Game as a Learning Tool in Environmental Education

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Abstract – This work approaches theoretically and empirically the outdoor game as an instrument of learning and as a framework of evaluating educational programs in the field of environmental education.

The theoretical part analyses the relationship between education and entertainment. The empirical part examines the implementation of an outdoor activity, based on the sport game Orienteering. For the purposes of the research a questionnaire was addressed to students before and after the game. The conclusions confirm the validity of the hypothesis that such a game entertains but also educates, provides a tool for evaluation, promotes socialisation and helps the development of stances for the environment.

Keywords – EDU-Orienteering, Outdoor Play, Outdoor Education, Research Tool, Edutainment.

I. INTRODUCTION

The relationship between play and learning has – in most cases – been considered a competitive one. Generations of students have grown up fully aware of this competitiveness, which necessitated the distribution of a student's time between studying and playing. A well-known and generally acceptable rule defined that a student should study, learn and then play; Accordingly, while students play, they do not study and, thus, they do not learn. An attempt of an evaluation of the role that game can play in the educational process becomes, thus, particularly interesting, in that it can reveal whether and, if so, to what extent game can have a positive effect.

This paper studies the application of game as a means of an evaluation of the educational process in a number of courses dedicated to environmental sciences. It suggests the implementation of this particular sporting game adaptation after the teaching of the theoretical context of world environmental problems, aiming at the evaluation of the efficiency of teaching and the successful comprehension of the information by the participants in a pleasant and creative way, without the stress of conventional evaluating processes. This suggestion also provides the educator with the opportunity of applying the suggested game, after suitable adaptations, for the evaluation of the successful, or not, teaching of each chapter.

More specifically, the game featured in this paper has been named EDU-Orienteering and it consists of an adaptation of the well-known outdoor sport called Orienteering. This game invites participants to answer questions, whose answers comprise the codes of defined parts of an area, in which the game unfolds. The players, after visiting those parts of an area, return to the starting point and report the path they followed. In the case of wrong answers, they re-approach the questions and start moving again in the area, offering the educator the opportunity of identifying, based on the mistakes of the teams, those parts of the theory which had not been understood by the students. In this way, the evaluating process becomes playful, and both offers useful information to the educators and benefits students, who play, exercise, cooperate and learn, while being evaluated.

II. THEORETICAL CONTEXT

A. Play as a Tool in the Learning Process

As the learning process is restricted in traditional approaches, the competitiveness between education and play climaxes. This restriction might be the reason behind the learning theories' lack of systematic research on the significance of play as a learning tool. Play has mostly been approached as a channel through which a child's needs for movement, amusement, action and communication were relieved. No one mistook the significance of play in the shaping of one's personality, yet very few considered it as a tool which can be widely identified with the learning process itself.

Contrary to older habits, in recent years, – as research on alternative ways of learning expands –, the value of play as a tool in the educational process is getting acknowledged by the day. It is noteworthy that this acknowledgement began from modern play – television programmes, computer games, films, software, video games, virtual reality and others are widely used for the amusements of both children and adults [1].

The value of this type of play lies in its wide attractiveness. Contrary to traditional learning processes, which constitute an obligation, rarely entertaining, children but also adults, without being compelled, spend many hours on these types of entertainment, which manage to fascinate and excite [2]. The possibility of combining those modern types of entertainment with education, if the extent of commitment to play could match the extent of commitment to learning activities, could significantly enhance the learning outcome. Moreover, some key-principles of lifelong learning, summarised in that we all are and should be in a swirl of constant learning, cannot materialise, unless time spent for entertainment also becomes learning time [3], [4].

The aforementioned hypothesis is under examination. Since the 1970s, the establishment of the term 'edutainment' (as a combination of the words education and entertainment) for the conceptual description of the kind of entertainment that is designed and implemented in order to educate and amuse at the same time, incorporating educational objectives in known forms of entertainment. In this light, play becomes a tool which does not only contribute in a child's cognitive, psychomotor and emotional development [5]; as a human activity, in which realistic situations are re-enacted in an entertaining way, play can constitute an alternative platform for the acquisition of knowledge the socialisation and the shaping of views and values [6].

The revision of obsolete views on the role of play regards both modern and traditional play. Play can be an activity of competition, luck, imitation; it can achieve its goal virtually or experientially. Activities, virtual or experiential, demonstrate some common features [7], which add to their value: they are non-typical and free, dynamic and flexible, they stimulate one's imagination, they are based on flexible rules and they contribute to the development of communication skills. For instance, a guided tour in a museum or a botanic garden, accompanied by interactive activities, combines entertainment and learning either as a virtual or as an experiential procedure. As an experiential procedure, it offers the benefit of being real and direct. Both cases offer advantages and disadvantages, however, the learning aspect of real or virtual play is never called into question. The selection of the traditional or the modern form, as well as other parameters (such as the time spent in play), depends on the cognitive field approached each time and the conditions which define play's effectiveness.

