International Journal of Innovation and Research in Educational Sciences
Volume 7, Issue 3, ISSN (Online) : 2349–5219

Design of an Educational Course in Higher Education for Teaching the Design and Creation of Educational Games

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Date of publication (dd/mm/yyyy): 04/06/2020

***Abstract* – The game-centered learning approach is an educational process based on game or game-based activities, which combines learning and entertainment (edutainment) and has beneficial results in every type of education and in every age group. The application of game-based learning can, in addition to achieving learning goals, enhance the joy of learning, which can include a variety of emotions and satisfaction with the acquired knowledge. In this context, a six-month course was designed to teach the process of the design, construction, evaluation and the process of conducting a techno-economic study and experimental testing of the effectiveness of educational board games. This course was adapted and implemented a) in the postgraduate program "Environmental Education" of the University of the Aegean in the course "Design, Implementation and Evaluation of Environmental Education Programs" and b) in the research course of the undergraduate program of the department of preschool education and educational design "The educational game in lifelong learning". During the four-year implementation of these courses, about a hundred original educational board games were designed and realized by small groups of students, the evaluation of which resulted from the analysis of specific indices, but also from the game-based experience they offered.**

***Keywords* – Educational Game, Game-Centered Learning, Edutainment, Game Design.**

I. INTRODUCTION

The relationship between games and learning has always been close – yet, this relationship has often been competitive. Generations of students have been nurtured recognizing this competitiveness, according to which student time is divided between studying and playing. The well-known and generally accepted rule has been that the student should study, learn and then play. Respectively, during playing, the student does not study or learn. There have been far fewer times in which, in the context of learning, games assist the process studying. In these cases, games are integrated into the educational process and the child learns while having fun.

The value of modern games lies in their great attractiveness. In contrast to traditional learning processes, which are mandatory, compulsory and rarely entertaining, children and adults, without being obliged to, dedicate many hours in these modern forms of entertainment, which are fascinating and alluring [1]. If it were possible to combine these modern forms of entertainment with education, and if the degree and time of involvement with games was synonymous with the degree and time of involvement with learning activities, then the learning outcome could be of a very high level. After all, the basic mottos of lifelong learning, which are summed up in the fact that we are all, and must be, in a vortex of continuous learning, can only be accomplished if entertainment time becomes simultaneously learning time [2].

The revision of our views on the role of games does not apply only to modern but also to traditional games: A game can be an activity of competition, chance, mimicry, or vertigo and can achieve its goal equally well in either the virtual or the experiential realm. Virtual or experiential, game activities have some features in common [3], [4], which make them valuable: they are informal and free, dynamic and flexible, they stimulate

the imagination, rely on flexible rules and help develop communication skills. For example, a tour of a museum or botanical garden, accompanied by interactive activities, combines fun and learning either as a virtual or as an experiential process. The choice of the traditional or modern form, as well as other parameters (e.g. the time devoted to the game), depends on the cognitive field which is approached and the conditions that each time determine the effectiveness of the game.

In this context, a six-month course was designed to teach the process of the design, construction, evaluation and the process of conducting a techno-economic study and experimental testing of the effectiveness of educational board games. This course was adapted and implemented a) in the postgraduate program "Environmental Education" of the University of the Aegean in the course "Design, Implementation and Evaluation of Environmental Education Programs" and b) in the research course of the undergraduate program of the department of preschool education and educational design "The educational game in lifelong learning".

II. THEORETICAL CONTEXT

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A. *Game-Centered Learning*

The concept of gameplay, although largely vague and approached from different perspectives, refers to the players' experience in their contact and interaction with the game. In shaping this experience, a decisive role is played by the type of game, the scenario, the rules, the complexity, the quality of its construction and the user. [5].

Game-centered learning is an educational activity organized in a game format, combining learning and entertainment (edutainment). It includes a) a scenario, which creates a virtual environment and specific conditions, involving the student in a targeted experience and b) the learning mechanism, which activates the student's learning processes and helps to achieve the goals which have been set [6].

