

Gamed-based Learning in Higher Education

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Abstract – The study aims to prove the efficiency of training in the management of logistic projects by applying a game-based method in higher education. To this end, we analyze the educational games in training logistics and logistic projects, which can be applied in training in logistic projects in schools of higher education and we present the design of an educational game (warehouse project game - WPG) via a game-based method. Groups of indicators for the degree of the success rate within the training in the management of logistic projects have been drawn up and based on a cluster analysis of the groups of trainees.

An empirical study has been conducted among students studying for a BA and MA degree and project managers. The findings of this study can be useful to researchers, teachers, course designers, and designers of game-based teaching applications.

Keywords – Gamification, game-based learning, high education.

1. Introduction

The transition to remote learning, which was necessitated by the COVID-19 pandemic, posed a lot of challenges to the training process in universities. This required that teaching methods should be adapted to an online environment and created new conditions for expanding the use of information and communication technologies, electronic platforms, educational resources, and etc.

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The future of training in the management of logistic projects will require further use of electronic game approaches, simulative games, interactive presentations, electronic tests, etc., which have the role of boosting students' interest and preparing them for their future career development in business organizations.

The topicality of the issue under examination is related to the need to boost the efficiency of remote learning, which can be achieved by a combination of the acquisition and consolidation of new knowledge and skills by raising the students' motivation, activity, and interest in the teaching material and boosting their confidence, creativity and teamwork.

The study aims to prove the efficiency of training in the management of logistic projects by applying a game-based method in higher education. To this end, we analyze the educational games in the training in logistics and logistic projects, which can be applied in the training in logistic projects in schools of higher education and we present the design of an educational game (warehouse project game - WPG) via a game-based method. Groups of indicators for the degree of the success rate in training in the management of logistic projects have been identified, and on this basis, a cluster analysis of the groups of trainees is presented.

The object of the study is students in a BA program, and students in an MA program who study the subject *management of logistic projects*. The study includes project managers who work for a project management business organization.

The research thesis is that using gamification in the management of logistic projects in higher education will boost the acquisition and consolidation of new knowledge and skills, will increase students' motivation, activity, and interest in the teaching material, and will boost their confidence, creativity, and team work.

The current study has two peculiarities: first, the authors have designed an educational game via a game-based method for logistic projects (*warehouse project game WPG*), and, secondly, a cluster analysis has been made of the trainees according to the degree of the success rate and motivation in training. According to Galabova, the digital transformation in higher education is related, on the one hand, to the management and operational work in the institutions

connected with the admission of students, and on the other – to creating new educational products and transforming the existing ones into digital [12].

The findings are a guideline in the educational policy in higher education and can be a guideline to teachers, researchers, and trainees in improving the higher education courses. In addition, the educational game created by the researchers is a contribution to the sphere, which is important for the scholars who deal with projecting games and game-based learning.

2. Literature Review

Logistics researchers such as Bowersox, Closs, Cooper [3], Christopher [5], Edward Frazelle [10], Dimitrov [8] describe the importance of logistics projects in the economy of the countries. Ozment and Keller [26] argue that with the transition to a more competitive global economy, there will be a growing demand for highly qualified employees to create and manage more efficient logistics projects and supply chains.

In the last ten years, there have been several studies related to logistics education [26], Tvrdon, Juraskova [33], some of which reveal the application of software products, simulation models that present a real and virtual environment in logistics training. Hofmann et al. [15] consider the term “emulation”, as a special case of simulation using the replacement of a physical technical system. This is a typical tool for developing and commissioning control systems and can be presented as part of students' logistics education.

Hofmann et al. [15] describes various researchers who use laboratories to visualize material flow in logistics education. [34]. According to him, laboratory work is significantly different from the theoretical presentation of information, and according to Alves et al, “the greatest teacher is the failed experiment” [28]. The practical work with students who study logistics and logistics projects can also be called “active learning”. Active teaching and learning methods as part of the educational methodology are widely used in universities, with greater responsibility for learning in the hands of learners themselves. One of the main challenges is to effectively address the learning needs of the new generation of students. [30], [29].

There is widespread use of games and simulations in the curricula of business universities that teach logistics and project management. Faria [11] described that 97.5% of accredited business schools use simulation games as part of their courses. Most of these games focus on logistics or strategic issues. Bodo [2] describes the development of the simulation in the selection of strategies created by the students. Innovative technologies are most often used in the

work of games. Doyle and Brown [9] are implementing a business strategy that uses e-mail and video conferencing, involving five teams of business administration students from universities in Ireland, France, and the United States. Also, guidelines for game development are provided by Heineke and Meile [14], which offer games to be effective by providing an “aha” effect and low stress for students [18].

In this paper, educational games (gamification, simulation, edutainment) will be discussed as part of the active learning of logistics and logistics project management students.

Educational games in logistics training and logistics projects

Educational games in training can have various manifestations, such as gamification in training, game-based training, simulation games, and others. Gamification is a unique method that can be used for learning through games. The term “gamification” is interpreted as “using elements of video games in non-gaming systems to improve the educational process and the engagement of learners” [7].

