

RESEARCH ARTICLE

Exploring kindergarten teachers' views on STEAM education and educational robotics: Dilemmas, possibilities, limitations

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Received: June 30, 2021;
Accepted: August 17, 2021;
Published: August 19, 2021.

Citation: Foti, P. E. (2021). Exploring kindergarten teachers' views on STEAM education and educational robotics: Dilemmas, possibilities, limitations. *Advances in Mobile Learning Educational Research*, 1(2), 82-95.
<https://doi.org/10.25082/AMLER.2021.02.004>

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Abstract: This paper will refer to STEAM education, focusing first on clarifying the STEAM acronym and then on the principles on which this methodology is based. Suggested pedagogical practices that can be adopted to integrate STEAM education in the educational program will be presented, followed by a reference to the interdisciplinary approach of educational robotics and its introduction in kindergarten. The research part of this paper will include a survey conducted in kindergartens of Primary Education in the Third District of Athens. The research aimed to explore perceptions, possibilities, and limitations expressed by preschool teachers regarding STEAM methodology and the introduction of Educational Robotics in kindergarten. This research highlighted the need to implement innovative approaches and ensure teacher training, which should be strengthened and upgraded by incorporating STEAM pedagogy and new practices for teaching and learning.

Keywords: STEAM, educational robotics, kindergarten teachers' perceptions

1 Introduction

John Dewey's principle is that education begins with curiosity (Savery, 2006), and he encourages students to go through all the steps of scientific inquiry: asking a question, planning how to evaluate a hypothesis, collecting data, analyzing the results, and sharing them (Pedaste et al. 2015). Students engaged in STEAM approaches actively participate in activities involving Science, Technology, Engineering, Science, Arts, and Mathematics. Teaching STEAM is about using hands-on experiences providing students with tools to unpack and enhance their potential.

Despite rapid advancements, education maintains an outdated system in technological, economic, and social conditions. However, an international effort is to reform curricula, encouraging innovative teaching models in primary education that promote STEM education and computational thinking as a problem-solving method (Papadakis et al., 2021). Traditional teaching and learning practices need to be transformed to respond to the modern workplace's evolution and prepare the future labor force (Vidakis et al., 2019). Online social networking environments that incorporate a multitude of interaction and communication capabilities can be a conditional, useful instrument in learning (Foti, 2020). The teacher also needs to transform his role and his profession and act as a researcher, as new knowledge is continually being revised. However, none would be essential if these changes are not focused on the curriculum (Tzagkaraki et al., 2021).

Future STEM students must understand and use technology in a classroom context from an early age. Young preschoolers have a natural predisposition to explore STEM challenges. It is a misconception that they lack skills and abilities such as expressing their experiences, making predictions and hypotheses, asking research questions, and drawing conclusions (Katz, 2010). Preschoolers can ask research questions, justify their opinions, and formulate interpretations of how the physical, social, and biological world around them works (NSF, 2012). They like to use various tools (e.g., magnets) to experiment, have an innate curiosity to explore, solve problems and puzzles, compare phenomena and objects (Sharapan, 2012), and investigate facts, patterns, and rules.

Problem-solving is also associated with learning coding, which at an early age helps develop communication skills, creativity, mathematics, and writing skills, as well as confidence and perseverance (Psycharis, 2016). Teaching a child how to code can help them develop a better understanding of the world around them, helping them to increase their chances of success in their personal and professional lives.

In this paper, the research aims to highlight the necessity and feasibility of implementing and applying programs designed with the STEAM methodology to preschool children, regarding the principles on which this methodology is based. Through this work, the research conducted in kindergartens of Primary Education in Athens will be presented to investigate preschool teachers' perceptions about the STEAM methodology. Furthermore, it will present their perceptions regarding Educational Robotics, the knowledge of the methodology, the existence of relevant training (what percentage has attended a seminar), the intention to apply this methodology in educational practice, and their concerns.

2 Theoretical framework - Concepts and definitions

2.1 Definition of STEAM

John Dewey's principle is that education begins with curiosity (Savery, 2006), and he encourages students to go through all the steps of scientific inquiry: asking a question, planning how to assess a hypothesis, collecting data, analyzing the results, and sharing them (Papadakis et al., 2015). Students engaged in STEAM approaches actively participate in activities involving Science, Technology, Engineering, Science, Arts, and Mathematics. Teaching STEAM is about using hands-on experiences providing students with tools to unpack and enhance their potential.

Over the last few years, increasing attention has been focused on developing children's acquisition of 21st-century skills and digital competencies (Chatzopoulos et al., 2021; Papadakis & Kalogiannakis, 2020). Concepts have been explored in terms of what is digital competence and what are the areas of digital competencies while proposal have been presented for the indicators of digital abilities of children in the Greek kindergarten (Foti, 2021).

