# Educational Robotics: The pleasure of participation

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**Abstract:** *The paper attempts to identify the pleasure and satisfaction of participating in educational robotic through an educational robotic program that takes place for children ages 9 to 15. The aim is also to identify, with the use of statistical comparisons, any signs of the relationship between pleasure and satisfaction with participation with characteristics such as the gender of learners, the age of learners and the level of parenting.The survey showed that the participants were satisfied with their participation in the program and did not feel tired or bored. Also from the research is obvious that through educational robotics children can learn to cooperate more effectively with each other, and the teaching of basic principles of computer science, mathematics, geometry, physics, engineering, and in general mechatronics can be more effective when it does not have the conventional form of education but it has the form of play.*

**Keywords:** *Educational Robotics*

**JEL Classification:** *I20, I29*

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## 1 INTRODUCTION

Living in a time of rapid developments where technology is in a continuous process and modern human barely succeeds in following it, the learning process cannot be left intact. Therefore, modern theories require the use of technological tools to enhance teaching and learning. Besides, constructivist learning (Piaget, 1974) and constructivism argue that apprentices build more effectively knowledge when they are actively involved in design and construction (managerial and digital) real objects that make sense to them either are sand castles, LEGO constructions and computer programs (Papert, 1991). The educational potential of robotics in this case consists in the ability of students to compose a mechanical entity (eg a car model) and to direct it with the help of a simple and easy-to-use programming environment. Students, of course, use natural engineering models and apply concepts and ideas to solve real problems. Physical models collect information from the environment and react with the stimuli they receive. In the context of the learning process, students learn the basic concepts of programming by implementing programs in a programming environment to determine the behavior of the model not on the computer screen but in their natural environment.

Educational Robotics (ER) as a teaching tool creates the need for a more flexible experiential curriculum that can support the cross-thematic and constructivist approach. For this reason, two approaches, experiential and cooperative learning, were selected during the planning of the seminars. Learning is usually perceived as the acquisition of knowledge, as an appropriation of intellectual content. But the relationship with knowledge, which defines the relationship with learning, is a subject's relationship with the world, with itself and with others (Charlot B., 1999). That is


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why, among other things, we should promote the experiential learning processes that will lead to the active participation of the pupil, the liberation of his creativity, responsibility for the course of his learning, the strengthening of his critique of thought and his consciousness.

A thorough review of the international and Greek research and theoretical literature on the issue of educational robotics has been carried out for the implementation of this work, while the relevant online references have been used in relation to applications in Greece. As far as the research part is concerned, this study was carried out using the method of quantitative research, namely the use of data gathered from a questionnaire, which was distributed and supplemented by 90 trainees. The questionnaire was constructed by the researcher exclusively for the purposes of the study and concerns students' attitudes and attitudes towards educational robotics. It consists of 2 parts, the first of which records the demographic characteristics of the sample, the second examines the degree of pleasure from participation in education. After the data were collected from the questionnaire, they were processed statistically by the methods of descriptive and inductive statistics, while some correlation checks were carried out. The research results are presented in tables in next chapter of the paper. The choice of quantitative research using a questionnaire is based on the fact that this methodological approach allows to obtain objective data that reflects the reality and is characterized by a high degree of reliability. In this way, it is possible to show specific trends of the wider population, in this case the educational community in Greece.

## 2 THEORETICAL FRAMEFORK

The particular benefits that can be derived from the exploitation of the possibilities offered by educational robotics have been studied by the pupils themselves, however, the relative research literature is extremely limited and is characterized by a high degree of heterogeneity both in research tools and in particular, to the respective objectives. However, in general, it can be argued that pupils' attitudes towards the applications of educational robotics are very positive. For example, research by Beran et al (2011) found that children attribute to the training robots various cognitive, behavioral and emotional characteristics while Ruiz & Aviles (2004) found that the degree of pupils' satisfaction with the use of robots is particularly while increasing their interest in science and improving their exploratory skills. Liu (2010), looking at students' views on educational robots, found that most of them find it particularly enjoyable, and that learning to use them can be a reason for choosing a career in the technology industry.

Apiola et al (2010), studying the views of secondary school children who participated in a robotics competition, found that after completing the competition, students had increased interest in STEM, increased levels of self-confidence, and improved problem-solving skills. A study by Varnado (2005) also found that after a period of eight weeks during which the students participated in a robotic project, they reported an increased level of self-confidence and better planning and problem-solving skills. In addition, Welch (2007) examined students' views on the social impact of science after participating in a robotics competition, finding that students developed positive attitudes towards technology and science. A study by Kandlhofer & Steinbauer (2016) also found that, according to children's views, educational robotics applications have a positive impact on their research skills in mathematics and science, teamwork and social skills.