In recent years, the model of gamification has become one of the leading topics worldwide. According to Groh, the concept of “gamification” is the use of play and desire to stimulate learner engagement in an activity [13]. Elements of gamification are often used in logistics and management training - simulations, real cases, videos, etc., and the application of specific games in business logistics can significantly increase the success rate of students in acquiring new knowledge.

Kohn [19] describes that to create a deeper understanding of lecture material; students need to be engaged in what they are doing. Passman [27], Applefield, Huber, and Moallem [1] describe the benefits of adopting a more constructivist model of teaching. According to McKeachie [21] involving students as active participants will lead to positive understanding and higher achievement. McKeachie explains that learning will improve if students make decisions and then have to respond to the consequences of each decision. [18]

One of the most popular games among teachers and students of logistics and supply chain management can be said to be the so-called beer game. This is perhaps one of the most famous demonstrations in logistics process management, which was created by John Sterman [32].

Gamed-based Learning is a term that is also widespread. One of the popular definitions of game-based learning is that of Halverson, Shaffer, Squire, and Gee [31], according to whom it is game-based learning with defined learning outcomes. This is the difference between game-based learning and gamification. Gamification is a broad concept, with

mandatory game elements such as incentive systems to motivate players to engage in a task they do not find appealing.

Game-based learning models are sometimes associated with the 70:20:10 model. According to this model, 70% of learning should be experiential - i.e., the learner acquires knowledge and skills through experience; 20% of learning is collaborative - i.e., the learner communicates, shares opinions and discusses with other learners and/or teachers; 10% formal learning - the learner learns through standard structured courses.

Simulation games as an educational method are games oriented to fun, but they are still suitable for use as a tool and method of teaching [6]. Learning through simulation games allows students to solve problems and participate in situations that in reality would be impossible and/or inappropriate in terms of price, time, place, or security considerations. The simulation environment allows students to gain experience that may be too difficult to achieve in the real world.

3. Research Methodology

The study presents an educational game on logistics project management, which was tested among 4th year bachelor students, masters from the University of National and World Economy, and project managers. The data was collected in the Fall Semester of 2021-2022. The game is specially developed for the purposes of a training course on logistics projects. The training aims are to provide knowledge about the nature, characteristics, and models for project management and develop skills in students to work out network schedules and to put into practice the methods of network planning - "Method of the critical path" and "Method PERT." The Warehouse project game (WPG) consistently goes through the disclosure of the content of the various stages of project management and project management processes. The game reveals the essence and features of logistics projects and management processes. Logistics projects are often complex and interdisciplinary, as they coordinate the planning, implementation, monitoring, and delivery of information.

The educational game is developed on the principle of the game-based method, putting participants in the role of logistics project management managers who have to build a specialized warehouse. The goal of the game is to build the warehouse faster and at a lower cost. The financial results determined how successful the students were after completing all the activities involved. This is measured by higher winnings (if any) or fewer outstanding loans and that is how the playing teams are ranked.

The methodology follows the model of education through gameplay in logistics. The model developed summarizes the key features of EODM (Event-Oriented Design Model) for Web-based learning and AODM (Activity-Oriented Design Model), to enhance the effectiveness of the business logistics and supply chains learning process by realizing the educational objectives and enhancing the quality of teaching and learning activities. Business Logistics & SC education Design Model (BL&SCEDM) includes the following elements (Figure 1):

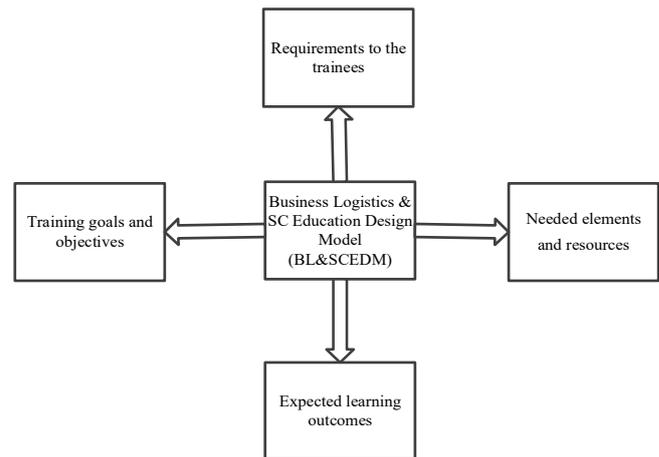


Figure 1. Business Logistics & Supply Chain Education Design Model (BL&SCEDM)

3.1. Training Goals and Objectives

The aim of the educational game *warehouse project game* (WPG) is to add new knowledge, skills, and competencies related to the management of logistic projects. To ensure an efficient training in the management of logistic projects via a game-based method, the goals and tasks should be clearly set. The most frequently encountered factors contributing to the failure of a logistic project are related to unrealistic or not specified goals of the project, inaccurate assessment of the necessary resources, inaccurately defined systemic requirements, inaccurate reporting of the state of the project, unmanaged risks, poor communication between clients, developers and consumers, using old-fashioned technology, inability to cope with the complexity of the project, etc.