Consequently, many education scholars have argued that teaching technology – the “T” in STEM (Science, Technology, Engineering, and Mathematics)– is vital in keeping up with 21st-century employment patterns. When used intentionally and appropriately, technology and interactive media are practical tools to support learning and development (Papadakis & Kalogiannakis, 2019). In early childhood, new interactive and smart screen technologies create opportunities to enhance young children's growing, learning, and playing. Technologies, such as those that involve robotics or coding apps, come at a time when the demand for computing jobs around the globe is at an all-time high while its supply is at an all-time low (Papadakis et al., 2021). At the same time, researchers and scholars have highlighted the vast cognitive benefits of introducing Computational Thinking (CT) skills to young children (Tzagkaraki et al., 2021).

Future STEM students must understand and use technology in a classroom context from an early age. Young preschoolers have a natural predisposition to explore STEM challenges. It is a misconception that they lack skills and abilities such as expressing their experiences, making predictions and hypotheses, asking research questions, and drawing conclusions (Katz, 2010). Preschoolers can ask research questions, justify their opinions, and formulate interpretations of how the physical, social, and biological world around them works (NSF, 2012). They like to use various tools (e.g., magnets) to experiment, have an innate curiosity to explore, solve problems and puzzles, compare phenomena and objects (Sharapan, 2012), and investigate facts, patterns, and rules. Problem-solving is also associated with learning to code, which at an early age helps develop communication skills, creativity, mathematics, and writing skills, as well as confidence and perseverance. Teaching children how to code can help them develop a better understanding of the world around them, helping them to increase their chances of success in their personal and professional lives.

In this paper, the research aims to highlight the necessity and feasibility of implementing and applying programs designed with the STEAM methodology to preschool children, concerning the principles on which this methodology is based. The research conducted in kindergartens of Primary Education in Athens will be presented to explore preschool teachers' perceptions on the STEAM methodology and Educational Robotics through this work. Furthermore, it will present the knowledge of the method and relevant training (what percentage has attended a seminar), the intention to apply this methodology in educational practice, and their concerns.

2.2 STEAM pedagogical approaches

STEAM focuses on solving authentic problem situations through an interdisciplinary approach through concepts, methodologies, tools from different scientific fields (construction, coding, collaboration) and teaches innovation by allowing students to explore better and more profoundly in all subjects. Besides, the complexity of contemporary social and economic problems requires a multidimensional approach (Morrison & Bartlett, 2009). Scholars have

long recognized that preschool children can engage in and complete basic programming and robotics tasks (Papadakis & Kalogiannakis, 2020b). Today, there is a newfound abundance of technological tools aimed at young children in the commercial landscape (Poultsakis et al., 2021). Mobile applications (apps) designed to teach young children coding skills in a fun, game-like way have become popular in recent years. For instance, apps such as Daisy the Dinosaur, the Kodable, and Scratch Jr., have been found to be used intentionally (Papadakis, 2020).

“We do not have a series of separate worlds, one a mathematician, another a physicist, another a historian. We live in a world where all aspects are connected, all studies are derived from relations of the one great common world, and as the child lives in changing and active relation to this common world, his studies are naturally unified.” (Dewey, 1990)

Problem-solving is a component of the STEAM methodology and is the ability of children to seek/identify and solve problems in their daily lives (Foti & Rellia, 2020). Problem-solving aims to make students “problem solvers” in the real world by learning to achieve this. They need to work together and devise a solution to the problem on their own (Foti, 2020). Collaboration among students and teachers is an essential element of integrating STEAM into teaching and learning by creating a “bridge” between the child’s earlier experiences and the focus of new knowledge (Thulin & Redfors, 2016). A vital element of the STEAM approach is a learner-centered process where students are further motivated when they feel responsible for solving the problem (Savery, 2006).

The problem-solving, collaborative form STEAM method is based on the value of questioning and questioning. It has been particularly emphasized in the US National Educational Standards (NES), according to which *“questioning through authentic questions generated from students’ experience is the central strategy for teaching science”* (Foti & Rellia, 2020).

As reported in research, kindergarten children can infer causal relationships from data and prove scientific thinking ability (Li & Klahr, 2006). The teacher plays an essential role in cultivating the skill of developing inquiry skills. To contribute, should guide the discussion to help students select and focus on a specific problem or question to be investigated. They also must teach students the nature and structure of inquiry, give examples of investigative questions, build on students’ interests and prior knowledge, and help guide them in what they want to learn (Foti & Rellia, 2020).

Martin-Hansen (2002) distinguishes three types of questioning. The open-ended questioning, which is student-centered and starts with a student question, followed by a group of students designing in-class inquiry investigations. Paired questioning is a combination of guided and open-ended questioning. By guided questioning, it is necessary to target a specific concept, idea, or pattern as the teacher chooses the question to guide the exploration. Finally, the type of combination of these explorations depends on the students’ ages and the subjects under consideration.

