Jornal homepage: https://devma.com.ua/en

DEVELOPMENT MANAGEMENT

UDC 37.031.2:378.147.88:004.942
DOI: 10.57111/devt.20(1).2022.43-52

Vol. 20, No. 1. 2022

Development of Human Potential: Design Thinking as a Way of Improving Professional Competencies of Economists

Irina Lebedeva*, Larisa Norik, Stepan Lebedev

Simon Kuznets Kharkiv National University of Economics
61166, 9A Nauka Ave., Kharkiv, Ukraine

Abstract. In a post-industrial society, the quality of professional education becomes a leading factor in the formation of human potential. One of the ways to ensure the effectiveness of this process is the use of innovative educational technologies aimed not only at the formation of professional competences, but also at the development of creativity which, in the future, will contribute to the search for non-standard ways of solving real problems. The purpose of the work is to study the influence of interactive educational technologies based on the concept of *design thinking* on the success of students of economic specialties and their internal motivation to study mathematical disciplines. The format of a business game has been chosen as a method of implementing the concept of *design thinking*. It involved the construction of a mathematical model of a real economic problem and the use of a mathematical apparatus to solve it. In order to evaluate the effectiveness of gamification it has decided to distribute students according to academic performance and students ranked classes according to their preferences using the method of hierarchies analysis. The experience of implementing business games demonstrated by the example of the discipline "Operations Research and Optimization Methods" confirmed the effectiveness of this technique in the process of studying the disciplines of the mathematical cycle precisely due to the increase in students' internal motivation. Compared to traditional teaching methods, the formation of students' professional competencies has been enriched by the experience of solving transdisciplinary tasks. The results of the study allow us to conclude that the professional competencies of future economists are significantly improved thanks to the use of a business game in the learning process where a real economic problem is adapted to the topic of the discipline

Keywords: knowledge economy, hard and soft skills, learning process activation, transdisciplinary tasks, learning technologies, business game, gamification

Article's History: Received: 04/18/2022; Revised: 05/31/2022; Accepted: 06/28/2022

INTRODUCTION

The leading paradigm of the development of post-industrial society is the reorientation from the accumulation of material goods to the development of human potential. Human potential (accumulation of knowledge and skills) and its subsequent transformation into human capital (the applicati on of this knowledge in practical activities) are considered as one of the main driving forces that ensure the success of not only an individual, but also an organization [1] and even the country as a whole [2]. Back in 1965, the United Nations Development Programme [3] was presented whose main task was and remains to ensure the sustainable development of member-countries. And human potential is the factor that determines the ability for such development. Therefore, since 1990, the United Nations Development Programme has been publishing a report on the Human Development Index every two years. One of the components of this integral indicator is the level of education, which reflects the level of literacy of the adult population, the level of involvement in the learning process of school-age children (expected years of education for school-age children). And since 2019, the Program has been publishing a report on the human capital index which reflects the quantitative indicators of education (expected duration of schooling by the age of 18) and the quality of education (scores of unified tests) [4]. The human capital development project [5] and similar global initiatives designed to promote larger and more effective investments in people aim to ensure the economic growth of each country and overcome social inequality among different nations. That is why, in recent decades, the attention of such

Suggested Citation:
Lebedeva, I., Norik, L., & Lebedev, S. (2022). Development of human potential: Design thinking as a way of improving professional competencies of economists. *Development Management,* 20(1), 43-52.

*Corresponding author

international organizations as the United Nations Development Programme, the United Nations International Children's Emergency Fund, the World Bank, the Organization for Economic Co-operation and Development has been focused on the problems of human potential development and its further capitalization.

The quality of education is the determining factor in the formation of human potential. It plays a leading role in the formation and development of the modern knowledge-based economy [6-8]. Many large companies, especially those with a high level of added value, have come to understand the vital importance of both individual and collective human skills. This is understood by the employees themselves. Among the main reasons that prevent today's youth from developing entrepreneurial activity 34-38% of respondents consider their own knowledge to be insufficient [9]. At the same time, the high level of initial knowledge that a person acquires at the beginning of professional activity is insufficient to ensure long-term success. Education is seen as a primary requirement that helps meet many other needs and improves the quality of life. However, the content of education should be aimed at the ability to learn new knowledge, update it when necessary [10]. The needs of the innovative economy require a person to constantly update their knowledge, that is, to carry out lifelong learning. The modern education system was created back in the industrial era, when a clear focus on acquiring a certain amount of knowledge was important [11]. Modern problems, as a rule, are interdisciplinary in nature. Therefore, students should improve their analytical abilities, practice creative thinking skills, learn to comprehensively justify decisions. Accordingly, changing the very paradigm of education requires significant changes in the educational environment [12]. And such opportunities are provided by the wide application of digital technologies. Digitalization makes education not only more accessible in space and time for a wide range of the population, but also allows creating an individual learning environment that increases a person's involvement in learning and improves their adaptability [13]. It is thanks to digitalization that it becomes possible to study online in a virtual environment adapted to the purpose of learning. Therefore, at the stage of post-industrial development, when the reproduction and further improvement of human potential are determined, first of all, by the level of education in the country, to increase the quality of education at all levels is strategically important for the formation of the ability not only to assimilate knowledge, but also to apply it creatively. This determines the search for ways to improve the educational process and the use of innovative technologies to increase the effectiveness of learning in all educational fields and for people of any age. This especially applies to the study of science and mathematics disciplines, since these are the disciplines that determine the competence of a person who is capable of critical thinking and knows how to logically justify decision-making. As a response to the need for fundamental changes in the education system itself, the state of higher education in recent decades can be characterized as a time of reforming all aspects of its activity. At the same time, both the ultimate goal of education and the methods by which this goal is achieved undergo significant changes.

It should be noted that the active introduction of the latest digitization-based technologies into the educational process has been observed since the beginning of the 21st century, but this issue is gaining special relevance right now, in the period of COVID-19 epidemic and the widespread transition to distance learning associated with it. And for Ukraine, these needs are intensified due to the need to ensure the learning process in the conditions of martial law in the country.