The idea of the educational game *warehouse project game* (WPG) is to build a warehouse as quickly as possible, at the lowest possible costs and the condition describes 12 tasks that should be performed and the costs necessary for each activity. The conditions of the game are related to renting a warehouse, repairs, and furnishing of the warehouse, and an office room. The educational game includes performing all activities and the repayment of the loan for performing the tasks. The players have to

perform the task of building the warehouse more quickly and at lower costs. Thus the loans will be repaid earlier and an income will be generated. The costs and the duration of the individual tasks are fixed in the game, and no influence can be exerted on them. If the activities are arranged on time, part of the money on interest on the loan will be saved and a lower rent will be paid before the warehouse is opened. The extent to which each of the teams has coped successfully depends on the financial results after the activities are performed. This is measured in terms of a higher profit (if there is one already) and fewer still not repaid loans. This is the result in terms of which the ranking of the playing teams is done.

The warehouse has an area of 285 square meters and an office room with an area of 40 square meters. The rent for the warehouse is 900 Leva per month and is paid each first day of the month. The players use a loan from a bank to perform the activities and tasks under the project and the bank can perform some of the payments on behalf of the contractors. The bank can decide to declare insolvency of the players or bankrupt them if more than the necessary resources are spent. The bank can terminate the loan also if work on the performance of the tasks related to the project is not well performed. What is determined is also an interest on the loan and the initial sum which each one of the players has the disposal of.

After the warehouse is put in operation the players will gain resources (after they have covered all costs, including the rent), which will be invested to repay the rent.

3.2. Requirements for the Trainees

The trainees are required to have basic knowledge of logistics and the management of projects. The basic rules of the game are given before the training and it is necessary to provide time for the players to draw up a strategy for performing the tasks. The game is conducted in rounds and each round lasts 10 days. During these rounds, the work that is to be performed in the next round is announced and the sum that is necessary to perform them. The bank has the right to charge fees to the contractors of the work in the case of non-compliance with the agreements.

All participating players receive instructions for work on an online platform, developed to this effect. The time for each round is determined according to the players and can vary depending on the trainees' selected strategy. Between the individual rounds, the participants have the opportunity to consider their decisions and the result. They get acquainted with new conceptions and then go back to apply what they have practically learned in the next round.

3.3. Needed Elements and Resources

The game has been developed via a web-based application, which can be played both offline and online by all trainers. The created simulation game has the functionality for registration and authentication of consumers, an administrative panel, and client version. The used technologies are backend framework - Flask version 2.0.1, ORM - SQLAlchemy - version 1.4.17, frontend - Jinja2 version 3.0.1, and Bootstrap version 3.3.7, HTML. Server technologies are unicorn version 20.1.0, Nginx version 1.19.0.

Before the beginning of the game, the players' leadership is ensured and assistance if questions happen to arise. The person leading the game may answer questions related to different activities during the active method of training. Before the beginning of the game, the students are provided a web-link with the precise instructions and passwords for the individual teams.

3.4. Expected Learning Outcomes

The expected results of the game are building theoretical and factual knowledge in the management of logistic projects, skills – cognitive and practical and competencies – independence and responsibility, social competencies, digital competencies, communicative and professional competencies.

After the game is conducted the students may perceive the management of logistic projects as a managerial approach, may understand the essence and the characteristics of the projects, may define the planning stages of the logistic projects, and may become aware of the benefits of managing projects. The training via the game-based method *warehouse project* game (WPG) will help understand the essence of the planning stages when performing the tasks related to the project.

The expected outcomes are that through team experience the students will be able to measure their performance and get feedback from a trainer, leading the game. This simulation of management of a logistic project compels the participants to leave their comfort zones. This allows quickly taking decisions as it happens in a work situation. An additional advantage of the educational game is that it provides immediate feedback. During the numerous game rounds, the students learn through experience and gradually find solutions to cope with complicated situations. In their attempt to find the best decisions, the trainees may experiment with a lot of scenarios for performing the tasks.

3.5. Hypotheses

The design of the study is based on certain indicators to determine the effectiveness of logistics project management training through the application of gamification in higher education. Several studies present indicators for measuring gamification in learning. Some authors [16] investigate the effectiveness of the game through widely used indicators in investments such as ROI (return on investment). In a study, Maria Therese Jensen [17] presents games in the field of education, which have two main goals - learning and performance goals. Several authors have studied the acquisition of new skills and the level of motivation in game-based learning methods. These questions have been explored by Meece, Nicholls, and Butler. [22], [23], [4]. More recent research on game-based learning during lectures in higher education has been done by Debita Tan Ai Lin, Ganapathy, M. and Manjet Kaur [20], István Varannai, Peter Sasvari, Anna Urbanovics [35], Margarita Ortiz, Katherine Chiluzia, Martin Valcke [25]. Noour and Hubbard [24] describes that there is a need for more research on the content of Logistics Education to meet the demands of industry and government.

Based on a detailed analysis of the existing literature, the following indicators of the degree of effectiveness of logistics project training are derived. The indicators are divided into three groups presented in Figure 2.