Considering the failure of traditional science teaching, the innovative approach, STEAM, argues for holistically introducing these concepts, from early childhood where children build proper scientific and mathematical concepts through experimentation and exploration of various materials. (Honey et al., 2014).

2.3 Educational robotics

Robotics is the most appropriate tool for highlighting aspects of STEM training and creating active creators. So, if we want to increase the number of future employees in STEM fields, a corresponding increase of the school’s relevant courses’ interdisciplinarity through the curricula is needed. Students need skills (often referred to as 21st-century skills) to help them cope with modern society’s demands (Vaiopoulou et al., 2021). Robotics enhances critical thinking, computational thinking, problem-solving, algorithmic thinking, making decisions, creativity, and collaboration. Educational robotics provides opportunities by integrating many subjects besides science, technology, engineering, and mathematics, such as art, dance, music, and more. Therefore, its integration into formal learning is reasonable (Ampartzaki et al., 2021).

Educational robotics may be related to STEM fields such as science, technology, engineering, and mathematics. For this reason, when robotics is evaluated, the results in students’ knowledge in the respective fields are evaluated. This means that for a clearer picture of educational robotics and its use in practice, it is necessary to study its application in other fields. Educational Robotics can be seen as an interdisciplinary approach that includes aspects as diverse as algorithmic designs, the construction and operation of robots and robotics kits, mechanical design structures, and the applicability of mathematical engineering, physics principles, and other scientific topics (Suza et al., 2018). In kindergarten, coding is much simpler than we think. Children as young as five years old can already grasp some basic coding concepts even if they do not know what

it is and if we introduce them in their language (Foti & Rellia, 2020). Basic coding concepts such as algorithm, sequencing, iteration, analysis, expansion/decomposition, and debugging are essential for young children to become familiar with when learning to code and as conversational skills functional throughout their lives (Foti & Rellia, 2020).

3 Methodological framework

3.1 Research process

Based on the form of data looked for in a survey, the choice between quantitative and qualitative research is made. In this research effort, quantitative research was applied because we considered it more effective to collect quantitative data and thus analyze them using statistical tools and methods. Quantitative data are in numerical or proportional form, and we can present them in charts and figures, which makes it easier for us to interpret the results of our research (Dimitropoulos, 2001). However, this quantification of the data does not, on the other hand, prevent the qualitative summary of the results (Dimitropoulos, 2001). At the same time, in quantitative research, it is possible: a) to produce numerical data that can lead us to a broader investigation of the issue (Cohen & Manion, 1994), b) to assess one or more hypotheses, c) to interpret cause & effect, and d) to make predictions/estimates. National and international research ethics guidelines will be followed (Petousi & Sifaki, 2020). As Petousi & Sifaki (2020) have stated, research misconduct jeopardizes trust relations between science and society and among scientists and researchers, and in the long run, science itself.

3.2 The research questions

The research, as mentioned above, was conducted in kindergartens of Primary Education in Athens, and was aimed at exploring the perceptions of preschool teachers regarding the STEAM methodology and Educational Robotics. Specifically, the questions that were asked were:

- (1) How important do you consider STEAM education to be for your students?
- (2) Would you integrate STEAM education and educational robotics into the educational process?
- (3) How could STEAM education help you in your educational practice if you implemented it?
- (4) Do you have some concerns on STEAM and educational robotics?

3.3 Data collection tool - Research sample

As mentioned above, we conducted a quantitative survey to collect the survey data. The research material on which we relied came from the completion of an electronic questionnaire which consisted of 17 questions, of which 15 were closed type based on the Likert measurement scale and two open type questions which allowed the respondent to develop a short answer. The survey was conducted during the period February 20, 2021 - March 10, 2021, and the survey sample consisted of primary school teachers who teach in kindergartens in the third grade of Athens. In total, the sample was 104 primary school teachers of the kindergarten specialty in primary education in Athens III who responded to the weighted questionnaire, which was constructed on a Google online form which can be found at:

https://docs.google.com/forms/d/e/1FAIpQLSeL7C4jRNNr5A04D_Rw9aJAXmvyOTuPa3Xu7V5GnS6zNV4n4Q/viewform?usp=sf_link

3.4 Reliability and validity of the research process and data measurements

To ensure the reliability of the questionnaire, we followed the following steps: 1) a letter from the researcher to the respondents was sent along with the questionnaire in order for them to understand the purpose of the research, the content of the questionnaire, and to feel protected by their anonymity in order to answer honestly 2) the questionnaire was completed voluntarily, 3) it was sent electronically through the google docs form, and 4) all the steps of a survey were followed. At the same time, each question of the questionnaire was evaluated for its appropriateness in terms of 1) its content, 2) its verbal wording, 3) its order in the questionnaire, and 4) its type (Paraskevopoulos, 1999). Finally, the closed-ended questions were given a wide range of suggested answers using a five-point Likert scale, and to increase validity, we included open-ended questions. The electronic questionnaire construction of the Google forms form of Google drive was chosen because it gives the possibility to collect and record the data in spreadsheets to make the statistical processing easier and easier to use.