However, distance learning has its drawbacks. In such conditions, the student mostly manages his/her own education. Accordingly, the success of studies largely depends on the internal motivation of the student, their focus on the result. Therefore, there is a need to develop and apply such learning technologies that would maintain a student's constant interest in the disciplines under study, would motivate him/her to persevere in learning, that is, would contribute to the development of human potential. And in the future, this would give an opportunity to creatively implement the acquired knowledge at a higher level, namely when solving problems within those disciplines that correspond to the professional purposes.

The purpose of this article is to study the peculiarities of the implementation of interactive educational technologies based on the concept of *design thinking*, in particular, a business game, in the context of the development of human potential, as well as the impact of these technologies on the formation of the internal motivation of students of economic specialties to study mathematical disciplines. For this, it was necessary to develop such a scenario of a business game that allowed to combine the study of mathematical methods and their application in order to solve real economic problems.

THEORETICAL FRAMEWORK

One of the most important needs of our time is not only the accumulation of knowledge, skills and abilities, but also the ability to creatively use them in professional activities that reflects the process of transforming human potential into human capital. Therefore, important components of the process of human potential formation are factors that contribute to the formation of a creative personality, their development and self-development. This approach is reflected in the concept of *"design thinking"*. This idea was proposed by brothers Tom Kelley and David Kelley [14] who taught creative thinking in solving transdisciplinary problems to the students of Stanford University. The term *"design"* in this context should be understood as "creating", "constructing", and *"design thinking"* is considered as a technique focused on the final product of knowledge and on team cooperation in determining innovative solutions to achieve the strategic and/or tactical goal of research. Although this concept was primarily focused on improving business efficiency [15], it is now becoming popular in the organization of the educational process [16-18]. And it is the teachers who become the developers of those educational technologies, with the help of which later students construct their system of problem vision, and this system is based on the acquired knowledge.

In general, design thinking or design-based research is considered as a method of creating non-standard projects, products and services, etc. This method is aimed at solving specific problems based on the interests of the potential consumer. And in this case, the consumer is a student who is

a future specialist in a certain field of knowledge [19]. It is noted that *design thinking* involves discussing the problem in groups, when the teacher does not act as a Teacher or Leader, but only as a facilitator, that is, a person who ensures the success of group communication. Design thinking includes a variety of creative strategies for managing multi-stakeholder projects and facilitating organizational innovation. It helps to overcome the ambiguities encountered in such projects, to formulate the right questions, as well as to determine the possibilities of accomplishing the task. In fact, the concept of *design thinking* is an embodiment of the central idea of connectivism according to which students form a community that uses already known knowledge to create new one. And the Internet, which contains a large volume of all kinds of information, gives unique opportunities for this. That is why online education has become so popular recently. So, on the one hand, e-learning creates conditions for freer communication in groups, and on the other hand, it requires the teacher to use such teaching methods that would contribute to the involvement of all students of the group in this process. In these conditions, the teacher's task is to develop and apply such interactive methods that would form students' internal motivation to study. The result of applying *design thinking* in the educational process can have a synergistic effect [20]. That is, not only the student as a user feels the benefits of this method of learning, but also the self-organization of education itself as a system of acquiring knowledge takes place.

The implementation of design-based research [21] involves certain stages that must be followed when applying this method in education. They can be presented in the form of such a scheme (Fig. 1).

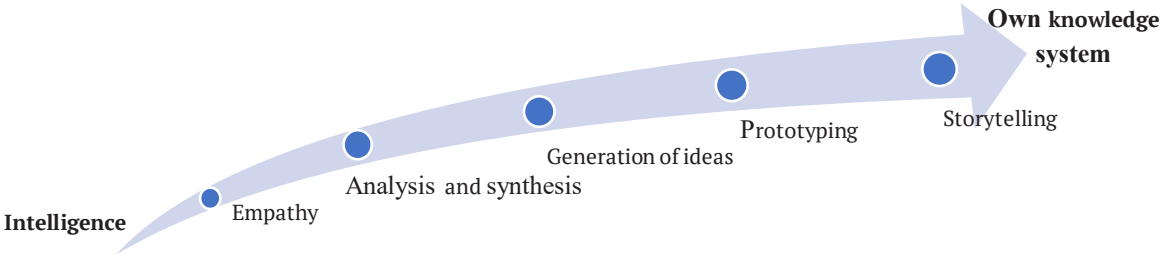

Figure 1. Stages of the design thinking implementation

The first stage is empathy, that is, the creation of such an atmosphere that would facilitate complete immersion in the problem. For this, it is necessary to reject stereotypes and be sensitive to new ideas. At the second stage, analysis and synthesis are carried out, i.e., the information obtained at the previous stage, is understood. The third stage involves the generation of ideas aimed at solving the main tasks within the limits of the investigated problem. In technical disciplines, new ideas can find their embodiment in the creation of models (prototyping) and their testing, and it is the fourth stage. In mathematical disciplines, simulation modelling can be used to test the correctness of proposed hypotheses. The final fifth stage (storytelling) is the generalization of the obtained results.

Among the learning technologies actively used in the educational process there are many interactive methods that implement the concept of design thinking to this or that extent. By its essence, *design thinking* has an interdisciplinary nature and is carried out as a project activity. These requirements are met by methods such as mind mapping (for generating ideas as a basis for conducted research), brainstorming (for generating new opportunities and alternative business models), workshop (where participants learn through their own active work on a problem), testing key hypotheses (for the formation of promising hypotheses that contribute to the implementation of the concept), etc. [18].

However, it is game techniques that most fully correspond to the principles of *design thinking*. This was even reflected in the term "Game Design" [21]. Gamification of the educational process allows for design-based research in any field of knowledge. Therefore, gamification can be considered as one of the leading trends in modern education in general [22; 23], as well as the national education system in particular [24; 25]. Gamification, as a rule, is used in school education, especially in the education of younger students and, accordingly, is aimed at teachers of primary school [26]. However, recently it has attracted attention in the teaching of different disciplines in high schools, as well as in business education. The expediency of using this educational technology in higher education was demonstrated by the example of studying various disciplines, including mathematical ones, though such examples are few [27; 28].