Educational games can be either games that to some extent contain educational goals or they can be activities organized in the form of a game, aimed at a combination of entertainment and learning. The most important element of the game, which should be taken very seriously when designing it, is the relationship between the scenario and the learning mechanism. An important factor in the success of designing an educational game is the relationship that exists between the scenario and the learning mechanism. In order to maintain a high degree of edutainment, i.e. an ideal combination of education and entertainment, the learning mechanism should be integrated into the scenario and the overall "experience" (gameplay), so that the interested party learns while playing. Depending on the correlation model of these two factors, the relationship between them is characterized as "endogenous", when the scenario activates the learning mechanism successfully and effortlessly, "relative", in which case the learning elements determine the development of the game and "arbitrary", in the case where the learning mechanism seems to be or is foreign to the game's scenario [7], [8].

According to Piaget [9], a game is a structural element of socialization. By observing game activities, he notes that "playing with rules" is the highest level of self-contained activity. Boocock and Coleman, found that games are a source of a personal efficacy sense. They provide players with clearer feedback on the consequenc--es of their decisions compared to the feedback they receive in real-life situations [10].

At the same time, the application of creative and game-based learning can enhance the joy of learning, which can include a variety of emotions, an intense effort to use imagination and knowledge creation, as well as satisfaction for the acquired knowledge. As far as cooperation in the game context is concerned, the analysis of cooperative behavior showed that interaction with tangible materials encouraged cooperation and cooperation in turn encouraged communication between the children involved, enhancing the degree to which children externalized their thoughts, thus increasing their awareness of the experience [10], [11].

According to the analysis of research data, enriched design games are superior to simple design educational games. At the same time, in cases where the design provided for many sessions, better results were recorded than in cases where the course was completed in a single lesson. Regarding the impact that competition has on learning, it was found that a) individual and competitive schemes are less effective than those without competition, b) competitive group cooperation of small groups is more effective than the corresponding individual schemes. It was also discovered that gamification, i.e. the use of game features in the "formal" learning process, such as gaining points and badges depending on the achievements and the level, has a positive effect on the learning process [5], [12].

In addition, relevant studies in the UK have also attempted to approach how games can be used successfully in school. The results showed that it is not only its content that differentiates a game from the limits of the curriculum. In particular, the results of the TEEM report [13] showed that teachers and parents recognized that games in the learning process could promote the development of important skills, such as strategic thinking, planning - designing, communication, numeracy, negotiating skills, decision-making within the group, and data management.

Through the children's interaction in the game context, the researchers also tried to find out what children really learn when they play. Learning outcomes are defined as any possible combination of cognitive, physical and social-emotional involvement. Therefore, learning environments, which include games and creativity, have the effect of enhancing the physical, educational, cultural and social-emotional well-being of students, but also encouraging the joy of learning. Among other things, students learn to develop their own ideas, test their boundaries, experiment with alternatives, import information, give information to other and create new ideas, based on their experiences [14].

Prensky formulated an analytical model of the levels of game-centered learning, in which he presents the way in which learning elements are integrated in a game [15], [16]:

- Definition of how the game is played, (how?).
- Formulation of rules, (what?).
- Selection of strategies, (why?).
- Definition of conditions, of the world in which the scenario is evolving, (where?).
- Decision making based on specific ethical values (when - if?).

A common categorization of games according to the type of scenario is [5]:

- Knowledge games, where the player tries to answer various questions.

- Games of chance, in which this factor plays a role or the most important role in the development of the game.
- Skills games, which are based on the skills of the players and less or not at all on luck.
- Strategy games, in which the player is asked to adopt and try to implement a strategy based on decision-making skills.
- Adventure-action games, where the player, impersonating a hero, initially tries to survive and at the same time carry out specific missions.
- Sports games, which are related to sports activities, in which the level of simulation and strategy ranges from simple references to very careful implementations in the case of electronic games.
- Simulation games in which players play a role, depending on the character they are impersonating.