4 Results

A total of 104 questionnaires were collected from the survey conducted through google docs form, and statistical analysis was done using excel, so it is univariate. The online questionnaire consisted of seventeen questions. Part A of the online questionnaire was about the demographic data such as gender of the respondents, age, level of knowledge, teaching experience, and their ICT knowledge. In terms of respondents' gender, there were all females. Regarding the sample age (see Figure 1), 36.5% were between 51 years and above, 35.6% between 41-50 years, 22.1% between 30-40 years, and 5.8% 23-30 years. (Figure 1)

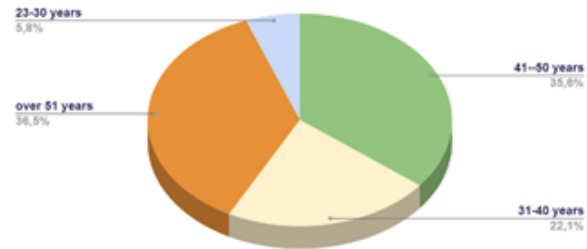


Figure 1 Age

Regarding knowledge level, 70.2% of the respondents had a university degree, 25% had a master's degree, 1.9% had a Ph.D., while 1% had completed the Marasleio Teaching School, as shown in Figure 2.

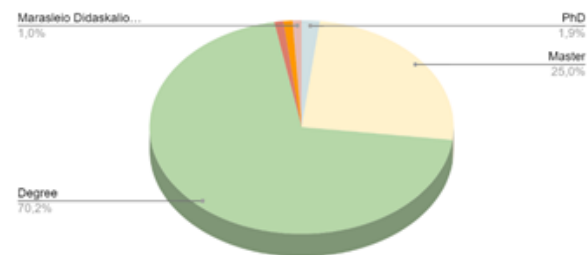


Figure 2 Level of knowledge

Regarding teaching experience, 47.1% have 13 to 20 years, 22.1% have 21 to 25 years, 16.3% have more than 25 years, 7.7% have 6 to 11 years, and finally, 6.7% have 1 to 5 years, as shown in Figure 3.

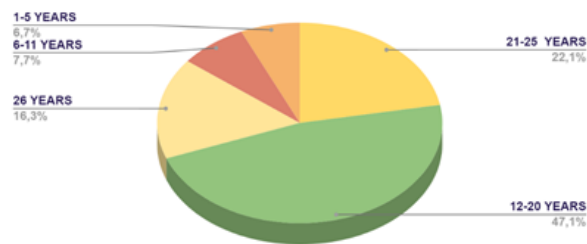


Figure 3 Teaching experience

Regarding ICT knowledge level, 51% of the respondents have completed B level, 46.2% have completed A level, and 2.9% stated that they are ICT trainers, as shown in Figure 4.

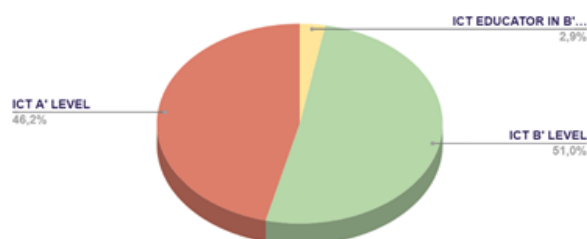


Figure 4 ICT knowledge level

Regarding knowledge in STEAM methodology, 16.7% of the respondents answered that they know a little, 30.6% enough, 41.7% not at all, and 11.1% little, as shown in Figure 5.

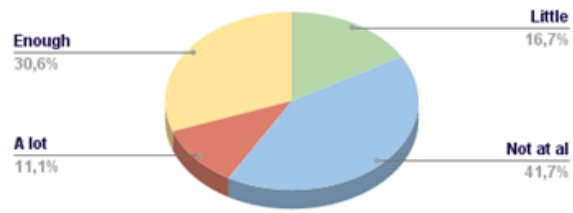


Figure 5 Knowledge about STEAM training

When asked if they have used STEAM training at school, 71.4% answered negatively and 28.6% positively, as shown in Figure 6.

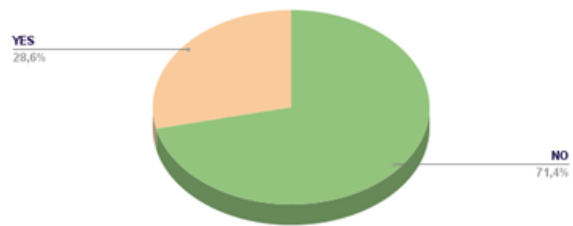


Figure 6 STEAM training at school

When asked if they have attended a seminar on STEAM, 73.1% of the respondents answered positively, and 26.9% answered negatively, as shown in Figure 7.