It is worth noting that the term "gamification of learning" has a fairly broad meaning. In most cases, it is about the use of computer games in education dedicated to one or another topic of the discipline and even the creation of game design of the discipline as a whole [21]. However, in this case, the student interacts only with the computer program, i.e. ready-made knowledge acquisition is offered, and the game format makes the educational process less formalized, and therefore, more interesting and makes it easier to perceive the educational material. On the contrary, the game as an embodiment of *design thinking* involves close communication among the participants of the game and working out common rules according to which the game is played. This is the format of business games. And precisely such games were introduced in our study to stimulate the internal motivation of students and to improve their professional competences when studying mathematical disciplines.

In the process of training future specialists in the field of economics and management, mathematical disciplines are considered as a basis for further mastering the methods of quantitative and qualitative analysis of economic phenomena. Therefore, it is advisable to orient students to the solution of complex transdisciplinary tasks at

the very first stages of studying mathematical disciplines. It is very important as, in the future profession, the manager will not only research the problem and develop his/her solution, but he/she must also be able to listen to the objections of other participants in the discussion and justify and explain the objective advantages of his/her decision. So, the ability to work in a group can be considered one of the professional qualities of a manager. Therefore, as interactive techniques that will contribute to the formation of internal motivation for learning and the development of professional competences, group business games have been considered, with the content determined by the program of the discipline, while e-learning provides communication within the group of students and between students and the teacher independently from their location.

The choice of game mechanics used in the e-learning process should depend on the way of how this process is implemented. It should be noted that online learning is divided into two types: synchronous and asynchronous. Synchronous class takes place in real time, for example, using video conferencing or online chat to transmit voice, image or alphabet. It is important that interactions occur simultaneously. So, although such a class is virtual, it provides an opportunity for interaction between students and the teacher, as well as between students themselves in real time. With the asynchronous form of classes, the student has the opportunity at any convenient time to review the material that the teacher has prepared in advance. This form of the educational process organization to a large extent involves self-regulation of learning, so it requires greater efforts from the teacher to motivate students.

MATERIALS AND METHODS

An analysis of the results of a pedagogical experiment on the introduction of game technologies and digitization into the educational process at Simon Kuznets Kharkiv National University of Economics has been carried out. In order to develop students' ability to think creatively, since 2008, the following forms of learning activation as debates, cases, business games, etc have been practised when teaching economic disciplines at S. Kuznets KhNUE. As a rule, they were used at trainings or while teaching minors to Master students. The effectiveness of this approach in studying mathematical disciplines was demonstrated by one of the authors by the example of teaching the discipline "Economic-Mathematical Models and Methods of Property Valuation" within the Master's Program 071 "Accounting and Taxation" [29; 30], taught by the Department of Higher Mathematics and Economic-Mathematical Methods. That is why, it was decided to apply this pedagogical experience in teaching mathematical disciplines to Bachelor students. The choice of game mechanics used in the e-learning process depended on how exactly e-learning was implemented.

It should be taken into account that the use of game methods in online learning involved communication in both synchronous and asynchronous modes. Interaction in the synchronous mode took place during the discussion of tasks (production stage), directly during the game (main stage) and discussion of its results (final stage) using video conferences. So, although such classes are virtual, they provide interaction between students and the teacher, as well as between students themselves. The asynchronous form was used by students throughout the game to choose a strategy and discuss individual elements of the game between team members at any convenient time. The LMS Moodle platform and Zoom Video Communications were used to support both synchronous and asynchronous classes. The MS Excel spreadsheet processor was used for calculations. This is a software product used for homework and laboratory work in all disciplines of mathematics.

As part of the experiment, during the 2020/2021 and 2021/2022 academic years, students of the 1st and 2nd years (approximately 300 students participated in the experiment each year) were offered to perform transdisciplinary tasks. The task involved solving an economic problem using the mathematical apparatus mastered by students at this stage in accordance with the curriculum of the academic discipline. The experiment consisted of two parts. The first part was a business game, and the second part was an evaluation of the methods used in teaching mathematical disciplines. As an experiment, game methods were introduced when studying certain topics of such basic mathematical disciplines as "Higher and Applied Mathematics" (specialty 242 "Tourism"), "Probability Theory and Mathematical Statistics" (specialties 122 "Computer Science" and 075 "Marketing"), "Operations Research and Optimization Methods" and "Econometrics" (specialty 076 "Entrepreneurship, Trade and Stock Market Activity"). For this, one of the topics of the discipline was chosen, which corresponded to the curriculum of the discipline and reflected the use of mathematical methods in real studies of economic processes and phenomena. Practical classes on this topic were conducted in the format of a business game. Thus, in the discipline "Higher and Applied Mathematics" when studying the topic "Function of Several Variables", students were offered the business game "Optimal Composition of a Mixture". In the discipline "Theory of Probability and Mathematical Statistics" when studying the topic "Basic Theorems of Probability Theories", students of specialty 122 were offered the business game "Think Like Bayes", and students of specialty 075 – the business game "Paradoxes of Probability Theory". In the discipline "Operations Research and Optimization Methods" when studying the topic "Transport Problem" students were offered a business game "Appointment to a Position". In the discipline "Econometrics" when studying the topic "Multifactor Model" students were offered a business game "Is this Sample Population Homogeneous?". The content of the tasks, the structure of the game, the rules of its implementation are the author's developments.