Games have certain formal characteristics - factors that determine and shape their structure and organization, such as the purpose and objectives, the number and roles of participants, the environment, the atmosphere, the initial situation, the rules, the rewards and penalties, the conditions for victory or defeat, etc. [17]. In particular, according to Alessi and Trollip [8] game factors consist of [18]:

- The goal and objectives, which normally precede the game and significantly determine its foundations. Objectives can be made known to players from the beginning or communicated during the development of the game.
- The rules define the whole context, plot, conditions for victory or defeat, all allowed and prohibited actions, the way in which players are rewarded and punished as well as anything required for the proper development of the game.
- Players and therefore the roles they are called upon to play are one of the most important parameters of any game.
- The difficulty of the game imposes the framework that the player will face in order to achieve the expected result, according to the game's design. The level of difficulty essentially determines the age group to which it is addressed, while it is often progressive and adaptable to the level of each player during the development of the game.
- Competition is a key feature of games as each player competes against himself, a teammate, a "machine" or just time.
- Imagination, i.e. the degree to which the game is similar to the real world, constitutes one of the main features and main factors of success and selection of the game.
- Safety is a feature of games, which they offer through the simulation process, allowing players to design by trying different options in the safe context of the game's virtual world.
- Space and the environment in general, tangible and imaginary, is determined by the construction's adequacy, but also by the imaginary context, which creates the scenario of the game.
- Time is often one of the most important parameters of games.

- Instructions are an extension of the rules of the game and are given more often at the beginning as well as during the development of the game's plot.
- Options, which are defined or adjusted (mainly in electronic games), in many cases, allow for the configuration and adjustment of the game to the age or level of the players.
- Knowledge, which can be offered from the beginning and be obvious or in other cases be hidden and discovered slowly with the repetition and immersion of the strategy of the game.

However, the use of games, especially in formal education, presents difficulties, especially in terms of their official integration into the curriculum. Some of the reasons for this are the following [10], [13]:

- The difficulty teachers face in identifying how a particular game is relevant and compatible with the curriculum,
- The difficulty that teachers who choose to use a game face in convincing colleagues and parents regarding the seriousness of their choice,
- General lack of time in the curriculum and
- The percentage of irrelevant content or functionality in a game, which seems to be a waste of time.

The differentiation of the use of game-centered learning depends mainly on the way and the degree of involvement of the students. The simplest version involves using a ready-made game, which is considered to have educational value and usefulness in a specific learning process. In these cases the teacher is sure to use something of quality, created by professionals, but it is often very difficult to adapt it successfully to the requirements of the course. Another particularly interesting case involves the design and creation of an educational game, according to the objectives and requirements of the specific course. In addition to all the other advantages, there is also the strengthening of creativity, cooperation, the development of various skills, etc., but at the same time this process requires a lot of time. The third variant is based on the transformation of a half-finished game and in this case more emphasis is given to the discussion of alternatives [5].

B. *Design of Educational Games*

A proposed design model consists of three components, a) the definition of learning objectives, b) the definition of the MDA framework, related to mechanics, dynamics and aesthetics, and c) the principles of teaching.

As far as the goal-setting phase is concerned, it is recommended that the person in charge addresses certain questions [19]:

- What should be taught to the group of trainees?
- What is the level of their prior knowledge, skills and generally their level of readiness?
- What are students expected to learn from the game?
- What can they learn?

To answer these questions, in addition to the objectives of the course, which should be known to the teacher, the teachers should reflect on and record the knowledge and skills of the students, possible activities that will be

beneficial to them and the knowledge and skills that according to Bloom are expected to be gained by the specific activities.

Concerning the second parameter, the determination of the MDA framework, during the design stage [20] a) the "mechanics" of the game consist of its basic elements, such as materials, rules, clarification of goals, moves and possible choices, b) the "dynamics" of the game consist of the behaviors and the general "atmosphere" that is expected to arise during the game, as a result of the application of "mechanics" and c) its "aesthetics", which refers to the overall subjective experience and pleasure, consist of a classification of aesthetic elements, such as the sensation, fantasy, narrative, challenge, fellowship, discovery, expression and submission, meaning the approach of the game as a pleasant pastime, [19].

The third component of this framework is the educational design using research-based principles.

Keller proposes the ARCS design model (Attention - Relevance - Confidence - Satisfaction), which is based on human motivation and relies on four factors: attention, relevance, confidence and satisfaction, with the aim of attracting and retaining the interest of the participants. More specifically [21]:

- Attention is focused on the processes of attracting and retaining the interest of the players, in order to balance the game between boredom and indifference on the one hand and stress and "hyperactivity" on the other.
- Relevance refers to the compatibility of the game with the objectives and content of the syllabus.
- Confidence is needed to enhance the players' sense of trust in themselves in achieving goals and success.
- Satisfaction is obtained by providing the appropriate "incidents" without excessive control and at the same time with the necessary encouragement.