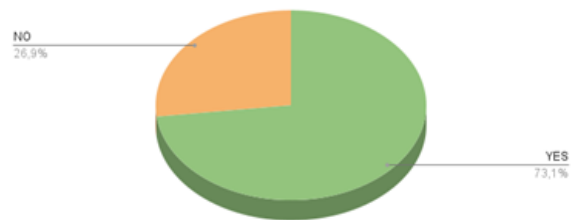


Figure 7 Attendance at STEAM seminars

When asked how important the students' general knowledge of STEAM training 48.3% responded that it is more important, 24.1% is less important, 10.3% that it is indifferent, while 10.3% of the respondents answered that it is essential and 6.9% not at all, as shown in Figure 8.

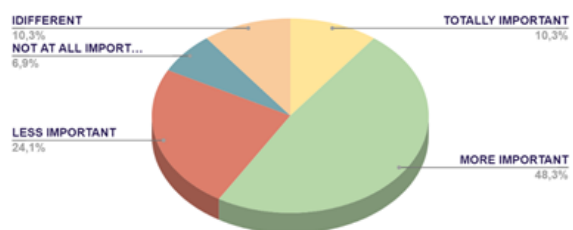


Figure 8 Students' prior knowledge and STEAM

As to how significant problem solving is in STEAM education, 62.1% answered that it is crucial, 31% less critical, and 6.9% indifferent, according to Figure 9.

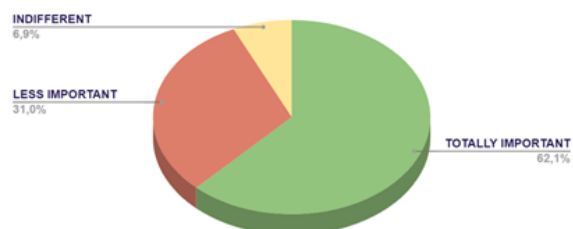


Figure 9 Problem solving and STEAM

As to how integral the student-centered approach to STEAM education is, 53.8% of the respondents answered that it is essential. 34.6% that it is more important, 7.7% that it is somewhat important, and 3.8% that it is indifferent, as shown in Figure 10.

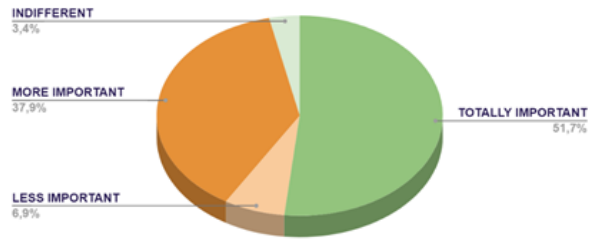


Figure 10 Student-centered approach and STEAM

As to how vital interdisciplinarity is in STEAM education, 51.7% answered that it is essential, 44.8% that it is more important, 3.4% that it is indifferent, and 6.9% that is less important (see Figure 11).

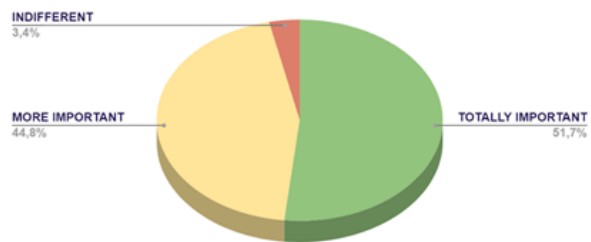


Figure 11 Interdisciplinary and STEAM

As to how important the connection between STEAM education and the natural world is, 41.9% of the respondents answered that it is essential, 35.5% more important, 12.9% less critical, and finally, 9.7% is indifferent to Figure 12.

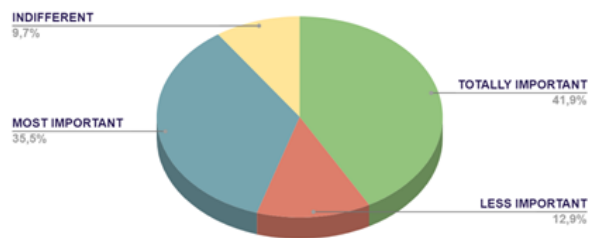


Figure 12 Connection with the natural world and STEAM

Regarding experimentation and its importance for STEAM education, 54.8% of the respondents answered importantly, 41.9% as more critical, and 3.2% as less critical (see Figure 13).

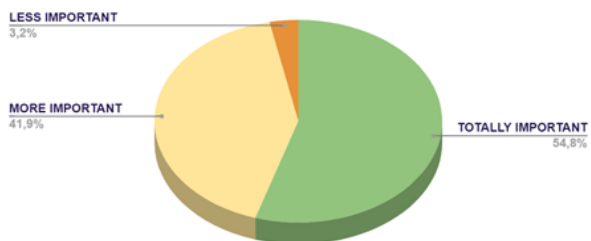


Figure 13 Experimentation and STEAM

Regarding how crucial experiential learning in STEAM education is, 54.8% responded that it is imperative and 41.9% responded that it is more important, and 3.2% is less important, as shown in Figure 14.