In general, as any implementation of *design thinking*, the scheme of the game consists of five consecutive stages (see Fig. 1). At the *empathy* stage, students receive a task, i.e., a topic on which they have to develop their own project, statistical data (in part) and, overall, criteria that this project is to meet. At the stage of *analysis and synthesis*, students analyse the received information, propose and clarify the project evaluation criteria and create a scale by which this evaluation will be carried out. They determine what additional statistical data they need and search for these data. When making the rating scale, students proceed from the fact that the business game is considered as an independent creative task and is rated at 8 points. The stage *generation of ideas* involves direct work on the project. During

this stage, students search for the necessary information and process it using the necessary mathematical apparatus. If desired, the task can be performed either by each student individually or by a group of 4-5 people. These subgroups were offered either to choose for themselves the direction of research or take the one proposed by the teacher, or find their own direction that corresponds to the topic of the game. At the *prototyping* stage, students present their projects. These projects are discussed within the academic group. The *storytelling* stage involves summarizing. The students of the academic group themselves determine the compliance of the projects with the requirements that were formulated by them during the discussion of evaluation criteria at the *analysis and synthesis* stage. And they also evaluate the effectiveness of the application of the business game in the educational process. At the same time, the teacher acts as a facilitator.

The second part of the experiment on the introduction of business games in the educational process (the final stage) was the study of students' opinion regarding teaching methods. This was done through a questionnaire in which students defined the most effective, from their point of view, types of classes and ranked them. Both classroom and online learning takes place in the conditions of a traditional lecture-workshop system, using individual and group work. According to the method of analysis of hierarchies, developed by Thomas Saati [31], students themselves determined the ranks of the following classes: lectures (a_1), workshops (a_2), laboratory work (a_3), homework (a_4), business game (a_5), writing a scientific article as an independent creative task (a_6). According to the method of analysis of hierarchies, a pairwise comparison of all alternatives is carried out and the result is recorded in the form of a matrix $\mathbf{A}=(a_{ij})_{n\times n}$. According to the scale of relative importance, the maximum score of 9 means the absolute preference of the alternative written in the row of the matrix over the one written in the column after the cell (i,j). For the elements of this matrix, the condition is fulfilled: $a_{ij}\cdot a_{ji}=1$ $(\forall i,j)$. Based on the matrix of pairwise comparisons, the vector of priorities $\mathbf{W}=(w_1,w_2,\ldots,w_n)$ is determined, and the consistency of the matrix **A** is checked. For this, the geometric mean (1) is calculated for each row of the matrix **A**:

$$\overline{w_i}=\sqrt[n]{\prod_{i=1}^{n}a_{ij}},\quad i=\overline{1,n}, \tag{1}$$

where a_{ij} ($i=\overline{1,n}, j=\overline{1,n}$) are the elements of the matrix **A.**

And after normalization, components of the priority vector (2) are defined:

$$w_i=\frac{\overline{w_i}}{\sum\overline{w_i}}. \tag{2}$$

The consistency of this reasoning has been verified. To do this, the consistency index and the consistency ratio were determined. First, the maximum eigenvalue λ_{max} of the inverse-symmetric matrix of pairwise comparisons is calculated according to formula (3):

$$\lambda_{\max}=\sum_{j=1}^{n}w_j\cdot\left(\sum_{i=1}^{n}a_{ij}\right). \tag{3}$$

Then the coherence index (4) is found:

$$CI(\mathbf{A})=\frac{\lambda_{\max}}{n-1}. \tag{4}$$

And the consistency ratio (5) is calculated:

$$CR(\mathbf{A})=\frac{CI(\mathbf{A})}{RI}, \tag{5}$$

where *RI* is a random preference consistency index, the value of which depends on the size of the matrix of pairwise comparisons and is determined according to the reference table [31].

RESULTS AND DISCUSSION

Let us consider the results of the first part of the experiment, namely, the expediency of using a business game in the study of mathematical disciplines. We emphasize once again that although within different mathematical disciplines, business games were conducted on different topics and involved the use of different mathematical apparatus, in general, the rules for all games were determined according to the same principles. According to the scenario of the business game, the solution of a real problem was supposed to be solved with the help of economic and mathematical methods taught within the framework of the discipline. For example, in the discipline "Operations Research and Optimization Methods", when studying the topic "Transport Problem", the business game "Appointment to a Position" was conducted. The assignment problem is one of the basic problems of combinatorial optimization. The name of the task comes from a situation common in work of HR managers, when it is necessary to select such specialists among applicants for positions that would bring the greatest efficiency to the company. The mathematical model of this problem is also widely used in the optimization of the distribution of indivisible resources: machines, buildings, containers, vehicles as well as performers of certain work. Such a problem is reduced to the transport problem, where the criterion of efficiency is the overall efficiency of the organization, and comprehensive evaluations of applicants for positions play the role of tariffs in the classic transport problem. The objective function of such a problem is studied to the maximum.

At the first stage (the empathy stage), students were asked to consider the offers of several consulting agencies for recruiting personnel for a company that sells household appliances. Students searched for this information independently using Internet resources and taking into account their own experience and common sense. Next, the stage of analysis and synthesis was carried out, where students had to process the received information and, if necessary, find additional information about the requirements that applicants for the position should meet. So, in the process of discussion, students first chose the positions that had to be filled and then formulated a list of requirements that applicants for these positions should meet. Then the selection of parameters was carried out, according to which the applicants should be evaluated. Then, according to the results of the survey of applicants for each position, whose roles were played by students from other subgroups, the degree of their compliance with a certain position was defined. When forming the list of questions that were asked to applicants for positions, students relied on data from consulting agencies. At the idea generation stage, the students had to use the acquired information to build a mathematical model of the task of appointing applicants for the position and with the help of the MS Excel software

environment, determine the optimal plan for this task. At the prototyping stage, students presented the optimal plan for the distribution of applicants by position with the help of which the company can achieve the highest efficiency under the given initial conditions. At the final stage (storytelling), each subgroup presented its vision of the problem, defended its version of the solution and critically analysed the proposals of other subgroups. Therefore, while analysing such a transdisciplinary problem, students not only mastered the principles of building mathematical models of optimization problems and methods of solving them according to a ready-made scheme, but also put forward their own ideas and demonstrated creativity. Although the algorithm for solving problems of this type is known, the students came to their own conclusions when working on the problem. In fact, for them it was a manifestation of design thinking. It can also be noted that the principle of conducting such business games is close to a workshop that always involves collective work on a problem, and the emphasis is on active cooperation within the group and a joint search for a solution to a complex problem. The final result is considered to be the construction of a managerial decision model in a certain specific situation.

