gamification has a positive effect on students' knowledge retention and the positive effect of gamification is independent of age and gender [22].

Studying using computer games is now an established educational process. Strategies and stimulators are used in games. Based on these strategies, students, school-children, and trainees have an opportunity to conduct investigations or to master skills that, for many reasons, might be difficult to obtain in the real world. For example, through level completion in games, one is able to study economy, history, military strategy.

A good game is one that can be used as a tool to significantly affect motivation. By creating a gamification system, the process of performing a task can be made pleasurable. We considered the positive trend of introducing e-learning into the learning process for creating a gamification-based training system for mathematical analysis. E-learning is the use of telecommunication technology to deliver information for education and training [23]. E-learning is being introduced as a fundamental part of the student learning experience in higher education, and is no longer restricted to being a core business for those universities with a mission for distance education [24].

Many authors have reported on e-learning in higher education and related students experiences [25, 26].
Gamification implementation among humanitarian disciplines is common and has yielded positive results. The following question then arises: "How can this technology be applied to technical and mathematical disciplines without breaking the fundamentals of education in order to turn the process of studying into a game?".

Materials and Methods

Two techniques were proposed: elaboration based on personal responsibility of trainees and visible results development based on gamification in mathematical disciplines.
All techniques were applied to different groups with the same instructor. The techniques were suggested during the training period of the two modules for the "mathematical analysis" discipline.
The first method was elaboration based on personal responsibility of trainees and visible results. For the purposes of this experiment, students' initial participation was voluntary. Accordingly, a group of trainees was divided into two groups: a group who initiated and who received additional tasks; and a group who studied in a "standard" way without "additional" material. Due to the fact that the results were better for the initial group, division control and experimental groups were divided according to a comparative pedagogical experiment. The experimental group studied using the experimental method and the control group studied the generally accepted method. The working hypothesis maintains that the new methodology is more effective.
As students are not always internally motivated, they sometimes need situated motivation, which can be found in the environmental conditions created by teachers [4-6]. Accordingly, a methodology based on students' personal responsibility and their visible results was implemented throughout their first year of study, and all students studied disciplines within the natural sciences [27]. The concept of personal responsibility is under-investigated in education [28]. Student engagement was voluntary. The sequence of strategies defined and marked in order to help students appeal to their personal potential, to make studying process more attractive and to include personal responsibility and public results. Here we provide several concise statements concerning the organizational stages of students' involvement in the educational process:
1) Question appearance and task setting in the lecture or seminar. Question appearance is a good sign and reflects trainee interest in the new material; it should not be restricted by short answers and it is better to encourage students' interests, as well as to offer further mini investigations in the same direction.
2) Collaboration while discussing problems as part of the teacher–student dynamic. The discussion of the wording of the task and the best ways of searching for solutions and obtaining additional information are best undertaken at this stage.
3) Deadlines are set regarding students' individual- or group work.
4) Coordination with the teacher regarding the results of the student's work. Results checking.
5) Group presentation of the results. This can be a short report on the seminar by the student using prepared material, which is good preparation for conference speeches. This should concern no more than 5–10% of the class.
We will highlight that competence produced by the student during the event's organization is based on personal responsibility, and that it belongs to cognitive and training, informational and communicative aspects. Therefore, the task or problem is considered as having been chosen by the student concerned. The teacher helps and directs during the implementation of the task, but for the student is responsible for the result and implementation (or non-compliance). This work as voluntary, and no punitive effects were implemented in the case of non-compliance. All tasks initiated by those students, all of whom chose to participate in the experiment voluntarily, were implemented on time. There are several main advantages regarding students' work according to this methodology:
- A creative approach to studying the subject and the ability to present a task, idea, or material;
- Work with resources of information, the ability to point out necessary in-formation, and the ability to provide a brief narrative of significant amounts of information using correct accentuation;
- Self-organization and the ability to meet deadlines while studying the topic in question;
- Teamwork (command task fulfilment) concerning a large amount of a material or short schedule, and brainstorming among the team);
- Informal "teacher–student" dialogue and the competitor spirit;
- Conducting a short investigation, which includes writing course papers, diplomas, articles, and conferences speeches;
- Public results given for the work, and a presentation given to groupmates.