Designing successful educational games requires the coexistence of specific structural attributes, which will be able to ensure the achievement of learning objectives and at the same time the involvement of participants in them. In particular, elements that could contribute positively to the final result are [10]:

- Learning through actions, based on direct experience.
- The use of simulation.
- Targeted learning in problem solving.
- Active and interactive learning.
- The relevance of the game-centered experience with the knowledge, experiences, values and interests of the participants.
- Attractiveness.
- The inclusion of challenges, missions, commitments.
- The immersion of players in the game-based environment and the parallel distancing from the real world.
- Being subject to "pleasant" disappointments through difficulties, which are nonetheless possible to overcome.

- The gradual difficulty of the game by applying graded challenges.
- The provision of continuous feedback through tips, hints and instructions, which will be offered in the right way and at the right time.
- The activation and recall of previous knowledge.
- Creating new experiences.
- The ability to adjust the degree of difficulty to the capabilities and requirements of the players.
- Providing the possibility of hidden, if possible, evaluation, in a way that does not interrupt the flow of the game and therefore will not detract from the fun experienced by the participants.

A typical design framework is Yussof's "Conceptual Framework", which includes the most basic design elements of educational games, as shown in Figure 1. [22]:

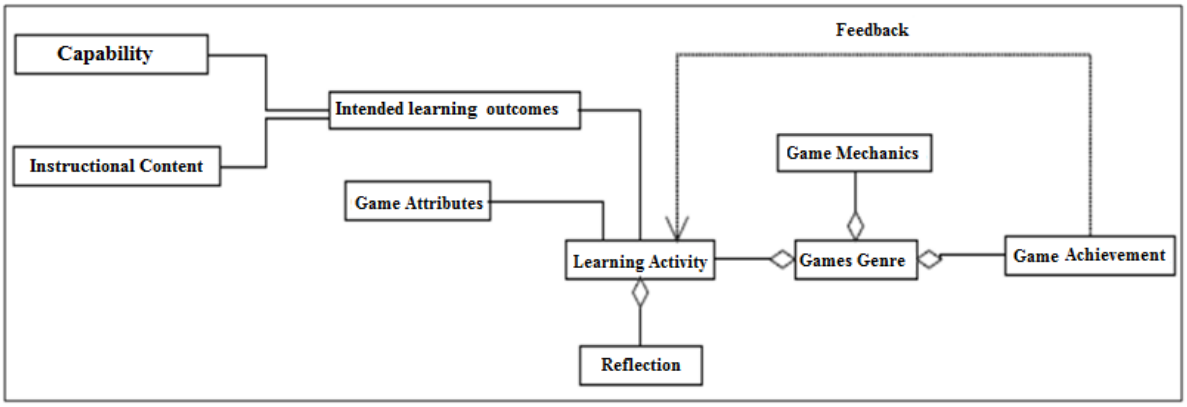

Fig. 1. Conceptual framework for serious games [22].

- Capability refers to the skills that the players are expected to develop from their contact with the game.
- Instructional content, which should be associated in accordance with the objectives that the participants have to learn.
- Intended learning outcomes, which are directly related to the skills and educational content.
- Game attributes include the interaction, gradual learning, systematic support, and the provision of incentives and rewards.
- Learning activity, which connects the expected learning outcomes with the attributes of the game, giving participants a game-centered experience.
- Reflection, which includes the processes of informing the players regarding their progress and the development of the game.
- Game genre determines the category, the characteristics and the type of the expected experience of the players.
- Game mechanics, include, according to the MDA framework, the game's type, materials, goal clarification, rules, moves and possible options and therefore shape the players' interaction with the game and largely determine the overall experience.

- Game achievements, refer to the way in which the game shows the successes of the players.
- Feedback is the process of informing the participants regarding the achievement of objectives and the fulfillment of specific goals to make it possible, if necessary, to redesign the educational activity, improving the effectiveness of the game and the overall game-centered experience.

C. *Design Stages*

The design process is essentially a form of "problem solving", as both at the beginning and during the whole project the instructor is called upon to successfully deal with "problems" that arise.