Serholt & Barendregt (2014), examining the views of students who participated in an educational robotics lab, found that the majority of them have positive attitudes towards robots with anthropomorphic characteristics while at the same time feel comfortable when interacting with them while Cross et al (2016), attempting to develop a tool for assessing children's views on robotics, suggested as the most important factors to examine the curiosity, interest, perceptual value and identity of educational robots . Kaloti-Hallak et al (2015) also found that pupils participating in a robotic project have particularly positive attitudes towards similar applications, as well as a high degree of motivation to participate in similar activities, which is even higher for girls. Finally, in Greece, Theodoropoulos et al (2017) studied children's attitudes towards educational robotics by observing that these applications have a particularly positive impact on levels of student collaboration, problem solving skills, creativity, acquiring knowledge about engineering and programming, and understanding the STEM concepts, with many of them stating that robotics should become a compulsory curriculum in schools.

Bakas (2011) investigated whether students' involvement in a robotic project can contribute to the achievement of part of the teaching objectives of the Grammar Programming Element of the 3rd grade of the EPAL and, more generally, in the teaching of programming in High School and Gymnasium. In particular, the Lego Mindstorms robotics kit was used to study the achievement of the general purpose of the Planning lesson, namely the development of methodological qualities and the solving of simple problems in a programming environment, which was finally confirmed by the results research findings. It has also been investigated whether this activity can contribute to increasing student engagement in the syllabus of programming which is generally described as difficult. This did not seem to be confirmed. Of course, the questionnaires concerned only the programming process and not the whole project. The researcher, however, observed behaviors that indicate a great deal of interest and involvement of pupils in general in all project activities. Therefore, it proposes a longer-lasting project so that students have the time to familiarize themselves with the programming environment and to work more closely with algorithm design and programming.

## 3 PROPOSED METHODOLOGY

As mentioned above, educational robotics is a very promising field of modern educational reality, having significant benefits for students in the development of their cognitive and social skills, while at the same time contributing to the upgrading of the quality of teaching and pedagogical approaches to teaching act. However, the implementation of educational robotics in Greece is still at an embryonic stage,

as it is occasional in nature, although some efforts are being made by some educators. In this context, the purpose of this work is to investigate the degree of the learner's satisfaction from participation in educational robotics, in order to highlight the perceived benefits and ease of use of hardware, software and real scenario development. The ultimate goal of the study is to map the current reality of educational robotics in Greece today, according to the views of the educational community. Based on the above, this study expects to provide answers to the following research question that have to do with the degree of adoption of new technologies, namely:

What is the degree of pleasure of participating in a robotics educational program?

According to Bird et al. (1999), there are no specific rules under which the method for studying a research problem should be chosen, as each has advantages and disadvantages. They explain that the choice of the research method is a function of various factors, such as the subject itself, existing resources, time available, etc. Considering that the aim of the research is to identify the pleasure and the satisfaction of participation, as well as the easy use of robotics, the gathering of the appropriate information is done through an improvised tool (questionnaire). Since the data collected are quantitative, it is possible to approach learners through the pilot projects that are being implemented, that it is possible to collect data from a sufficient number of them (sample) and that the time available for carrying out the research and the processing of its results is relatively limited, the first method of this research is chosen to be descriptive, quantitative, sampling, basic with a view to implementing its results and implemented with tool a questionnaire.

In order to identify the actual criteria that affect the particular group of people and in conjunction with the relevant research and the corresponding literature, we have come to the factors that have been concerned about the pleasure and satisfaction of participation in educational robotics in the present work. The questionnaire was given to 6 people from each department (5 classes) and they were asked to record which could be the factor for the satisfaction to participate in robotics education. The 6 people in each class tried to belong to the respective age groups of interest to both sexes. From the preliminary questionnaire given, there was evidence of pleasure and satisfaction with participation in the program (joy of participation, fear of not being able to do so, fatigue from participation, if they liked it altogether if it was recommended others, etc.). These were taken into account in the compilation of the questionnaire.

About the sample, the questionnaire was completed by trainees who participated in an educational robotics program for primary and secondary school children. A total of 90 people attended the training program in groups of 18 people. The questionnaires were distributed during the courses in the training sessions.