B. *Outdoor Play as a tool of Learning and Evaluating in Outdoor Education*

Outdoor education is a field with varying goals. Amongst them, the comprehension of environmental issues, the acquisition of knowledge and skills, the sensitization, the shaping of views and values regarding the environment, the adoption of positive examples and mainly the creation of a close relationship between a person and the environment, stand out.

As the outdoor education is a new cognitive field and it has a direct relationship with the space surrounding us, its introduction in education relates to innovative learning approaches. Student-centeredness, constructivism, cross-curricular thematic teaching, interdisciplinarity, cooperati--ve learning, experiential learning, research-learning, problem-solving are only few of the learning methods which can be applied on outdoor education. In the quest for appropriate educational tools, play seems important.

For the selection of the appropriate type of play, innovative, alternative learning environments are sought for, in spaces outside the conventional classroom, more attractive and less impersonal. In this quest, the outdoor natural environment can be of help, as it constitutes a significant source of information, motivates and urges with various stimuli, benefits communication, and, above all, brings people close to nature. In the outdoor environment, the development of bonds with nature, which constitute an essential goal of environmental education, is immediate, unconstrained and experiential, redefining where and how one learns, offering opportunities of interconnecting knowledge and reality, and offering material for the evaluation of the educational effectiveness of such programmes [8].

The incorporation of play in the outdoor educational procedure offers new dimensions to activities, increases their attractiveness and identifies the learning process with entertaining activities. Play increases one's disposition for the undertaking of initiatives and spontaneity, brings the trainer closer to the trainees and offers itself as a significant tool for the peaceful and stress-free evaluation of the trainees, particularly significant in the evaluation of adults' performances.

However, despite the now recognised value of the outdoor play [9], the application of outdoor educational programmes based on play and the empirical evaluation of their efficiency is limited [10]. Factors, such as the safety of the trainees, the lack of relevant training for the teachers, the lack of time and sources, the lack of wider educational changes, even the lack of suitable outdoor space, constitute the main reasons for the marginalisation of educational activities for decades [11].

III. METHODOLOGY

A. *Research Field*

Taking into consideration the aforementioned conclusion that play in environmental education, and particularly outdoor play, can efficiently meet the goals of this cognitive objective, research conducted as part of this project attempted to investigate the effectiveness of an adaptation of the sport-play Orienteering. This adaptation named EDU-Orienteering was designed in order to respond to particular educational and entertaining goals.

B. *Description of EDU-Orienteering*

The game tested in this paper was named EDU-Orienteering; it constitutes an adaptation of Orienteering, a well-known outdoor sport launched in the 19th century in Sweden. In Orienteering, one's ability to orientate, physical condition and special skills are evaluated, depending on the way it is performed. The participants, using a map and a compass, are asked to trace a sequence of marked stations in the shortest time possible. It is a flexible game applied, if appropriately designed, to groups of different interests, ages and capabilities.

According to the specifications of the adaptation applied, the participants consisted of two coordinators and 33 students separated into 4 teams. During the first stage, each team was asked to record as many environmental issues as possible. Hence, a list of such issue was formed, out of which 4 –as many as the teams– were drawn randomly. The environmental issues drawn in this particular case were a) air pollution, b) the ozone hole, c) the waste of water resources, and d) tropical deforestation.

Each team was then randomly assigned the investigation of one of the aforementioned environmental issues through the game. Each team was also given a map with various points highlighted, a card, a colour and a shape, as well as a table with 30 sentences corresponding to the highlighted points of the map. Of those sentences, each team had to select five which would correspond to the team's environmental issue, and then correspond them to points on the map.

Each point on the map corresponded to a spot in the forest. The team's members had to reach all five spots and collect from each spot one of the five parts of the given shape. The completion of the shape in a puzzle-like manner meant the completion of the game. The group completing the task faster than the other ones was the winner and received the highest mark in the evaluation.

Each team would start with the selection of sentences representing their own environmental issue; they would then trace them on the map and plan the best route. The orientation in the forest –with the map and compass– would be the succeeding task, for the fulfilment of the route planned on the map and the crossing of all marked spots. Each team, when reaching the highlighted spot, would find a hand-made coloured piece of the team's shape. If the team's colour matched the colour of the piece, the team's members would have to draw the piece's form on the card and then move on to the next point. In any other case, the team would realise their mistake and they would then need to return to the starting point to trace anew the correct answers.