A widespread model - product design process under the Instructional System Development is ADDIE, (Figure 2.), the name of which consists of the initial letters of the words: Analysis, Design, Development, Implementation and Evaluation. The origins of this model are undetermined, while the first reference was made by Branson in 1978, [23], [24].

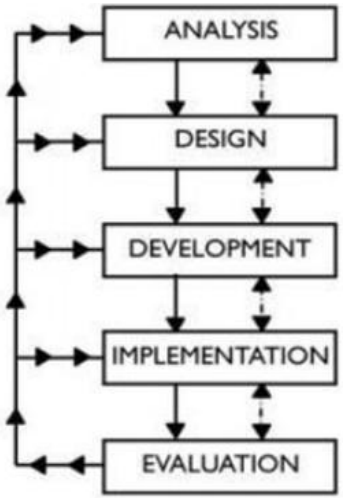

Fig. 2. ADDIE model [24].

A variation of this model is the ten-step model, designed by Merrienboer and Kirschner (2007) which includes the following steps:

A/A	ADDIE model	10-step Model
1	Analysis	Design learning tasks
2		Sequence of actions
3		Setting performance objectives
4	Design	Design supportive Information
5		Analysis of cognitive strategies
6		Analysis of mental models
7	Development	Design of procedural information
8		Analysis of cognitive rules
9		Analysis of prerequisite knowledge
10	Evaluation	Design of practical exercises

The process of designing educational board games includes three main stages, the preparatory, the productive and the final stage [25].

Preparatory Stage

- Creating the working group.
- Defining goals and determining exactly what needs to be taught.
- Understanding the characteristics of the trainee group.
- Defining the depth of knowledge of the instructors and the whole team on the subject and planning courses to fill the gaps.
- Defining the depth of knowledge and skills of the instructors and the whole team in game design.
- Research in similar games.
- Playing many board games to gain similar experience.
- Creating a positive and game-based atmosphere, which can be achieved by presenting to the team different options and materials.
- Raising the students' awareness and inspiration on the particular issue, which they should deal with.
- Investigation by the whole team of the subject, on which the game will be based.
- In the preparatory stage the choice of the type of the game and the key elements of its scenario will be decided and at this point the brainstorming technique is very effective.
- Recording several ideas and reflecting on them.
- Selection of the most prevalent solutions.
- Recording difficulties and ways to deal with them.
- Initial reflection on the characters, the interaction, the moves, the rewards and the penalties and all the main features and parameters of the game.
- Original name of the game.

Production Stage

- Finalization of the game type.
- Attract specialists.
- Start designing the prototype or its parts in simple form.
- Finalization and refinement of the main plot of the game.
- Definition of all the characters, the interaction, the moves, the rewards and the penalties and all the main features and parameters of the game.
- Definition of all the details that affect the development of the game and their organization.

- Enrichment and improvement of the prototype.
- Selection of materials that will be used during the construction of the game.
- Find the required materials and tools that will be required.
- Completion of the design of the board and other objects.
- Construction of all parts of the game.

Final Stage

- Playing the game many times, trying all the individual scenarios and options with different groups of people with different characteristics.
- Keeping a record of observations and identification of problematic points and processes that can be improved.
- Carrying out corrections and improvements.
- Creation of evaluation tools on the effectiveness of the game on the following main axes:

I. Degree of achievement of the learning objectives which were set.

II. Degree of satisfaction and enjoyment on behalf of the player.

III. Degree of difficulty.

- Reflection and possible repetition of one or some stages, depending on the data of the evaluation and the overall assessment of the game-centered learning experience.
- Finalization of the game.
- FInalization of the game's name.

During the design stage of educational games, we can identify some potential errors such as [26]:

- The choice of the form of the game before the teacher finalizes the objectives of the educational intervention.
- Creating perfected prototypes.
- Failure to perform a sufficient number of tests of ready-made games.
- Failure to test ready-made games with the right audience.
- Ignoring, intentionally or unintentionally, feedback messages.
- The loss of "strong" elements of the game in the testing phase.
- Inserting elements that are not needed or degrade the game.
- Inserting incorrect elements into a game, leading players in the wrong direction.
- A design that leads to a quick loss of interest.