In the questions concerning general trainees, it was considered appropriate to ask for gender, age, housing and parenting level, as they are crucial to the results of research, thus defining the independent variables of the survey. The questions of the second section refer to the details of the implementation of the educational process. Questions 6, 7, and 8 refer to whether they have a PC at home, how often they use it, and why, questions 9, 10, 11 and 12 address the prior knowledge and use of programming, robotics, algorithms and Lego devices. Questions 14, 15, 16 and 17 detect the desire for participation and possible inhibitory factors of the operation in a group as well as the possible problems that may arise from them, while Questions 13, 18, 19, 28, 29 and 30 refer to the pleasure - satisfaction that the participants felt. The above questions are based on the structured USE (Usefulness, Satisfaction, Ease of Use) questionnaire proposed by Lund (2001) as a tool for categorizing users' responses to the usefulness, ease of use, satisfaction and ease of learning.

## 4 RESULTS

The survey sample consisted of 90 trainees, of whom 51 (56.67%) were boys and 39 (43.33%) were girls.

Table 1: Trainees Gender

| Gender | Quantity | Perc. |
|---|---|---|
| Boys | 51 | 56,67% |
| Girls | 39 | 43,33% |
| **Total** | **90** | **100.00%** |

With regard to their ages, 13.33% of respondents are 9 years old, 20% are 10, 14.44% are 11, 24.44% are 12, 10% are 13, 11.11% are 14 and 6.67% are 15 years old (table 2)

Table 2: Trainees Age

| Age | Quantity | Perc. |
|---|---|---|
| 9 | 12 | 13.33% |
| 10 | 18 | 20.00% |
| 11 | 13 | 14.44% |
| 12 | 22 | 24.44% |
| 13 | 9 | 10.00% |
| 14 | 10 | 11.11% |
| 15 | 6 | 6.67% |
| Total | 90 | 100.00% |

Of the 90 trainees in the sample, 2 (2.22%) have a mother with a primary school degree, 5 (5.56%) with junior high school degree, 29 (32.22%) high school degree and 54 (60%) with university degree. In relation to the fathers of the 90 trainees in the sample, 1 (1.11%) of them has finished primary school, 11 (12.22%) of them have a junior high school degree, 35 (38.89%) high school degree and 43 (47.78%) have a university graduate.

Table 3: Parents Education Level

| Education Level | Mothers | Perc. | Fathers | Perc. |
|---|---|---|---|---|
| Primary School | 2 | 2.22% | 1 | 1.11% |
| Junior High School | 5 | 5.56% | 11 | 12.22% |
| High School | 29 | 32.22% | 35 | 38.89% |
| University | 54 | 60.00% | 43 | 47.78% |
| Total | 90 | 100.00% | 90 | 100.00% |

Table 4 presents a memo of the variables reported in learners' desire of participation and work in a team, used in Table 5 and Graph 1

Table 4 A memorandum of variables relating to desire of participation and work in a team

| Variable | Symbolism |
|---|---|
| Did you know the rest of your team members? | A14 |
| Have you worked with them again? | A15 |
| Did you feel moral shyness (shame) when you joined your team with other members? | A16 |
| Did you feel that you are being skipped within your team? | A17 |

Table 5 and Graph 1 show the descriptors of the variables relating to learners' desire to participate and work in a team. The answer scale is from 1 to 4 where, as the price increases, the grade of their desire increases. Specifically, the value 1 indicates the answer «At all», 2 «A little», 3 «Enough», and 4 «Much». Also, they claimed that they knew the rest of their team members enough (2.97), but they answered that a few times they have worked with them again (2.13). In the end, the respondents replied that:

- they didn't feel that they are being skipped within their team (1.45).
- they didn't feel moral shyness (shame) when they joined their team with other members (1.26).

Table 5 Descriptive elements of the variables relating to desire of participation and work in a team

| | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|
| A 14 | 90 | 2,97 | 1,115 | ,102 |
| A 15 | 90 | 2,13 | 1,159 | ,106 |
| A 16 | 90 | 1,26 | ,615 | ,056 |
| A 17 | 90 | 1,45 | ,851 | ,078 |

Graph 1 Average values of variables relating to desire of participation and work in a team

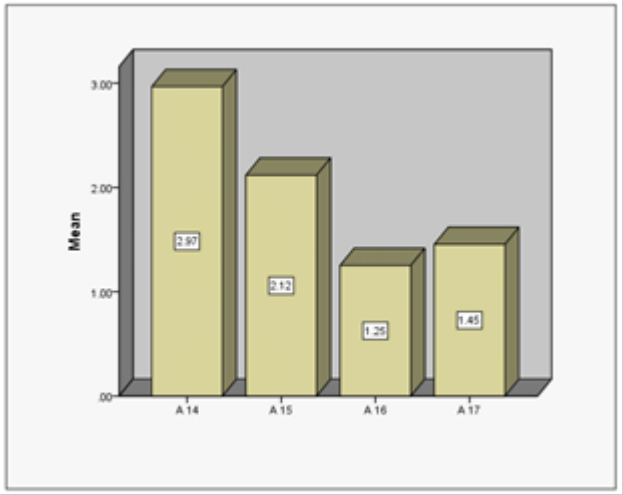



Table 6 presents a memo of the variables reported in learners' pleasure and satisfaction from participation, used in Table 7 and Graph 2.