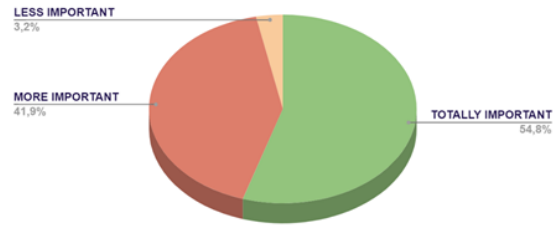


Figure 14 Experiential learning and STEAM

Regarding how important collaborative learning in STEAM education is, 58.1% of the respondents answered that it is totally important, 38.7% more important, and 3.2% less important, as shown in Figure 15.

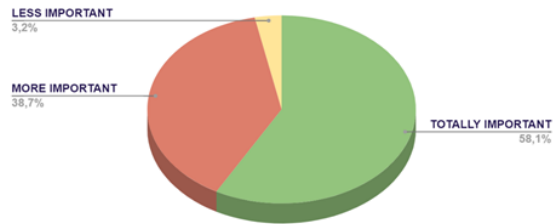


Figure 15 Group collaborative approach and STEAM

Regarding how vital the formulation of questions and hypotheses in STE(A)M training is, 58.1% of the respondents answered that it is essential, 38.7% answered that it is more important, and 3.2% that it is less important, as shown in Figure 16.

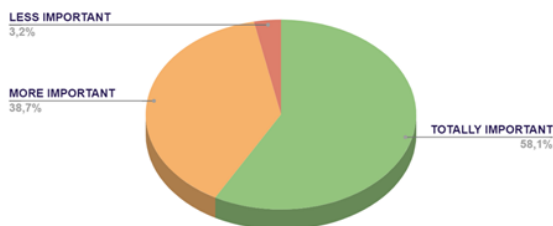


Figure 16 Formulation of questions and hypotheses in STEAM

Regarding the connection between STEAM education and the labor market, 32.3% responded indifferently, 22.6% important, 19.4% more important. In comparison, 19.4% and 6.5% are less critical and not at all, as shown in Figure 17.

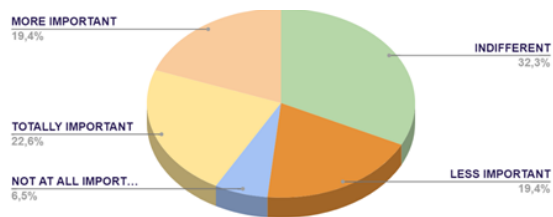


Figure 17 Connection in STEAM education and labor market

When asked how important is training and information in STEAM education, 64.5% of the respondents answered that it is totally important and 29% is more important. In comparison, 6.5% answered that it is less important, as shown in Figure 18.

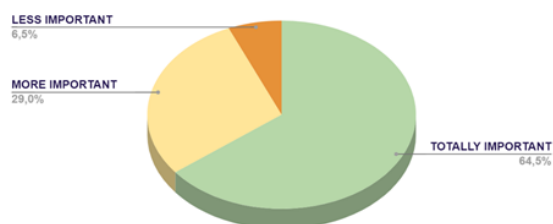


Figure 18 Training and information in STEAM education

Regarding how important STEAM education is for students, 42.5% of the respondents answered that it is more important, 38.7% answered that it is most important, 9.7% answered that it is important, and 6.5% answered that it is less important, as shown in Figure 19.

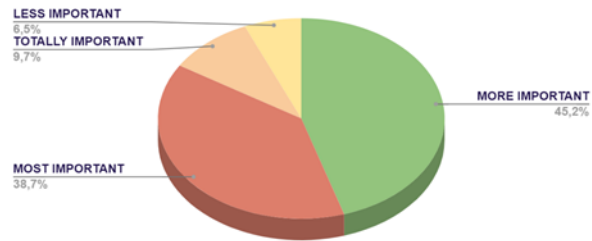


Figure 19 Importance of STEAM education in students

When asked whether they consider that STE(A)M Education will help you in your daily educational practice, 38.7% of the respondents answered quite a lot, 35.5% answered a lot, 16.1% answered very much, 6.5% answered less. 3.2% answered not at all, as shown in Figure 20.

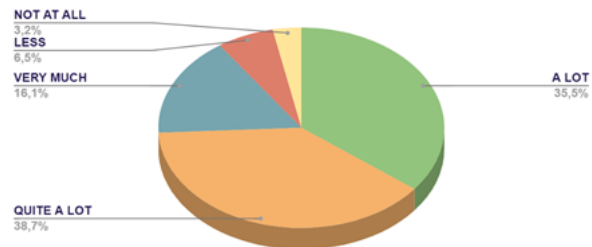


Figure 20 STEAM training and educational practice

Regarding whether they have attended a seminar regarding educational robotics, 68.8% of the respondents answered positively, and 31.3% answered negatively, as shown in Figure 21.