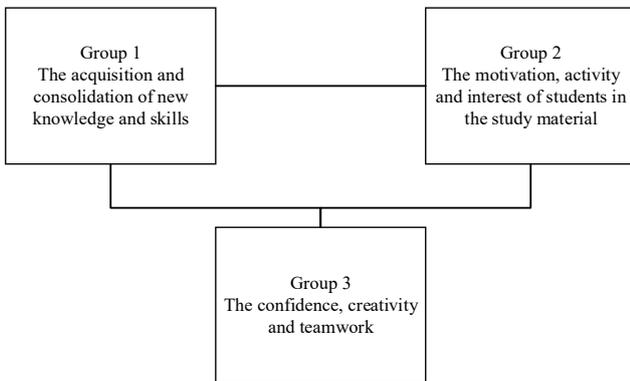


Figure 2. Groups of indicators of the degree of effectiveness of training on logistics projects

Based on these groups of indicators, sub-indicators are derived to evaluate the implementation of the educational game in logistics project management training (Table 1).

Table 1. Group of indicators for the degree of efficiency of training in logistic projects

Groups of indicators	Sub- indicators
Group 1. Indicators related to the acquisition and consolidation of new knowledge and skills	1. A deeper understanding of the essence of managing logistic projects
	2. Acquisition of new knowledge and understanding of the plan-schedule of project management
	3. Achieving the goals of training in the management of logistic projects (understanding the stages of planning logistic projects and becoming aware of the benefits of managing projects)
Group 2. Indicators related to the students' motivation, activity, and interest in the teaching material.	4. Increasing the capacity to memorize information related to the subject area;
	5. Boosting the skills for working with new technologies
	6. Boosting the skills for decision-making based on facts
	7. Building strategic thinking
	8. Maintaining the students' interest and commitment
	9. Boosting the students' activity related to the process of learning
	10. Increasing the students' motivation
	11. Increasing the trainees' concentration
	12. Boosting the students' confidence
	13. Boosting creativity and critical thinking
Group 3. Indicators related to confidence, creativity, and team work	14. Boosting the skills to manage resources that the trainees have at their disposal
	15. Boosting the skills to adapt to the quickly changing environment
	16. Prepares students for the real business life
	17. Encourages cooperation and team work

Table 1. (continue)

The research hypotheses are the following:

H1: The trainees will increase their knowledge and skills in managing logistic projects while using contemporary game-based instruments;

H2: The trainees will increase their motivation and interest in learning management of logistic projects while using contemporary game-based instruments;

H3: The trainees will boost their confidence, creativity, and team work while using contemporary game-based instruments.

After applying the training model via gamification the effect of the educational game on the behavior of the target consumers is measured through a questionnaire before the game is conducted and after the game is conducted. The experiment is carried out in two stages. The first stage is related to establishing the students' initial level in terms of knowledge, motivation, and team work. This stage reveals the students' knowledge and skills related to managing logistic projects. The second stage involves proving the hypotheses by using a cluster analysis of the results from the questionnaire on the efficiency of training in logistic projects and by applying educational game in higher education, conducted after the game. The cluster analysis aims to group n number of objects (interviewed) into k ($k > 1$) groups (clusters) by using p ($p > 1$) number of features (variables). The chosen method of cluster analysis (the method of K-Means Cluster) requires that the number of clusters is defined in advance.

The cluster analysis is used to obtain the students' summarized assessment in the training in logistic projects after the educational game is conducted. It provides for forming of clusters by grouping the units according to the indicators that have been selected to assess the efficiency of training. These indicators are given in the questionnaire via which the trainee students have been studied. The results after the game are conducted and compared to the results from the questionnaire before the educational game is conducted.

The data on the sub-indicators are achieved via concrete questions from the questionnaire and measured as average for the respective question. The indicators are measured for the whole totality and the data are presented in groups, that are the indicators summarize more than one sub-parameter. The assessments range from 1 (not at all) to 5 (to a great extent). The average meanings of the indicators are achieved by calculating an average for each sub-parameter based on which an average is calculated for the indicators.

4. Results from the experimental testing

The educational game *Warehouse project game* is designed with definite results related to the aims of the course on managing logistic projects and allows more commitment during the training. The testing of

the game is done online via the Teams platform. The students are grouped into teams, each one of which consists of 3 students. The students included in the study are 4th year BA students, MA degrees in management of logistic projects, and a simulation is conducted in a business organization among project managers. The developed game was experimentally tested with 73 BA students and 25 MA students studying Business logistics. The game was tested during the management of logistic projects classes. 7 top managers in the management of logistic projects took part in WPG. The total number of participants is 105, who tested the game in the period December 2021 – to February 2022. Figure 3 presents the distribution of the participants in testing the warehouse project game – WPG.

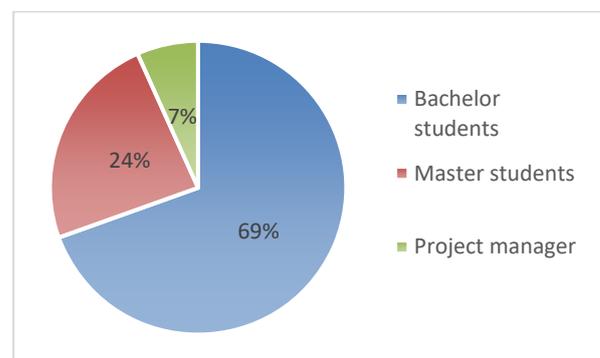


Figure 3. Distribution of participation

The testing of the game was conducted at different times with the individual groups of participants. The educational game was first conducted with BA students, divided into two parts. The first group includes 11 teams, and the second part of the game includes 15 teams each comprised of 2-3 students working in a team. The MA students that took part in the game are also divided into 9 teams each comprised of 2-3 students and the managers in managing projects conducted the game independently and each one of the managers plays on behalf of a team. Before the educational game begins, the trainees fill in a questionnaire that includes basic questions related to the management of logistic projects, to the students' motivation and interest in the teaching material, and to the trainees' creativity and confidence during the traditional classes.