It was noticed that, statistically, work effectiveness increased when the results of an activity were considered as being a visible result and as having a public character that brings about societal recognition. Everything mentioned is a good motivator for a work, and it is also important to mention the main advantages of the teacher's work using this methodology:
- Informal dialogue and the teacher–student competitor spirit;
- Seeing the problem from a non-standard view using "students' eyes", thereby providing a "fresh" approach to the material taught;
- The identification of the most interesting task, and the topic of the student's work;
- Improvement of study results due to application of the methodology.

Here we highlight what can be presented as student elaboration:
- Short examples, applied mini tasks (task making, example searching, theory of real examples and their implementation);
- Historical reference, work containing a considerable amount of information with the accentuation and material presentation, and info scheme making;
- Independent review, a formulated idea whereby the

scientific approach should be applied;

- Short tasks and short examples can be presented by students on the lessons they have received; short-reports not exceeding 5–10% of inductor-led hours can be made with the agreement of the lecturer.

We give the following results collected from the two groups following the technique based on personal responsibility of trainees.

Results collected from the two groups were then analyzed: groups of the first year of study groups, studying disciplines of natural-science cycle ("Mathematical analysis") during the first semester. Conditional division of the students into groups:

- Group 1 – initiating and getting additional tasks;
- Group 2 – studied according to the standard program.

All participants in group 1 were given additional tasks, which they could initiate on their own. Most participants in group 1 coped with the tasks they received, though sometimes additional consultations were required. It is worth noting that the final ac-cumulated score was the result of both control and test work, and that this was the same for participants in both groups. A diagram representing the results of applying the methodology for the first half of the first year can be seen depicted in Fig. 1.

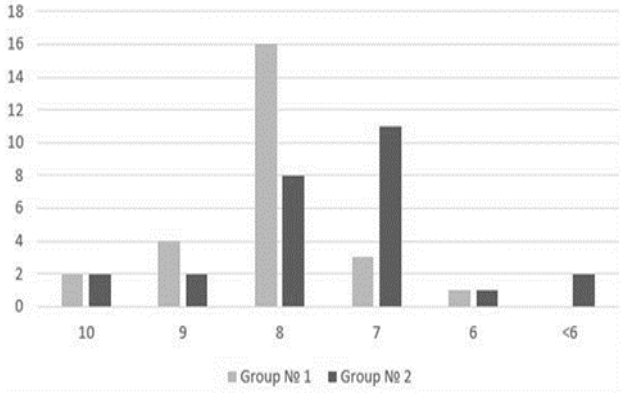

Figure 1. Distribution of accumulated points by group, first half of the year

The language of the mathematic discipline is built on abstract notions. In the process of the subject studying and task implementation (in particular, those mathematical disciplines that are studied throughout the first year of the study), students are confronted "face to face" with the formal task settings and the technical parts of the problems posed. Throughout this time, when students in their first year of study have an urgent need to "ensoul" the discipline they are studying, attempts are made to ap-ply knowledge to real life examples in order to gain emotional support from the teacher and the student's groupmates.

The evaluation was carried out using a 10-point scale, and the results obtained show that the participants in group 1 received higher scores than students in group 2. The average score of participant in group 1 was 8.1 points, while the average score of the participant in group 2 was 7.3 points.

The material used for the second half of the first year was more difficult in regard to both its theoretical and practical aspects. The results of the accumulated score for this period can be seen depicted in Fig.2

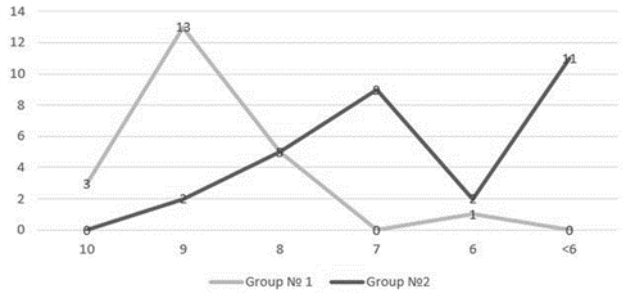

Figure 2. Distribution of accumulated points by groups, second half of the year

It can be seen that students of group 1 had excellent results, and that these are obviously higher than those of the students in group 2. Moreover, no participants could be found that had a score lower than 6 points; comparatively, 13 participants in group 2 received scores below 6 points (including unsatisfactory ones). Thus, the average ac-cumulated score for the participants of group 1 was 8.7 points, while the average student score from group 2 was 6.4 points.