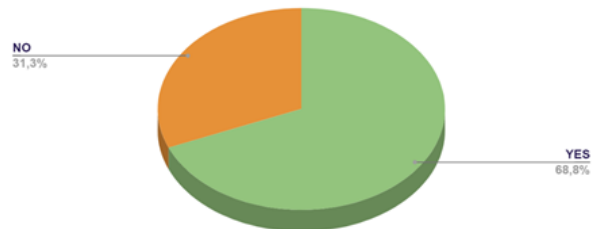


Figure 21 Attendance at educational robotics seminars

Regarding how critical the hardware infrastructure of schools is for educational robotics, 64.7% of the respondents answered importantly, 29.4% answered most essential, and 5.9% answered that it is indifferent, as shown in Figure 22.

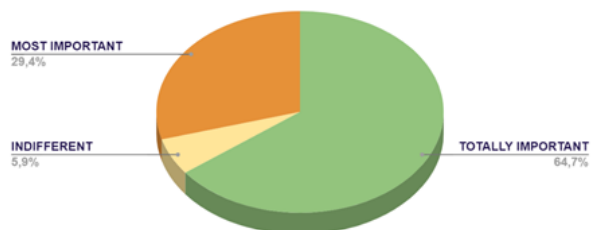


Figure 22 Hardware infrastructure and educational robotics

Regarding how necessary the knowledge of using educational robotics is, 61.8% answered that it is imperative and 35.3% most important, and 2.9% answered that it is little essential, as shown in Figure 23.

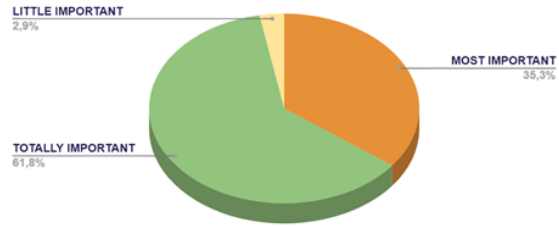


Figure 23 Knowledge about educational robotics

Regarding how crucial educational robotics is to be applied in all STEAM disciplines, 53.6% and 35.7% answered that it is totally important and most important, 7.1% answered that it is different, and 3.6% answered that it is somewhat important, as shown in Figure 24.

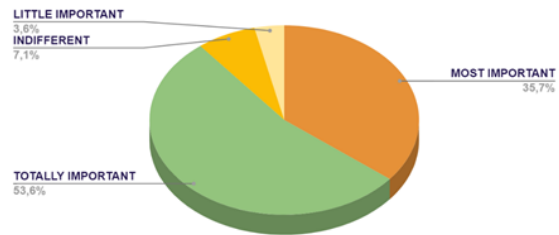


Figure 24 Educational robotics in all STEAM fields

Regarding how important it is for the curriculum to integrate educational robotics in STEAM education clearly, 40.5% and 37.8% answered totally and most importantly, 13.5% answered little essential, and 8.1% answered indifferent, as shown in Figure 25.

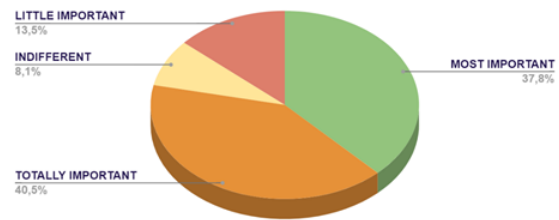


Figure 25 Curriculum, educational robotics, and STEAM

Regarding how important it is to introduce educational robotics playfully, 64.9% answered that it is essential and 35.1% that it is most important, as shown in Figure 26.



Figure 26 Educational robotics in a playful way

Regarding the vital connection between educational robotics and the student’s natural environment, 41.9% answered importantly, 48.4% answered most essential, and 9.7% answered indifferent, as shown in Figure 27.

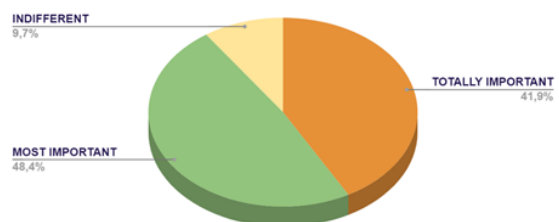


Figure 27 Educational robotics and natural student environment

Regarding integrating STEAM Education and Educational Robotics in the educational process, 71% answered positively, 25.8% answered maybe, and 3.2% answered definitely. At the same time, there was no negative answer to this question, as shown in Figure 28, a finding that reinforces the need that STEM approaches should be introduced in early childhood approaches.