Table 6 A memorandum of variables relating to pleasure and satisfaction from participation in a team

| Variable | Symbolism |
|---|---|
| How much did you want to participate in the robotics seminar? | A13 |
| How much happiness do you feel every time you participate in a seminar activity? | A18 |
| How afraid were that you wouldn't be able to meet the requirements of the lessons? | A19 |
| Have you been tired or bored during the lessons? | A28 |
| Did you like the seminar on the whole? | A29 |
| Would you recommend it to a friend of yours? | A30 |

Table 7 and Graph 2 show the descriptors of the variables relating to learners' pleasure and satisfaction from participating in a team. The answer scale is from 1 to 4 where, as the price increases, the grade of pleasure and satisfaction of the respondents increases. Specifically, the value 1 indicates the answer «At all», 2 «A little», 3 «Enough», and 4 «Much». We observe that the respondents' answers relate more to the first and last price of the scale.

In particular, the respondents replied that they:

- liked much the seminar on the whole (3.69).
- much wanted to participate in the robotics seminar (3.67).
- feel much happiness every time they participate in a seminar activity (3.58).
- would recommend the seminar to a friend of theirs (3.43).

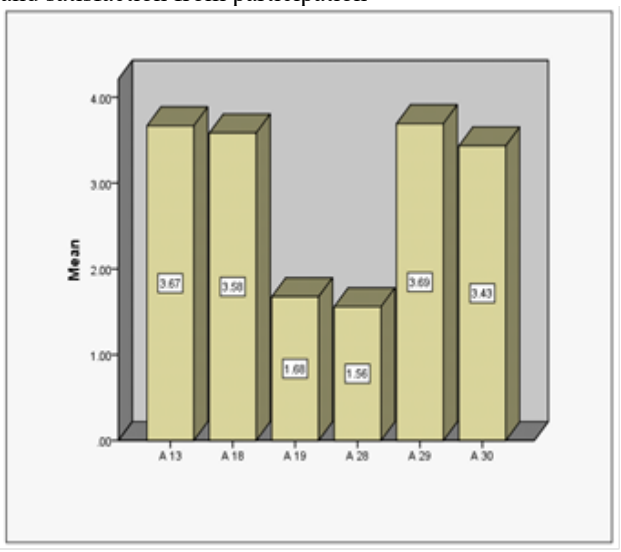
On the other hand, the respondents replied that they:

- weren't afraid that they wouldn't be able to meet the requirements of the lessons (1.68).
- have not been tired or bored during the lessons (1.56).

Table 7: Descriptive elements of the variables relating to pleasure and satisfaction from participation

| | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|
| A13 | 90 | 3,66 | ,626 | ,057 |
| A 18 | 90 | 3.58 | ,668 | ,061 |
| A 19 | 90 | 1,68 | ,871 | ,080 |
| A 28 | 90 | 1,56 | ,797 | ,073 |
| A 29 | 90 | 3,69 | ,646 | ,059 |
| A 30 | 90 | 3,43 | ,914 | ,083 |

Graph 2 Average values of variables relating to pleasure and satisfaction from participation




## 5 CONCLUSION

As shown in the tables in the survey, participated children of both sexes, aged 9-15 years old. Of these, most have a mother or father or both who are graduates of high education. Also, the survey shows that the participants, although they were generally aware of each other but had not worked together in the past, did not feel any moral shake during their participation in the program and did not feel crowded within their group. Their desire to participate in such a program was strong and the seminar satisfied them. This was clear in the excitement they had shown for the seminar and in their anxiety about the successful implementation of their missions, leaving no space for controversy. This satisfaction from their participation in the program is also highlighted by the question of their intention to propose the program to a friend. In particular, the overwhelming majority of participants say happy about it and would recommend it to someone familiar. From the above, it can be concluded that the innovation that technology delivers can only be closely related to young people, who are fascinated by its developments. It is, therefore, evident that the introduction of new teaching methods that exploit this familiarization of children with technology is required. Learning is usually perceived as the acquisition of knowledge through the appropriation of intellectual content.

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