It has been given an example of business game implementation for only one of the mathematical disciplines. For other disciplines, the structure of the game was the same, and the choice of the topic of the game was determined by the mathematical apparatus studied within this discipline.

The most difficult to solve are the so-called "wicked problems" that do not have obvious (unequivocal) solution algorithms. Problems of this type were offered to the most successful students of the second year of study. These students have already acquired a certain amount of knowledge in economics and management and could use it to analyse the algorithm for building mathematical models. They chose "wicked problems" voluntarily and their choice fully coincides with the theory of Abraham Maslow [32], who is considered the father of research into human potential and self-actualization. Thus, according to the hierarchy of needs proposed by him, self-actualization is the highest level of Maslow's pyramid. As an example of tasks of this type multi-criteria optimization tasks, a transport task with intermediate points, dynamic programming can be mentioned. These topics are included in the program of the discipline "Operations Research and Optimization Methods". "Wicked problems" in the discipline of "Econometrics" include, for example, building an econometric model in the presence of multicollinearity between external variables.

The second part of the experiment on the introduction of a business game as an element of *design thinking* in the educational process consisted in studying the opinion of students regarding the attractiveness of various methodological elements of education from the point of view of their effectiveness. The student survey, whose purpose was to rank teaching methods according to their cognitive properties, was conducted within each academic group. The analysis of the results of the ranking showed that there are two opposite principles according to which students choose the most convenient learning method for them. Some students (almost 30% of all respondents) prefer academic teaching methods. An example of pairwise comparisons matrix for this subgroup of students is given in Table 1.

Table 1. Matrices of pairwise comparisons according to the preferences of students who consider academic teaching methods attractive

	a_1	a_2	a_3	a_4	a_5	a_6	w_i
a_1	1	1/5	3	6	4	7	0.227
a_2	5	1	6	6	5	9	0.472
a_3	1/3	1/6	1	4	4	7	0.143
a_4	1/6	1/6	1/4	1	1/5	4	0.044
a_5	1/4	1/5	1/4	5	1	7	0.092
a_6	1/7	1/9	1/7	1/4	1/7	1	0.022
λ_{max}=7, CI(**A**)=0.205, CR(**A**)=0.165							

For the matrix of pairwise comparisons given in Table 1, by formulas (1) and (2) the values of the components of the priority vector are calculated. They are listed in the last column of the Table 1. According to these values, there are the following arrangement of alternatives (6):

$$a_2 \succ a_1 \succ a_3 \succ a_5 \succ a_4 \succ a_6 . \quad (6)$$

Thus, this part of students preferred traditional forms of education, i.e. workshops, lectures, laboratory work, and creative tasks they ranked in the last place.

Let us check the consistency of this reasoning. To do this, using formula (3), the maximum eigenvalue is calculated, which for the matrix given in the Table. 1, is equal to λ_{max} and by formula (4) the consistency index 0.205 is calculated. According to the reference table [31], it is found that for a matrix of order n=6, the random consistency index is equal to I=1.24. So, according to formula (5), CR(**A**)=0.165 is found. Since CR(**A**)=0.165<0.2, the judgment of students who prefer academic teaching methods does not contain internal contradictions.

The rest of the students (approximately 70% of all respondents) are interested in learning methods that give more space for creativity. An example of pairwise comparisons matrix for this subgroup of students is given in Table 2.

Table 2. Matrices of pairwise comparisons according to the preferences of students who prefer creative teaching methods

	a_1	a_2	a_3	a_4	a_5	a_6	w_i
a_1	1	3	1/5	3	1/7	4	0.108
a_2	1/3	1	1/5	2	1/9	2	0.060
a_3	5	5	1	4	1/5	2	0.199
a_4	1/3	1/2	1/4	1	1/9	1/5	0.034
a_5	7	9	5	9	1	5	0.531
a_6	1/4	1/2	1/2	5	1/5	1	0.068
λ_{max}=6.78, *CI*(**A**)=0.157, *CR*(**A**)=0.126							

In this case, the following ranking results (7) were obtained by the components of the priority vector:

$$a_5 \succ a_3 \succ a_1 \succ a_6 \succ a_2 \succ a_4. \quad (7)$$

Students of this subgroup preferred those learning methods that provided an opportunity to show independence in searching for information and creativity in solving tasks. These students willingly accepted a business game learning format. They were active at all stages of the game and showed leadership qualities at the stages of decision-making and discussion of results. It should be noted that for this subgroup consistency ratio is *CR*(**A**)=0.126<0.2, that is, the judgments of these students do not contain internal contradictions and are even more logical than those of students who prefer academic learning.

The correlation between subgroups of students with different opinions on teaching methods may be different for different academic groups. In groups where the average score in mathematical disciplines is 7 points or higher (on a 12-point scale), the second type of alternatives arrangement dominates.

A more detailed analysis showed that students' preferences regarding the forms of education are correlated with their attitude to education and with their success. For most academic groups, the distribution of students by academic performance can be considered bimodal (Fig. 2).

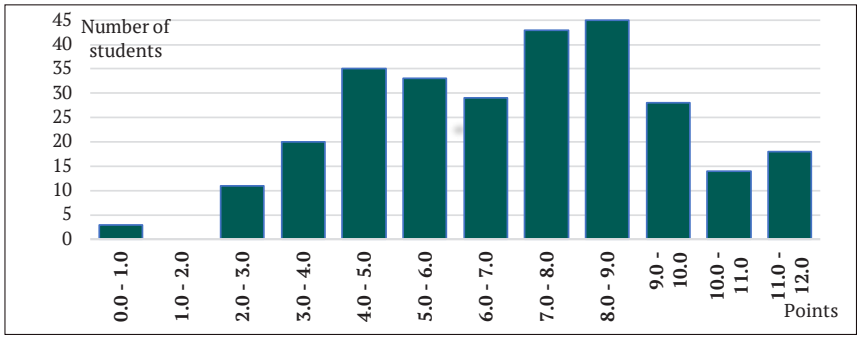

Figure 2. Distribution by academic performance of students who participated in the business game

For the part of students who prefer tasks that require creativity, the average score is high enough. So, Figure 2 shows that the mode of success distribution for this subgroup is equal to 8 points on a 12-point scale. These are students who perform creative tasks that include writing a scientific article or participating in scientific conferences, they play leading roles in business games, and in the 2021/2022 academic year they also take part in the Coursera educational project. So, they are not only more motivated to study, but also prone to independent acquisition of knowledge. On the contrary, students of the subgroup for which the mode of success distribution is 4.5 points have a tendency to use ready-made algorithms, that is why they prefer lectures and workshops. Such students do not seek to perform creative tasks and are passive when conducting business games.