D. *Evaluation*

A typical and easy-to-use evaluation framework is one developed by Donald Kirkpatrick about 50 years ago to evaluate corporate training. It includes four levels - types of evaluation, in terms of reaction, learning, behavior and outcome [27].

Evaluation Level	Evaluation Type (What is measured?)	Description & Evaluation Features	Methods of measuring Tools
1	Reaction	Evaluation of the experience	Feedback forms observation research with questionnaires
2	Learning	Measuring of learning before and after implementation or between different groups	Experimental research with data collection from various research tools
3	Behavior	Recording the behavior back to work	It is a process that requires time and is done with standard research tools
4	Outcome	Measuring the impact of learners on structure	Management system tools

According to another approach, the evaluation includes various sections, during which a specific skill is evaluated [28].

Evaluation Level	Evaluation Type (What is measured?)	Description & Evaluation Features
1	Knowledge building	Exteriorization of perceptions and ideas
		Formulation of predictions
		Application of newly acquired knowledge
		Expansion and replacement of ideas
		Utilization of new skills
2	Board game design skills	Modification and enrichment of game elements
		Problem solving
		Originality of game
		Imagination
		Creativity
		Specification of game elements
		Game standardization
		Object design
3	Collaborative skills	Presence
		Collective decisions
		Team support
		Contribution of ideas
		Participation
		Number of actions

Evaluation Level	Evaluation Type (What is measured?)	Description & Evaluation Features
		Disagreement management
		Completion of tasks
		Acceptance of criticism
		Work allocation

III. METHODOLOGY

A. *Research Approach*

This particular research application included the design and implementation of a six-month teaching course on the process of the design, construction, evaluation and the process of conducting a techno-economic study and experimental testing of the effectiveness of educational board games. This course was adapted and included in the course "Design, Implementation and Evaluation of Environmental Education Programs" of the postgraduate program and in the research course "The educational game in lifelong learning" of the undergraduate program of the department of preschool education and educational design of the university of the Aegean.

The aim of designing this course was to formulate and teach a framework for how this particular subject can be taught. For this reason the design tried to support four main axes, a) that of game- centered learning and board educational games, b) the axis of the techno-economic study of the creation of educational board games, c) the practice of designing and creating educational board games and d) in the context of experimental research, how a teacher can design experimental schemes to evaluate and investigate the effectiveness of the application of educational games in the classroom.

Upon completion of the teaching and learning activities of the course, students are expected to have the following knowledge, skills and abilities:

Knowledge

- They have knowledge on the educational game and its application in lifelong learning.
- They gain knowledge on the process of designing a Techno-economic study to construct educational board games.
- They have proven to have sufficient specialized knowledge and a high level of understanding on issues related to the methodology of experimental research.
- They have basic knowledge of how the SPSS statistical analysis software works.

Skills

- They have developed skills that allow them to design and implement educational board games.
- They have developed skills that allow them to design and conduct research in the context of education.
- They have developed skills that allow them to interpret research data either from the SPSS software or from other published scientific texts.

- They have the necessary research skills, which allow them to continue their studies and produce new knowledge in the cognitive field of the course.

Abilities

- They have the ability to combine knowledge and critically manage complex educational topics, in the context of research design and implementation.
- They have the ability to design and construct educational board games.
- They have the ability to design and implement a small-scale quantitative survey with a questionnaire and to make a descriptive analysis of the data.
- They have the ability to operate the SPSS software.
- They are able to contribute responsibly to the academic and scientific debate in this field.
- They are able to contribute responsibly to the dissemination of knowledge on topics related to the content of the course and to clearly present the relevant reasoning, logical assumptions, arguments and conclusions on their subject to a specialized and non-specialized audience.