It is evident that returning to the starting point would be time-consuming and tiring for the teams (quantitative element of evaluation), while it would also give the teacher the opportunity of observing the team's movements, behaviours and deficiencies in specific thematics (qualitati--ve element of evaluation).

After the completion of the puzzle, all teams would return to the starting point to take their time measurement. Time, marked symbols on the cars and returns to the bases for re-tracing of the route constitute a nexus of elements used in the evaluation.

C. *Empirical Investigation of the Effectiveness of EDU-Orienteering*

1. *Selection of Research Method*

The research was conducted in two stages, one before the implementation of EDU-Orienteering and one after its completion.

The general hypothesis of the research is that **participants, when aware of outdoor activities, believe that these activities can constitute a tool of learning and evaluation, useful in the daily educational process.**

2. *Sample*

The research sample consists of the 33 students of the Master's Programme "Environmental Education" of the Department of Preschool Education and Educational Design of the University of the Aegean, who participated in a field exercise in the forest of Agios Silas in Rhodes during the first month of their attendance at the Master's programme.

3. *Obtainment of Data*

The use of questionnaires was selected as a means of data collection corresponding in the best way possible to the particularities od the research and ensuring valid results [12].

The questionnaire consists of three main sections: a) letter, b) personal data, and c) main body, including all questions. The questions selected are mainly closed-ended [12], for the effective exploitation of the limited time, but also because of the inconvenience open-ended questions often cause to participants, therefore increasing the possibility of the participants' leaving them unanswered [13]. At the same time, open-ended questions were also used –when deemed necessary– mainly for the verification of previous answers. In certain closed-ended questions, the Likert scale was used, in which participants were asked either to declare the extent of their agreement or disagreement with sentences presented to them or to quantitatively evaluate a sentence according to a graded scale.

4. *Data Analysis*

For the analysis of the research data collected, Excel software was used for the recording and control of recordings and SPSS (Statistical Package for Social Science) for the statistical analysis.

At the stage of descriptive statistic, tables of distribution of frequencies are given in the case of nominal variables, while the average is also shown for quantitative ones as a measure of central tendency and typical deviation as a measure of dispersion [14], [15].

At the stage of deductive statistic, the non-parametric statistic **Mc-Nemar criterion,** which follows the χ^2 distribution, was applied for the control of the cohesion between two categorical variables with only two categories stated before and after the activity [16].

For the control of the relation between two categorical variables, of which the first one has two categories and the second one five, the χ^2 test was used when the application conditions stood and the Fisher's Exact Test when the application conditions did not stand.

At the same sage, for the control of the relation between a categorical variable of two categories and a qualitative variable in a 5 point likert scale, the Paired t-test criterion was used for dependent samples.

Finally, it is worth adding that in all cases of statistical control p = .05 was adopted as a minimum level of statistical significance.

IV. RESULTS

The presentation of the results will unfold on two levels, a descriptive one for the determination of the sample and a deductive one for the comparison of the participants' statements prior to and after the implementation of this project.

A. *Description of Descriptive Statistical Results*

75% of the participants identified themselves as female and 25% as male. According to the age distribution, participants aged 25 or less, comprised 18,8% of the sample, participants aged 25-29 comprised 46,9%, participants aged 30-39 comprised 15,6% and participants aged 39 or more comprised 18, 8% of the sample. Their academic background was mainly humanity studies (81, 2%), with a middling teaching experience (75%). 14 of them (43, 8%) had participated in the past in outdoor Environmental Education activities and a significant part of the sample associate environment with nature (68, 7%), mainly recognising its natural dimension (40, 6%).

The participating students stated that they mostly use the built environment as a space for the implementation of educational activities (75, 9%), while only 29% use the forest in similar conditions applying the project method (69, 2%). 84, 4% of the participants had never used or participated, before the implementation of this project, in mapping activities, mainly due to insufficient training (83, 3%).

In regard to the suggested activity, participants stated after the completion of the project that they regard EDU-Orienteering – although only 16, 1% of the participants were aware of it prior to this project – as a particularly efficient method (4, 51)[1], which they are willing to use in the future (93, 1%).

For the use of this activity as an evaluation tool, 85, 7% agree and believe that it is possible that several aspects can be evaluated (88%), such as knowledge, skills, cooperation, observation et al.

Table I. Distribution of frequency of participants' answers regarding their views on EDU-Orienteeing.