The educational game may be conducted in an infinite number of rounds. To fulfill the aims of the current study the results of all trainees in the 12th round are presented in Table 2.

Table 2. Results of the educational Warehouse project game

Trainees	All tasks performed in the period	Activities not completed	Overdrawn loan	Number of rounds	Number of teams	Number of trainees
BA students	22,7%	77,3%	97,2%	10	26	73
MA students	32%	68%	88%	10	9	25
Project managers	57%	43%	57,1%	10	7	7
Total	100%			10	42	105

The table shows the real results from testing the Warehouse project game, consisting of training students and managers. A mere 22,72% of the BA students completed all the activities for the period, which shows the players' lagging behind. 32% of the trained MA students coped with performing all activities. The project managers coped to the highest extent, which shows good practical training. Apart from the performed activities, the trainees took more than the necessary loan for completing the tasks on performing the project and also for covering the interest and fees which were accrued while performing the tasks. The average expenditures for a team are 35600 euros, although it is not the typical situation in which the expenditures should exceed 24000 euros for performing the tasks and 2700 euros for the rents for 10 rounds. What is more indicative is that the divergence from optimality is not accidental. Although individual teams are quantitatively different, they always show the same behavioral models, which find expression in the following:

1. The announcement and the performance of the activities are dominated by big amplitude fluctuations and a frequent delay since there is no preliminary strategy and no drawn up plan-schedule of the tasks.

2. Phase delay is frequently obtained when the students start to accumulate forfeits when the agreements are not complied with. To start performing the tasks the players should first of all have at their disposal in the cash-box sums equal to or exceeding the whole sum for the work. They should also have completed the preceding tasks without which this work cannot start. The average forfeit for all teams is 960 euros for the whole period. This leads to a "chain" mistake since not performing one task stops the next tasks and thus a lot of forfeits are accumulated.

During the game-based method, the emotions in the individual teams become stronger. Some of the trainees report a feeling of insecurity and helplessness. Students blame their members of the team for the problems during the simulation and also disputes may arise between the players in the individual teams.

Before the beginning of the game, the students have the opportunity to answer questions that are related to what they have studied during the lecture course. The data show that the students realize the complexity of managing logistic projects and the peculiarities typical of them. Moreover, all students are acquainted with the methods and instruments for planning the projects and the basic processes involved in managing projects.

After the game is conducted the trainees again fill in a questionnaire which includes questions related to what has been studied during the educational game in managing logistic projects and questions related to becoming aware of the role of planning in projects. The data and indicators from group 1 related to the acquisition and consolidation of new knowledge and skills before the game and after the game are presented on Figure 4.

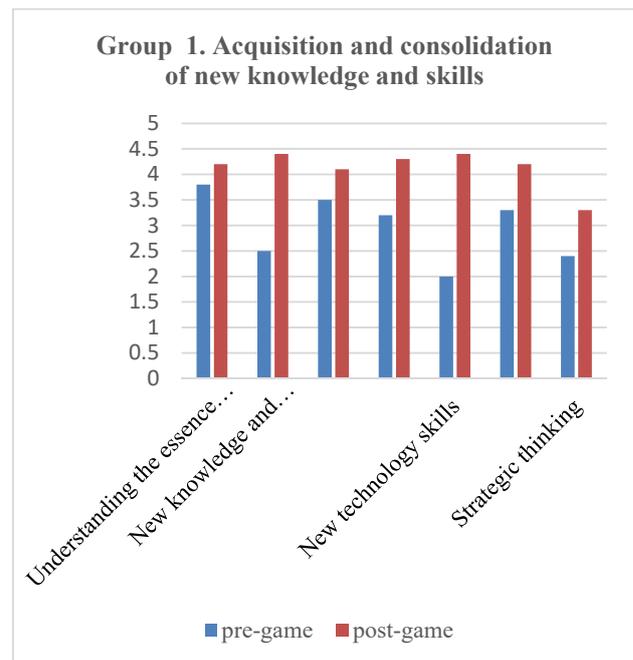


Figure 4. Measuring the indicators for assessment of the acquisition and consolidation of new knowledge and skills before and after the conducted educational game

The data show that the understanding about the essence of the management of logistic projects is enhanced. All sub-indicators have higher values after the game is conducted and the greatest difference is observed in the case of the skills to work with new technologies and the understanding of the plan schedule of project management. The sub-parameter that shows the lowest increase is related to

understanding the essence of managing logistic projects. Probably the students during the traditional lectures understand project management and the basic models and techniques for planning the projects, however, they do not become aware of the role of models and techniques for planning projects such as Gant's diagram, the Technique for review, and evaluation of programs - PERT (Program Evaluation and Review Technique) and the method of critical path CPM (Critical Path Method).