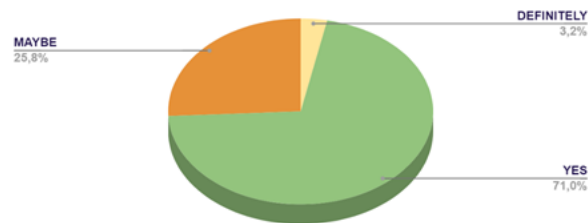


Figure 28 Integrate STEAM and Educational Robotics in the educational process

To the open-ended questions such as whether they have been involved in Educational Robotics, respondents answered that they had used programmable floor robots Beebot and Lego we Do and have participated in the Eu Code Week. At the same time, the following opinions were recorded on whether they would like to give a reflection or an opinion regarding STEAM and Educational Robotics:

(1) They are teaching methods that meet the needs of young children and the needs of our time.

(2) It helps the child to process data and solve problems. It encourages critical thinking and creativity.

(3) Introducing STEAM in practice, with training and appropriate educational materials for all schools, not just at the level of educational robotics philosophy, which de facto all teachers work with their students daily.

(4) Stem and educational robotics in the curriculum of the kindergarten.

(5) As part of the graduate program I am attending, I have understood how vital this method is and how important it is for children to engage with educational robotics.

(6) The financial realities of schools act as a deterrent for teachers to engage in educational robotics.

(7) Educational robotics equipment in all schools.

(8) In my opinion, STEAM education and educational robotics is another methodology that we can use to develop skills related to problem-solving and other skills and competencies focused on mathematics, science, engineering, technology, and their interaction. Early, childhood educators have been planning our educational interventions in an interdisciplinary and interdisciplinary way for years. Of course, by focusing on the sciences, the excellent use of technology (and beauty to children), it is easy to overlook the social dimension of the issues and the cultivation of values (except cooperation). These aims are critical in preschool education. These methodologies and tools can combine the partnership of the sciences with the same results and a greater emphasis on the social dimension of the issues under consideration. It is also concerned about its 'strict' framework in terms of its approach, which, on the one hand, can ensure the validity of the educational process, but on the other hand, may limit the creativity of teachers and children. Another choice must be added to the educational process, a valid methodology with specific tools. However, I would prefer it to remain a possibility and not be introduced as a critical approach in the curriculum.

5 Conclusions

Children's experiences in their early years are significant for their brain and development (Kermani & Aldemir, 2015). In combination with other areas, children's involvement in science at an early age helps them become aware of and increase their interest in Science (Mantzicopoulos et al., 2009) and affects their school and education performance. Research has shown that attitudes and learning towards science are formed in the early years of education, and then it is difficult to change (Archer et al., 2010). The STEAM approach encompasses the understanding, skills, and abilities to address problems individually, in groups, in society, and on a broader global level (Bybee, 2010).

Improving students' interest and motivation in STEM education is a multifaceted and complex issue. Novel approaches must be implemented to ensure concrete and practical improvement, and innovation must be extended and integrated into everyday educational practice. The change

must be made at the grassroots, i.e., in kindergarten. A program should be created that focuses on STEAM to include the latest developments in scientific research and better integrate reality-based issues into authentic problems.

Teacher training should be strengthened and upgraded by incorporating new forms of STEAM pedagogy and new mechanisms for teaching and learning (Papadakis, 2021). In preschool classrooms where STEM activities are conducted, children build appropriate scientific and mathematical concepts through experimentation and exploration of various materials. In this way, STEM education provides them with meaningful learning and can lead to incredibly positive future educational experiences. Education based on the STEM approach and then STEAM aims to prepare children for global issues through exploration, creative and critical thinking, collaboration, effective interaction, and communication (Quigley & Herro, 2016).

"All that the school can or needs to do is develop students' ability to think..."

John Dewey.

6 Discussion

Despite rapid advancements, education supports an outdated system in technological, economic, and social conditions. However, an international effort is to reform curricula, encouraging innovative teaching models in primary education that promote STEM education and computational thinking as a problem-solving method (Dorouka et al., 2021). Students need skills (often referred to as 21st-century skills) to help them cope with modern society's demands (Karakose et al., 2021). STEM or STEAM enhances critical thinking, computational thinking, problem-solving, algorithmic thinking, making decisions, creativity, and collaboration. Educational robotics provides opportunities by integrating many subjects besides science, technology, engineering, and mathematics, such as art, dance, music, and more. Therefore, its integration into formal learning is reasonable.

Educational robotics may be related to STEM fields such as science, technology, engineering, and mathematics. For this reason, when robotics is evaluated, the results in students' knowledge in the respective fields are evaluated. This means that for a clearer picture of educational robotics and its use in practice, it is necessary to study its application in other fields (Li & Khlar, 2006).

STEAM is where several foreign countries have invested, supplying grants and funds, designing curricula, and training teachers. Through the research, the need has appeared for the State to give proper attention to education, taking into account the approach and designing a framework for its integration at optional or compulsory level, training teachers, providing appropriate STEAM and Educational Robotics materials for activities or workshops.

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