The application of this method of involving students in the educational process has yielded positive results. However, these results cannot be considered to be absolutely reliable, since the choice of the group was voluntary. This is because motivated students are more likely to choose a group that involves more in-depth study of a subject, a greater number of assignments, and consequently, a potentially higher score for the work done.

The second method was based on gamification in mathematical disciplines.

The main aim of gamification regarding the development of the curse is to organize students' learning activities, motivate them to perform assignments in time and strive to get high marks for the task-control blocks. But the main thing that gamification is able to provide, and that cannot always be provided by the learning process it-self, is to create a sense of progress and satisfaction from the effort and result; this is undoubtedly aimed at increasing the motivation toward learning. Since gamification requires constant feedback from students, several important points need to be fulfilled by the teacher:

- Constant adjustment of the learning process through the game;
- Dynamics of the game, creating stories, and using and inventing techniques that contribute to creating a sense of ownership among players, creating an interest in fictional goals;
- Step-by-step complication of goals and objectives as players gain experience;
- The ability to combine the competition of each individual player into teamworking and increase the spirit of partnership.

We note the main steps that should be explained when connecting the gamification course with the studying process:

- Effective use of time provided for students' self-study work;
- Giving students the opportunity to control their progress;
- Participation in the game process should be

voluntary, otherwise the game becomes an indispensable element of learning and, therefore, ceases to be a game and becomes an obligatory part of the program;

- Complicating, which should lead to an improvement in the quality of the work performed by students.

It is especially important to consider that the students of the first courses have more emotional reactions to their assessment by both teachers and classmates as com-pared to students of senior courses. In the process of studying the subject and completing the assignment, the student "remains alone" with the formal statement of the problem. This is especially true for first-year students studying mathematical disciplines, since the language of mathematics is built on abstract concepts. As already noted, first-year students have an urgent need to "ensoul" the discipline they are studying. Gamification can therefore be used as a link to overcome the barrier between the student and the abstract language of mathematics.

Students are not always internally motivated and sometimes require situated motivation, which can be found in the environmental conditions created by their teachers [4-6]. We have the task of practically implementing gamification in a certain part of a course, thereby creating of additional favorable conditions for increasing the students' motivation, as well as analyzing the results of this implementation. Students in their first year studying the discipline of mathematical analysis proposed to do their home assignment using gamification elements.

Note that students always receive homework for self-preparation, which is mandatory and which must be carried out in accordance with the curriculum. As previously mentioned, this is perceived by students as being a training attribute following on from their school education, and is not a strong motivator. Part of those tasks completed by the students is standard, and checks the basic theoretical knowledge of students and their ability to apply them when solving problems. Taking into consideration that most of the tasks correspond to the standard course, and that they cannot be considered when trying to solve more interesting problems of application, such as for old-er training courses, it was suggested that the solutions of the problems were linked to the game script.

Increasing the efficiency, effectiveness, motivation, and engagement of students through e-learning can be achieved through gamification. Gamification applies elements associated with video games, such as game mechanics and game dynamics, to non-game applications, and aims to increase people's engagement and promote certain behaviors [29].

A special site was created for the implementation of this project, upon which narrative storyline assignments of the game were laid. Several plot lines of the game were suggested during the training period of the two modules for the "mathematical analysis" discipline. For example, the first script looked like this:

"In the magic land of Math-For, all residents waited for the New Year. Little gnomes and elves were preparing gifts for each other, composing songs, making Christmas decorations...But the wicked wizard Tartaran brought down a strong hurricane to the magic forest...Good traveler, help the inhabitants of the magic forest! If you do not help to build houses, the elves and gnomes will freeze in the winter forest..."