The results from the first group of questions related to the acquisition and consolidation of new knowledge and skills indicate the following:

- After the simulation is conducted, the trainees to a greater extent become aware of the complexity of managing logistic projects;
- The students alone determine the models to work with during the game on managing logistic projects;
- The students to a greater extent become aware of the significance of managing the supplies in the management of logistic projects;
- The students can determine the factors impacting the process of managing projects and know the financing sources.

During the game, the trained students used different methods for planning activities. They most commonly used the Gant schedule, PERT, and the network schedule for decision-making to perform the activities and tasks. This shows that the greater part of students makes decisions based on facts.

It could be argued that the educational game *Warehouse project game* ensures the mastering of a new approach to consolidating, expanding, and summarizing knowledge; boosting the retention of information related to the subject area and boosting the skills for working with new technologies. The complicated system of tasks and variants, of rules, and content of the game-based method, leads to the occurrence of new situations, in which the trainee becomes an active subject of the practical and cognitive actions, organized by the structures of the game, and makes efforts to control them and exert self-control.

The second group of indicators is related to the students' motivation, activity, and interest in the teaching material. The results of the questionnaire conducted after the testing of the game show that all students participating in the educational game warehouse project have actively taken part in it and have conducted all rounds, although they report difficulties during the simulation. The results of the questions related to motivation, creativity, and team work before and after the game are conducted and presented on Figure 5.

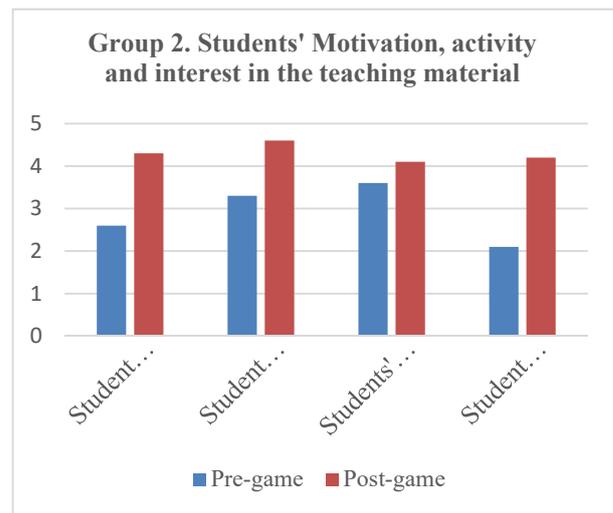


Figure 5. Measuring the indicators for the evaluation of the students' motivation, activity, and interest in the teaching material before and after the educational game is conducted (evaluation on a five-point scale)

The results from the second group of questions before and after conducting the educational game show that the students' motivation, activity, and interest in the teaching material have been boosted in terms of all sub-indicators. This is understandable, given that the students during the game have an interest and are committed to participating in completing the set tasks and this has led to boosting the trainees' concentration.

The construction of the warehouse is an additional product, although the cognitive goals are considered as a condition for achieving success in the game, and the game goals dominate and subordinate them. Thus the game-based method helps boost the motivational characteristic of the learning process in managing logistic projects. *The warehouse project game* is directly subordinate to the teaching goals of the content that has to be acquired. The significance of achieving the teaching goals is because the game motives and the motive-stimuli prove to be not so significant in them, but rather ensure an emotional support when achieving the teaching goal.

The students from the current study show high values of motivation and commitment during the WPG game. The problematic situations that arise during the simulation both between the team members and between different teams develop the trainee's intellectual sphere.

The third group of criteria is related to confidence, creativity, and team work. In the questionnaire, the trainees report that at the beginning they had vague moments, but during the testing itself of the educational game, all of the conditions of the game were clear. The third group of criteria includes some of the most important competencies that young people should possess: to be convinced in what they do, to be creative, and to work in a team. Figure 6 presents the results from the third group of sub-indicators before and after the game was conducted.

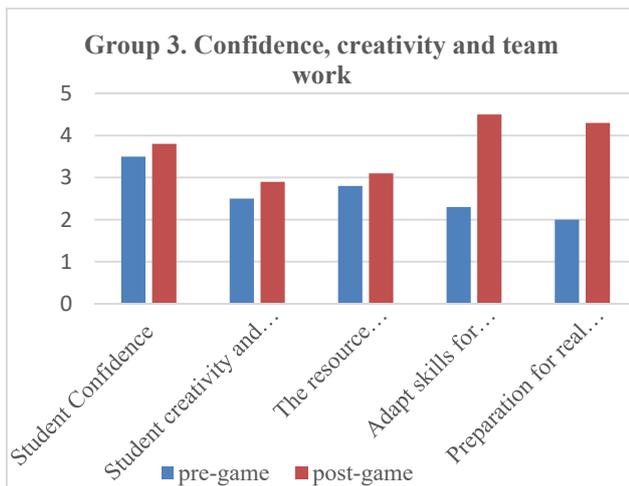


Figure 6. Group 3. Measuring of the indicators for the evaluation of confidence, creativity, and team work (evaluation on a five-point scale)

The data from the questionnaire show the students' increased confidence after the game is conducted. The emotional satisfaction of each student, which is achieved as a result of their participation in the game, contributes to a favorable "psychological climate", which is established during the learning process thanks to the mechanism for transferring the emotional states.