N & % of Evaluation / Section of Evaluation	N A lot & Very Much	% A lot & Very Much
General Evaluation	26	97,0%
Learning Tool	28	100,0%
Evaluation Tool	24	85,7%
Research Tool	23	82,1%
Entertainment	27	96,4%

Opportunity of Cooperation	28	100,0%
Physical Activity	24	85,7%
Waste of Time	0	0,00%
Dangerous Activity	1	3,6%

B. *Presentation of Results of Inductive Statistic.*

A significant difference in the recorded statements can be noted before and after the project's implementation.

Particularly, after the application of **Mc-Nemar** criterion, it was ascertained that 15 of the participants who had declared that they had not cooperated with any fellow students in the duration of their master's programme reported that during this activity they managed to successfully cooperate with fellow students. Moreover, 10 students managed to successfully define the term Environmental Issue, although in their initial respond it seemed that it was not clear for them. In the third variable, which related to the selection of the outdoor space for the implementation of programmes, 14 responses changed to positive views regarding the exit of students from the school class. Finally, 14 differentiations were noted regarding the knowledge of the term outdoor activity and 23 for the term Orienteering from people not previously aware of the terms.

Table II. Distribution of frequencies of differentiated statements. Control of the statistical significance of the differences with the Mc-Nemar criterion.

Differentiated Statements / Control Variables	N	Description of Differentiated Statements	Control of Statistical Significance	
			df	p
Cooperation	15	Cooperated amongst those who previously had not done so	1	.000
Definition of Environmental Issue	10	Successfully defined the term Environmental Issue amongst those previously mistaken	1	.012
Selection of Outdoor Space for Programme Implementation	14	Selected outdoor space for programme implementation amongst those who had initially selected a built environment	1	.000
Knowledge of the Term Outdoor Activity	14	Successfully defined the term Outdoor Activity amongst those previously mistaken	1	.001
Knowledge of the Term Orienteering	23	Successfully defined the term Orienteering amongst those previously mistaken	1	.000

In the next table (III), another significant differentiation appears, one regarding the selection of a method for the implementation of a supposed outdoor activity. Initially, 30,5% selected the much-advertised project method and later, after the familiarisation with educational games of simulation and the flexibility and immediacy these games offer, they selected simulation (18,6%).

Table III. Distribution of responses of students on their choice regarding the selected educational method for an outdoor activity. Control of statistical significance of the differences.

Time of Research / Educational Methods	Before		After		Control of Statistical Significance		
	YES	NO	YES	NO	χ^2	df	p
Project Method	30,5%	69,5%	16,9%	83,1%			
Notion Mapping	1,7%	98,3%	1,7%	98,3%			
Ethical Dilemma	5,1%	94,9%	5,1%	94,9%	11,424	4	.022
Role Play	11,9%	88,1%	6,8%	93,2%			
Simulation	1,7%	98,3%	18,6%	81,4%			

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[1] Participants recorded their view on the activity noting their general evaluation of this activity and of individual aspects of this activity on a 5 point likert scale (very much: 5 – a lot: 4 – somewhat: 3 – not much: 2 –not at all: 1).

The final statistical test of our research data refers to the vies of the students on the advantages of outdoor activities. They were asked to grade on a 5 point likert scale, in relation to nine parameters. The statements with the highest differentiation before and after the implementation of the project (table IV) refer to the outdoor activity as a form of entertainment and an evaluation tool, which most likely means that they experienced an entertaining educational experience, which at the same time can work as an evaluation tool without putting pressure on the participants.

Table IV. Averages and typical deviations of the views of the participants on outdoor activities as forms of entertainment and as an evaluation tool. Control of statistical significance of the differences of the averages.

Aspects of Outdoor Activity	Before		After		Control of Statistical Significance		
	Indexes						
	Av.	T.d.	Av.	T.d.	t	df	p
Entertainment	4,14	0,848	4,57	0,953	-3,576	27	.001
Evaluation Tool	3,70	0,634	4,33	0,679	-3,253	26	.003

V. Conclusions

The conclusions of the conducted research confirm the findings of our observations during the implementation of this outdoor programme. They are activities significantly contributing to the learning process, while at the same time they offer knowledge and skills and increase the cohesion of educational groups.

Edu-Orienteering influences positively the attitude of participants on outdoor activities. It can function as an evaluation tool of knowledge and skills, depending on the way it is designed and implemented. Its most significant advantage lies in the conversion of a naturally stressful process, the evaluation process, into an entertaining game, which offers several quantitative and qualitative elements to the evaluator both on an individual and on a team level.

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