The lesson plan included:

Axes		**Lessons**	
1	Game-centered learning	1	Lifelong learning, Experiential learning
		2	The game - board game
		3	Educational game in lifelong learning
		4	Design of educational board games
2	Techno-economic study of the construction of educational board games	5	Techno-economic analysis - Theory
		6	Techno-economic analysis of the construction of educational board games
3	Laboratory, Practice on constructing educational board games	7	Workshop: Design and construction of educational board games
		8	
		9	
4	Evaluating the effectiveness of educational board games, Experimental research	10	Evaluation of educational board games
		11	Experimental research on the evaluation of innovative educational interventions
		12	Experimental research: Scheme of many experimental groups
		13	Experimental research: Multiple measurement scheme

B. *Research Methodology*

The methodological design of this research intervention included the inclusion of this course to undergraduate

and postgraduate classes of the department of preschool education and educational design of the University of the Aegean for four years, from 2016 to 2020. In the context of the evaluation of this effort the following were used: a) observation of the overview and the cooperation of the participants mainly during the design, construction and testing of the board games, b) evaluation of game parameters, and c) application of an experimental multi-measuring scheme (BEFORE - AFTER) for assessing the knowledge.

During these four years, 205 students participated in the courses, 160 in the postgraduate program and 45 in the undergraduate, of which 67% were women and 33% men.

At the stage of observation for the analysis of the overview and the cooperation of the students, a qualitative analysis of the content of the recorded information was conducted. For the evaluation of the game parameters each game was evaluated according to a parameter key, calibrated from 1 to 5, where 1 corresponded to the worst score and 5 to the best. As part of the experimental multi-measurement research, students were assessed at the game testing stage, once before the start of the game and once after the game to test the achievement of the cognitive goal of the games with “right - wrong” questions. In this case the analysis was carried out per question with the McNemar statistical criterion, while the overall comparison of the averages with the Wilcoxon statistical criterion as it was found that with the Kolmogorov - Smirnov criterion, the values did not follow normal distribution (p<, 05).

Evaluation Type	**Evaluation parameter**	**Description & Evaluation Features**	**Indices 1-5**
Observation	Overview	Presence	4.32
		Interest	4.51
		Willingness	4.01
		Effort	4.22
	Cooperation	Communication	4.60
		Cooperation	4.58
		Collective decisions	4.24
		Team support	4.41
		Contribution of ideas	4.71
		Participation	4.09
		Disagreement management	3.89
		Completion of tasks	4.56
		Acceptance of criticism	3.95
		Work allocation	4.62
Evaluation of game design parameters	Game parameters	Originality of the game	4.05
		Scenario – overview	4.69
		Scenario – completeness	4.74

Evaluation Type	Evaluation parameter	Description & Evaluation Features	Indices 1-5
		Scenario – interest	3.99
		Scenario – complexity	3.24
		Imagination	4.28
		Creativity	4.00
		Identification game elements	4.95
		Recording rules - instructions	4.98
		Game standardization	4.50
		Object design	4.90
		Problem solving	4.46

Experimental application of multiple measurements	Knowledge according to the objectives of the game	Acquisition of cognitive objects according to the objectiv. of the game	Avg 1st 2,82	Avg 2nd 4,46	P.021

Finally, in the context of the analysis of the data of the measurements of the experimental research, carried out before and after the games for the assessment of the achievement of the cognitive objectives of the games, it was found that there was a statistically significant difference between the averages of the two measurements (Avg 1st 2, 82 vs Avg 2nd 4.46), which indicates a significant improvement in cognitive level (p = .21).

IV. CONCLUSIONS

The value of modern games lies in their great attractiveness, in contrast to the traditional learning processes, which constitute a mandatory and compulsory process. To this end, an attempt has been made to design and teach a six-month course, which comprehensively teaches how to design, construct, evaluate, carry out a techno-economic study and experimentally test the effectiveness of educational board games. Throughout this experimental effort, continuous and multilevel evaluation was performed to test the effectiveness of the course in achieving the goals which were set. This course was implemented with similar adaptations in seven classes of postgraduate and undergraduate studies of the University of the Aegean over a period of four years. From the whole process it is concluded that this educational intervention is an excellent teaching experience, which contributes, in addition to achieving the cognitive goals, to the cultivation of cooperation and the development of creativity.

ACKNOWLEDGMENT

The preferred spelling of the word “acknowledgment” in American English is without an “e” after the “g.” Use the singular heading even if you have many acknowledgments. Avoid expressions such as “One of us (S.B.A.) would like to thank ....” Instead, write “F. A. Author thanks ....” Sponsor and financial support acknowledgments are placed in the unnumbered footnote on the first page.

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