WPG helps the formation of the trainees' psychological readiness to participate in the labor activity and real business life since it places them in an environment of constantly changing conditions. The game facilitates the creation of some essential preconditions for labor and the management of available resources. The results of the conducted game do not differ in the case of project managers.

In accordance with the three groups of indicators, a cluster analysis is made after the game is conducted which arranges the trainees into groups depending on the indicators for the acquisition of knowledge, the motivation and activity indicators, and the indicators related to confidence and team work. The cluster analysis is conducted in several steps with a different number of clusters, starting from six. The results of the analysis show that the students that are participating in the research can be grouped into four clusters (see Figure 7).

The first cluster includes 42,85% (45 students) of the students participating in the game, the second 38,09% (40 students), the third includes 12,38%, (13 students) and the fourth one includes 6,66% (7) of the trainees.

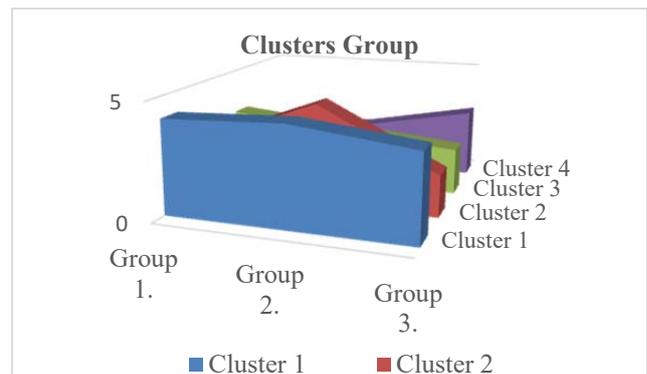


Figure 7. The distribution of the trainees in four clusters

The results of the K-Means Cluster show that the first cluster includes students who have high total marks on the acquisition and consolidation of knowledge, and also on confidence and team work. This confirms H3 that the trainees will boost their confidence, creativity, and team work while using contemporary game-based instruments. According to the achieved results, the motivation in these students is lower compared to the other groups from the cluster maybe because these students have also had motivation in advance during the traditional lectures.

The second cluster includes students that have the highest motivation while using gamification in training. In the case of these students, the interest in the teaching material has increased considerably. After the game was conducted this group of students shows a very high level of motivation and willingness to acquire new knowledge and skills. This shows that the respective cluster of students may join the excellent performers if appropriate teaching methods are employed. This confirms H1 that the trainees will boost their knowledge and skills in managing logistic projects while using contemporary game-based instruments.

While using game training models this group of students may considerably boost their motivation, which confirms H2 that the trainees will boost their motivation and interest in training in the management of logistic projects while using contemporary game-based instruments.

The third cluster is similar to the first one, but it has lower values of the criteria from the first group, which are related to the acquisition and consolidation of new knowledge and skills, and a third group of criteria which is related to confidence, creativity, and team work. What is interesting about this group of students is that while using game approaches the criteria related to the acquisition and consolidation of new knowledge and skills may be increased.

In the fourth cluster, the marks on all three groups of criteria are very low, which shows that these are students that have no interest in training as a whole. The total mark in these students is low and other types of motivation in training should be sought with them. The distribution of the four clusters in terms of sub-indicators is presented in Figure 8.

The results of the cluster analysis show the formation of natural groups based on the measured indicators on the acquisition and consolidation of new knowledge and skills, the student's motivation, activity and interest in the teaching material and confidence, creativity, and team work.

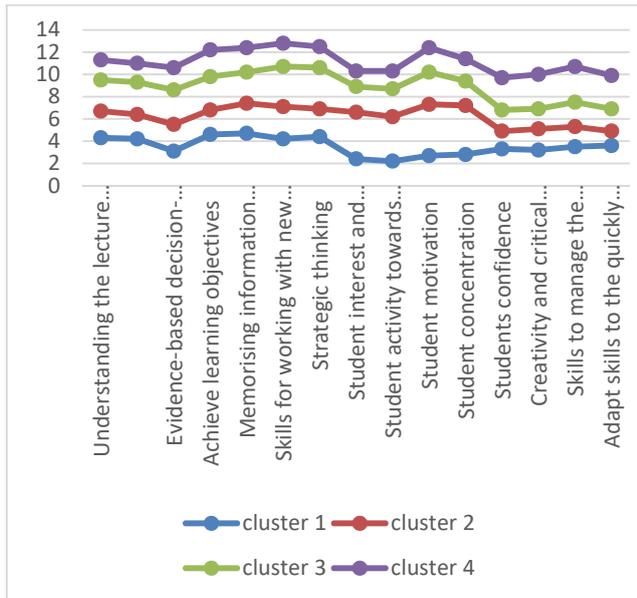


Figure 8. Distribution of the four clusters in sub-indicators on the efficiency of training in the management of logistic projects by applying the game-based method in higher education

The survey results show that there is no difference between Bachelor students, Master students, and practitioners (Project managers), therefore the data is aggregated.