Just to compare, let us make a success analysis of the 2018/2019 students who were not offered business games when studying mathematical disciplines (Fig. 3).

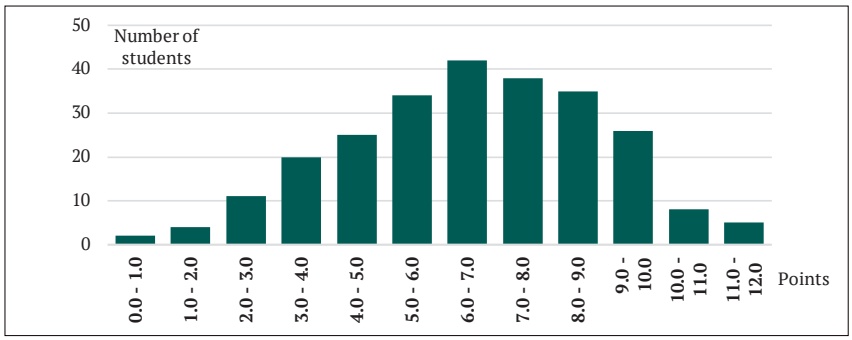

Figure 3. Distribution by academic performance of students who did not participate in the business game

Figure 3 shows that the law of distribution can be considered close to normal. The mode of success distribution of such students is approximately equal to 6.5 points. This fact can be explained by the following. Students who are prone to a creative attitude to learning, capable of generating creative ideas, do not have the opportunity to show these qualities in the conditions of academic teaching methods. So, the realization of such qualities during the business game is another positive outcome of the application of business games in studying mathematical disciplines.

A comparison of these results with the data of other studies [33] shows that business games can be easily adapted to the requirements of different specialties, that is why their application in the process of training future managers is more effective than that of cases or tests. It should be noted that the business game in the format developed by the authors involves active cooperation of the participants, but this does not mean that it can be used only when teaching in the classroom, i.e., in face-to-face communication. Skype, video conferences and other simultaneous electronic forms of communication can be used to organize communication. In the modern world, where people are used to using gadgets, this form of communication does not affect the quality of the educational process. In addition, the digital literacy that a student acquires in the context of e-learning not only improves academic performance, but also contributes to better employment [34].

It is emphasised once again that among the requirements that project managers must meet, most sources list both "hard skills" and "soft skills" at the same time. "Hard skills" presuppose the presence of professional knowledge and skills, which include knowledge of certain software, the understanding of mathematical apparatus on which these programs are based, and the ability to use it in solving economic problems. On the other hand, "soft skills" include: skills for solving transdisciplinary problems; teamwork; adaptability and flexibility when looking for managerial solutions; the ability to perceive feedback. It was for the purpose of forming these "hard and soft skills" that the business game was used as an element of the curriculum in mathematical disciplines studied by future economists and managers. The use of gamification elements of *design thinking* in the educational process when teaching mathematical disciplines allows students to acquire not only "hard skills", but also "soft skills". Therefore, the analysis of the peculiarities of the development of human potential caused by the introduction of interactive technologies into the educational process testifies about the effectiveness of the application of *design thinking* concept and its implementation in the format of a business game aimed at solving real tasks of the economy. These results correlate with the proposals made by the authors of the work [9] in which they emphasized the need to focus the educational process on solving real economic problems, and the formation of knowledge acquisition skills was regarded as a productive force. All these will allow such a specialist to occupy a higher socio-economic level in the future.

The obtained results are also well consistent with the concept [35], according to which the mastery of instrumental methods of education and the integration of differently oriented tasks contribute to the formation of future specialist's readiness to deepen his/her knowledge and improve his/her skills. This concept is gaining particular popularity in Eastern European developed countries. Adapting the provisions of this concept to the modern needs of society and strengthening it with gamification elements of *design thinking* will allow building a model for training a new generation of specialists in economics. And *design for learning* is regarded as a concept of the educational process primarily focused on training specialists in those fields of knowledge that require a research approach, and is a methodology of the 21st century [36].

A business game as an implementation of design thinking is a powerful addition to the recommendations outlined in the study [37]. The study has reviewed practical teaching and analysed the impact of collaboration, group work, and problem-based approaches that use interactive activities to increase student engagement. The format of the business game can also develop the approach outlined in the work [38], where the authors evaluated the effectiveness of information, communication and electronic technologies integration in teaching and learning. Although there is also the opinion that studies of the effectiveness of training methods based on the concept of *design thinking* are just emerging and their number is insufficient to draw final conclusions [39].

Therefore, the results of the conducted experimental research show that the *design thinking* technology provides the principles of goal orientation, activity, person-oriented, situational and competence approaches in the process of learning mathematical disciplines and is a powerful factor in the development of human potential. Innovative forms and methods of *design thinking* contribute to the improvement of the quality of learning mathematical methods, the development of cognitive activity, the skills and abilities of critical understanding of a problem, the acquisition of experience in independent processing of educational material, search work, i.e., those qualities that are necessary for further self-education and self-realization. The competent component of human potential in the form of motivational-value, operational-cognitive and emotional-volitional components of *design thinking* makes it possible to reflect not only the formation of knowledge, abilities and skills necessary for future economic activity, but also is important for the formation of motivational, cognitive, strong-willed and adaptive personality.