News appeared on the site periodically, the winners, etc. Students were invited to consider themselves as participants of the events in the country of the mathematical forest, wherein it was possible to provide assistance to the inhabitants of the country after having correctly solved a certain number of tasks from structured blocks in a special way. Thus, the solution of additional tasks of increased complexity, which were blocks for construction, helped in the construction of houses and a castle.

Each homework assignment was accompanied by a certain game story. Students became participants in the game and felt themselves to be heroes of "Math-For". Here we point out the main gamification aspects mentioned in this project:

- Creation of a common game experience that promotes the emotional involvement of players;
- Use of the script to simulate the players' behavior;
- Use of script elements that are inherent characteristics of online games, such as virtual rewards, statuses, etc.;
- Social interaction, at this stage this was affected to a lesser degree than other elements, but one of the blocks of the game involved team performance of homework, in which the "players" communicated both online and in person.

Despite the fact, that participation was voluntary, students were interested in the new approach and some of them took part in the game. The minimum number of correctly performed tasks was suggested for each of the blocks, whereby students could choose the number of tasks for themselves, while correctly solved tasks should be no less than a certain number. A total of 80% of the players implemented more tasks than were required in order to win. Sometimes the number of assignments was doubled: if the minimum was N, then the student did 2N assignments. Thus, the student often doubled the number of homework assignments for themselves.

Two groups were formed in order to check the results and confirm the effectiveness of the proposed methods for the following year of training: one group in which work with a student audience was carried out in consideration of the specifics of students appealing to personal responsibility and the fulfillment of additional tasks; and a second group in which the work was carried out in the usual way.

During the academic year in which the discipline of mathematical analysis was studied, one of the groups used a method based on personal responsibility and selected public results. The remaining group's training was conducted in the usual way. The number of student participants in the experimental group was 25, while the number of student participants in control group was 27.

Student's t-test is often used to test hypotheses based on the comparison of two averages. The criterion allows us to find the probability that both averages are in the same population. If the probability (p) is below the significance level ($p<0.05$), then the samples are considered as belonging to two different sets, and that the differences be-tween the results obtained are reliable and vice versa. Comparatively, if the probability is higher than the significance level ($p>0.05$), then the differences between the results obtained are not reliable.

First, it is necessary to check the normality of the distribution of the received data. To verify the normality of a data distribution, we used the modified criterion of Kolmogorov and Shapiro–Francia. The normality test was carried out using a selected threshold value of 0.05. According to Kolmogorov's criterion, the statistics and P-value for the experimental group were 0.159085575 and 0.217118372, respectively; according to the Shapiro–Francia criterion the results were 0.939987989 and 0.268697614, respectively; for the control group, the statistics and P-value were 0.149601313 and 0.254381257, respectively, according to Kolmogorov's criterion; and, 0.930757026 and 0.140867073, respectively, according to the Shapiro–Francia criterion. It can therefore be concluded that the results do not deviate from the hypothesis of normality.

Thus, the distribution of the experimental data can be considered normal, and in order to calculate the reliability of the differences between the results obtained, we can use Student's t-test. It should be noted that, the mean value for the experimental group was 7.76, while the mean value for the control group, who were undergoing standard training, was 5.85; this is a significantly lower value. Based on the Student's t-test criterion, the following statistics were obtained: the value of the statistics was equal to 2.825695519 and the P-value two-sided was equal to 0.003381431. Based on the obtained probability value, one can conclude that the differences between the results obtained in the experimental and control groups are reliable. Since the probability of random occurrence of the analyzed samples is 0.003381431, which is lower than the significance level (0.05), the average samples are considered to be significantly different from one another. Accordingly, we can speak about the reliability of the differences and about the greater effectiveness of the experimental training methodology.

We give the following results collected from the two groups following the technique based on gamification.