The advantages of the game-based methods in the training in logistic projects according to the conducted research are the following:

1. The game-based training methods can boost the acquisition and consolidation of new knowledge and skills.
2. They help the trainees in building a strategic type of thinking – a great part of the variety of educational games and simulations help the trainees in building a long-term type of thinking. The acquisition of strategic thinking is an important part of training in economic specialties and more particularly in logistics and the management of projects. The educational games as part of the contemporary methods of training in universities may play an important role in terms of building the skill to make correct, precise, and prompt decisions in

different situations. The skills are extremely useful in a real business environment.

3. Expanding the focus of training – the game-based methods have an extremely useful effect on boosting the students' abilities and expanding the knowledge, on focusing and directing the efforts towards achieving a given goal.

4. The game-based methods of training may boost the students' motivation, activity, and interest in the teaching material;

5. They help develop social contacts between the students – the educational games may create interaction and contact between the trainees. This would be useful for the student's social life and expanding the circle of followers with which they communicate. The alpha generation, which is expected soon to enter the universities, will grow up with the contemporary methods of communication, social networks, and online games. The contemporary platforms will be an indispensable part of the alpha generation's life both in terms of entertainment and in terms of training. Therefore media, games, experiences, virtual reality, etc. via edutainment will be the next generation's real life. It is namely due to these that in the past years educational games, edutainment, simulation games, and others are increasingly being implemented as methods of training in universities.

6. The game-based training methods may boost the student's confidence – according to the current study WPG is directly related to boosting confidence in their knowledge and abilities. Moreover, it can promote creative thinking and find new variants and opportunities for solving a given problem.

5. Discussion

The game-based methods of teaching have a lot of advantages regarding the students' intellectual and personality development. Practically these training methods are appropriate for people of all age brackets, not only for the students studying in schools of higher education and this is proved by testing the game with the project managers. Despite this fact, educational games cannot exist independently in the teaching process in higher education. For the acquisition of the teaching material, traditional methods should also be used, such as lectures and seminars. However, game-based methods and gamification have their place in higher education.

The study shows how with the help of game-based methods through educational games for training in higher education new knowledge and skills can be increased and consolidated, the students' motivation, activity, and interest in the teaching material can be boosted, and also their confidence, creativity, and

team work. The educational game enhances the students' knowledge and helps the decision-making process, based on facts by developing a lot of mental and practical actions.

The presented WPG is designed in accordance with the teaching program set in the teaching plan and the programs for learning in the Business logistics specialty. The game is designed to be integrated into the contents of the subject Management of logistic projects to ensure an easier acquisition of experience and skills in real business life.

The process of creating educational games can also assist the teachers in considering the teaching content, the learning process, and binding the goals of education with the results in a new way.

The game-based methods and games in the teaching program should take into consideration the changes, not only establish the students' state and progress and should provide the opportunity for decision-making – stimulating and correcting, should generate ideas and alternatives.

As a result of the conducted cluster analysis under the indicators, it has been established that all interviewed are grouped in 4 clusters according to their evaluation of the acquisition and consolidation of new knowledge and skills, of the students' motivation and interest in the teaching material and confidence and team work. The results of the cluster analysis prove the efficiency of training in the management of logistic projects by applying gamification in higher education.

For future research, it is interesting to investigate individual clusters of students and how they can be motivated.

6. Conclusion

The contemporary requirements of our educational system necessitate a change in the way of teaching and the student's acquisition of skills and competencies. From a passive listener and performer, the students should become active participators in the teaching process, which means creating an opportunity that the students can perform well, can prove their argumentation, and offer new decisions. This requires methodological work in the lectures, which does not depend only on the teacher, but also on the knowledgeable and capable student.

In conclusion, we should say that the key to the students' successful acquisition of knowledge and skills in managing logistic projects lies in the skillful implementation of traditional and contemporary training methods. The requirements for the teachers have always been and continue to be high – they should meet a definite standard and should follow a definite teaching program. The contemporary teaching methods and the inclusion of game-based

elements in education will commit more students and will motivate them to achieve better results.

The results of the study show a lot of advantages while using the simulation game in higher education, which are comprised of boosting the knowledge and skills in managing logistic projects, increasing the motivation and interest in managing logistic projects, and in boosting confidence, creativity, and team work.

After WPG is conducted, the students have boosted the following skills:

- They define the component activities of the process of planning, compose network schedules and apply the technologies of CPM and PERT in the network analysis;
- They understand the analysis of expenditures under the project, the drafting of a budget, and the formation of prices and evaluate the logistic project.

The better the teacher understands the unique combination of factors that motivate each generation to acquire new knowledge, the more they will direct their efforts and ambitions to teach the students new knowledge and skills by using the appropriate methodology for teaching and motivating.

The presented cluster analysis may help identify a group of trainees in a definite subject in accordance with their knowledge, skills, motivation, activity, and interest in training. This may help focus on an individual cluster with the aim to achieve higher results among the students and find motivational stimuli for the individual groups.

The results ensure the information on the achieved success and the mistakes made in training. The exposed omissions provide the opportunity for decision-making with the aim to correct them.

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