CONCLUSIONS

In the context of the development of human potential, the analysis of the features of the implementation of interactive educational technologies based on the concept of *design thinking*, as well as the impact of these technologies on the formation of the internal motivation of students of economic specialties to study mathematical disciplines, allows us to draw the following conclusions:

– it is expedient to enlarge the use of applied transdisciplinary tasks in the study of mathematical disciplines,

– the use of a business game that employs *design thinking* technologies makes it possible to encourage students to participate in solving applied problems and stimulates better interaction between students and the teacher,

– teamwork of students when developing a project on the topic of a business game ensures the acquisition of communication competences and stimulates the ability to

generate own ideas, analyze them, be critical of comments and find optimal ways to solve transdisciplinary tasks,

– the active use of modern information technologies, in particular the LMS Moodle environment, in the implementation of *design thinking* technology tools allows students to create their own learning environment and provide them with an access to learning in synchronous and asynchronous modes.

Since real economic problems were chosen as the topic of the business game, their solution helped students to find out the feasibility of applying mathematical methods in their future practical activity. This increases their interest not only in studying the topic on which the game is conducted, but also in the possibilities of using the mathematical apparatus as a whole. Therefore, the introduction of a business game into the learning process increases students' motivation to study mathematical disciplines. The results show that the use of elements of gamification as one of the technologies of *design thinking* in teaching mathematical disciplines allows students of economic specialties not only to acquire certain competences of professional training, but also to create prerequisites for their further self-development while working at enterprises, organizations, establishments, institutions.

It should be noted that our experience with the application of a business game in the educational process testifies about the rapid effect of the implementation of such a method to improve the process of learning a certain discipline. However, more research is needed to analyze the long-term effect of this technique.

In the future, it is planned to introduce elements of the business game not only when studying one of the topics of a mathematical discipline, but also to extend this approach to conducting laboratory work and workshops in mathematical disciplines. Therefore, the content of the individual and independent work of students should be the solution of professionally oriented and innovative tasks that will contribute to the formation of practical skills of how to apply mathematical apparatus to solving real managerial tasks, acquiring the ability for creative thinking and communicative competence in future economists.

REFERENCES

[1] Qin, N., & Kong, D. (2021). Human capital and entrepreneurship. *Journal of Human Capital*, 15(4), 513-553. doi: 10.1086/716344.

[2] Zolin, M., & Vale, D.N. (2020). The effect of increasing human capital investment on economic growth and poverty: A simulation exercise. *Journal of Human Capital*, 14(1), 43-83. doi: 10.1086/708195.

[3] United Nations development programme (UNDP). (2022). Retrieved from https://www.wikigender.org/wiki/united-nations-development-program/.

[4] World Bank Publications. (2020). *The human capital index 2020 update: Human capital in the time of COVID-19*. Washington: World Bank Publications.

[5] The human capital project: An update. (2019). Retrieved from https://www.devcommittee.org/sites/dc/files/download/Documents/2019-09/Human%20capital%20project%20Final_DC2019-0007.pdf.

[6] Mamuli, L. (2020). Human capital development and higher education. *European Business & Management,* 6(4), 61-66. doi: 10.11648/j.ebm.20200604.1.

[7] Marquez-Ramos, L., & Mourelle, E. (2019). Education and economic growth: An empirical analysis of nonlinearities. *Applied Economic Analysis*, 27(79), 21-45. doi.org/10.1108/AEA-06-2019-0005.

[8] Khasanova, G., Nikadambaeva, Kh., & Kenjaboev, Sh. (2021). The role of education system in human capital development. *Eastern European Scientific Journal*, 2(66), 48-51.

[9] Lyashenko, V.I., Prokopenko, O.V., & Omelyanenko, V.A. (Eds.). (2019). *Institutional model of innovative economy*. Kyiv: Institute of Industrial Economics.

[10] Dušan Cvetanović, D., Despotović, D., & Cvetanović, S. (2018). Education and skills as components of human capital. *Knowledge – International Journal*, 23(1), 25-31.

[11] Bodinet, J.C. (2016). Pedagogies of the futures: Shifting the educational paradigms. *European Journal of Futures Research,* 4, article number 21. doi: 10.1007/s40309-016-0106-0.

[12] Cheung, S.K.S., Kwok, L.F., Phusavat, K., & Yang, H.H. (2021). Shaping the future learning environments with smart elements: challenges and opportunities. *International Journal of Educational Technology in Higher Education*, 18, article number 16. doi: 10.1186/s41239-021-00254-1.

[13] Zamecnik, A., Kovanović, V., Joksimović, S., & Liu, L. (2022). Exploring non-traditional learner motivations and characteristics in online learning: A learner profile study. *Computers and Education: Artificial Intelligence,* 3, article number 100051. doi: 10.1016/j.caeai.2022.100051.

[14] Kelley, T., & Kelley, D. (2013). *Creative confidence: Unleashing the creative potential within us all*. Redfern: Currency.

[15] Hernandez, R.J., Cooper, R., Tether, B., & Murphy, E. (2018). Design, the language of innovation: A review of the design studies literature. *The Journal of Design, Economics, and Innovation*, 4(3), 249-274.

[16] Shevchenko, B.O., & Nepokupna, T.A. (2019). The factors in formation of the human potential of an innovative economy. *Business Inform,* 7, 48-53. doi: 10.32983/2222-4459-2019-7-48-53.

[17] Cook, K.L., & Bush, S.B. (2018). Design thinking in integrated STEAM learning: Surveying the landscape and exploring exemplars in elementary grades. *School Science and Mathematics*, 118(3), 93-103.

[18] Ivanova, V.V. (2019). The role of design thinking in education. *Intelligence XXI*, 4, 93-97.

[19] Panke, S. (2019). Design thinking in education: Perspectives, opportunities and challenges. *Open Education Studies,* 1(1), 281-306. doi: 10.1515/edu-2019-0022.

[20] Batechko, N., & Mihaylichenko, M. (2020). Evolution of educational paradigms in modern scientific discourse. *Osvitology*, 9, 29-37.

[21] Luhova, T.A. (2021). Game-design-oriented approach to development of educational disciplines of higher educational institutions. *Information Technologies and Learning Tools*, 81(1), 235-254.