The results of the first stage of the game were summed up and the results announced to students. In the second stage, the number of players increased by 80% from the first stage, and more than half of the total number of students took part in the "game" (one standard group took part in the game). Data obtained as a result of this experiment are presented in Table 1. Conditionally the students were divided into groups according to the points obtained earlier. As can be seen from Table 1, as a result of the tasks, the average score in each of the groups increased.

Table 1. Points before and after several stages of homework with the use of gamification

Number of students who took part in the first stage (groups were selected according to the initial agreement as "excellent"/"good"/ "satisfactory"/"unsatisfactory"	Level BEFORE (average score on the 10-point system)	Level AFTER (average score on the 10-point system)
35%	9.2	9.5
40%	6	8
25%	5	6.3

Taking into consideration that participation in the game was only initially possible on a voluntary basis, the scores of more motivated students could have been higher. The transition from the "ordinary" group to the voluntary group through the use of gamification was carried out throughout the period in which the game was played. As students did not join group at a particular time, comparative statistical analysis was not conducted.

This methodology was very popular among students in the course of mathematical analysis classes. Accordingly, students were divided into two groups during the following study year in order to check the results concerning the application of gamification. In one group, training was conducted using the elements of gamification and the game scenes were realized using internet technologies. In the other group, classes were conducted in the usual way, though in this instance division as arbitrary and was not conducted on a voluntary basis as was the case in the previous version. A total of 22 students were allocated to the group which received training using gamification elements, while 26 students were allocated to the standard group. The period during the two modules (1 semester) was considered. Training was conducted as part of the mathematical analysis discipline. To test the hypothesis based on a comparison of the two averages, the Student's t-test was used to analyze the two independent samples. Considering that the number of observations for each group does not exceed 30, the Shapiro–Wilk and Shapiro–Francia criteria were used to check the normality of the distribution. The normality test was carried out using a selected threshold value of 0.05. The P-value and the two-sided values for the experimental group, according to the Shapiro–Wilk criterion, were found to be 0.935909344598055 and 0.323901451255546, respectively; while the corresponding values according to the Shapiro–Francia criterion were found to be 0.946783917 and 0.474842207, respectively. According to the Shapiro- the bilateral value was found to be 0.944245464 and 0.362655420521789, respectively, and 0.956991820062805 and 0.577427201286614, respectively, according to the Shapiro–Francia criterion.

the experimental data can be considered normal; when the threshold value is changed to 0.01, the data distribution can also be considered normal. The Student's t-criterion was used to calculate the reliability of the differences between the results obtained. Note that in the experimental group, the average value was found to be 6.6818, while the average score in the control group undergoing standard training was 5.3386, which is a significantly lower value. Based on the Stu-dent's criterion, the statistic was equal to 2.05265021094299 and the P-value was two-sided equal to 0.04582053180472. Based on the probability value obtained, one can conclude that the differences between the results obtained in the experimental and control groups are reliable. Since the probability of random occurrence for the analyzed samples is less than the significance level (0.05), these average samples are considered to be significantly different from one another. Accordingly, we can speak of the reliability of the differences, and about the greater effectiveness of the experimental teaching methodology.

Conclusion

The application of gamification among humanities disciplines has become increasingly popular. How to apply this technology to mathematic and technical disciplines by partially turning the studying process into a game and without breaking the fundamentals of education remains uncertain.

The experimental study conducted using a total of 100 participants, all of whom were first-year students. Of these, 52 students comprised the experimental and control groups for the student's personal responsibility and visible result part of this study, while 48 participants comprised the experimental and control group to whom the method of teaching using elements of gamification was applied.

As a result of the experiment (both in one case and in another case), is possible to mention that:

- The effectiveness of students' work was increased;
- The levels of perception regarding information, and the final score on the topics covered was increased;
- Regarding the modeling of preferable behavior among students by the teacher, more time was provided for the repetition of the material covered, as well as to the studying of additional materials and student preparation).

Therefore, the methods presented herein have been shown to be a successful method for organizing training, which has pedagogical potential, including when ap-plied to mathematical disciplines. Both methods assessed in this paper have elements that allow an increased level of activity among students when performing assigned tasks.

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