[22] Głowacki, J., Kriukova, Y., & Avshenyuk, N. (2018). Gamification in higher education: experience of Poland and Ukraine. *Advanced Education*, 10, 105-110. doi: 10.20535/2410-8286.151143.
[23] Bertram, L. (2020). Digital learning games for mathematics and computer science education: The need for preregistered RCTs, standardized methodology, and advanced technology. *Frontiers in Psychology*, 11, article number 2127. doi: 10.3389/fpsyg.2020.02127.
[24] Perejaslavska, S., & Smahina, O. (2019). Gamification as the current trend of national education. In *Open educational e-environment of modern university: Special issue "New pedagogical approaches in steam education"* (pp. 250-260). Ivano-Frankivsk: Precarpathian National University. doi: 10.28925/2414-0325.2019s24.
[25] Tsarapkina, J.M., Vaganova, O.I., Lapshova, A.V., Koldina, M.I., & Sedov, I.A. (2021). Gamification in modern education. *Eduweb*, 15(3), 192-203. doi: 10.46502/issn.1856-7576/2021.15.03.16.
[26] Stepanyuk, A.V., Mironets, L.P., Olendr, T.M., & Tsidylo, I.M. (2022). Methods of future science teachers training to use smart-technologies in the professional activity. *South Florida Journal of Development*, 3(1), 510-527. doi: 10.46932/sfjdv3n1-038.
[27] Elshiekh, R., & Butgerit, L. (2017) Using gamification to teach students programming concepts. *Open Access Library Journal*, 4(8), article number e3803. doi: 10.4236/OALIB.1103803.
[28] Garcia, J.M.S., & Sabay, R.L. (2020). GADIMATH: Gamified discrete mathematics. *Philippine Social Science Journal*, 3(2), 181-182.
[29] Lebedeva, I. (2018). Training "Realtor: We help you create your future". In *Training in a higher education institution* (pp. 262-276). Kharkiv: S. Kuznets KhNUE.
[30] Malyarets, L., & Lebedeva, I. (2017). Long mathematical learning in economics: Knowledge, skills, competence. *Physical and Mathematical Education*, 4(14), 53-58.
[31] Saati, T. (1993). *Making decisions. Hierarchy analysis method*. Moscow: Radio and communication.
[32] Maslow, A.H. (1943). A theory of human motivation. *Psychological Review*, 50(4), 370-396.
[33] Stupak, O. (2020). Educational technologies in training future managers. *Advanced Education*, 15, 97-104. doi: 10.20535/2410- 8286.200229.
[34] Khan, N., Sarwar, A., Chen, T.B., & Khan, S. (2022). Connecting digital literacy in higher education to the 21st century workforce. *Knowledge Management & E-Learning*, 14(1), 46-61. doi: 10.34105/j.kmel.2022.14.004.
[35] Zagorodnya, A.A. (2018). *Professional training of specialists in the field of economics in higher education institutions of the Republic of Poland and Ukraine*. Kyiv: Edelweiss.
[36] Åkerfeldt, A., & Åberg, E.S. (2021). Designs for learning: A research approach**.** *International Journal of Educational Methodology,* 7(4), 547-555. doi: 10.12973/ijem.7.4.547.
[37] Ullah, A., & Anwar, S. (2020). The effective use of information technology and interactive activities to improve learner engagement. *Education Sciences*, 10(12), article number 349. doi: 10.3390/educsci10120349.
[38] Asad, M.M., Hussain, N., Wadho, M., Khand, Z.H., & Churi, P.P. (2021). Integration of e-learning technologies for interactive teaching and learning process: An empirical study on higher education institutes of Pakistan. *Journal of Applied Research in Higher Education*, 13(3), 649-663.
[39] Lee, C.S., & Yew, L.Y. (2022). Enhancing customer satisfaction through open innovation communities: A comparison of knowledge management approaches. *Knowledge Management & E-Learning*, 14(1), 81-102. doi: 10.34105/j.kmel.2022.14.006.

Розвиток людського потенціалу: дизайн-мислення як спосіб удосконалення професійних компетентностей економістів

Ірина Леонідівна Лебедєва, Лариса Олексіївна Норік, Степан Сергович Лебедєв

Харківський національний економічний університет імені Семена Кузнеця
61166, просп. Науки, 9А, м. Харків, Україна

Анотація. У постіндустріальному суспільстві якість професійної освіти стає провідним фактором формування людського потенціалу. Одним із шляхів забезпечення ефективності цього процесу є використання інноваційних освітніх технологій, які спрямовані не лише на формування професійних компетентностей, але й на розвиток креативності, що в подальшому сприятиме пошуку нестандартних шляхів розв'язання реальних завдань. Метою роботи є дослідження впливу інтерактивних освітніх технологій, що базуються на концепції *design thinking,* на успішність студентів економічних спеціальностей та їх внутрішню мотивацію до вивчення математичних дисциплін. У якості методу реалізації концепції *design thinking* обрано формат ділової гри, яка передбачала побудову математичної моделі реальної економічної проблеми та використання математичного апарату для її розв'язання. Для оцінювання ефективності гейміфікації визначався розподіл студентів за успішністю, а також за допомогою метода аналізу ієрархій студенти здійснювали ранжування видів занять за уподобаннями. Досвід впровадження ділових ігор, який продемонстровано на прикладі дисципліни "Дослідження операцій та методи оптимізації", підтвердив ефективність застосування цієї техніки у процесі вивчення дисциплін математичного циклу саме завдяки підвищенню внутрішньої мотивації студентів. Порівняно з традиційними методами навчання формування професійних компетентностей студентів було збагачено досвідом розв'язання трансдисциплінарних завдань. Результати дослідження дозволяють зробити висновок, що професійні компетентності майбутніх економістів суттєво удосконалюються завдяки використанню у процесі навчання ділової гри, в якій реальна економічна проблема адаптована до теми навчальної дисципліни

Ключові слова: економіка знань, жорсткі та м'які навички, активізація навчального процесу, трансдисциплінарні завдання, технології навчання, ділова гра, гейміфікація