USING ROBOTICS TO ENHANCE ACTIVE LEARNING IN MATHEMATICS

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ABSTRACT:

The use of technology, which is linked to active learning strategies, can contribute to better outcomes in Mathematics education. Within the framework, the question raised was "What are the conditions that promote effective active math learning with robotic support?" Interventions at different educational scenarios were carried in order to explore three educational levels: elementary, secondary, and high school. The findings point to three key conditions: level, motivation, and teacher training. The obtained results show a very favourable impact on the attention and motivation of the students, and they allow for establishing the conditions that need to be met for an effective relationship between the teacher and the technological tool, so that better learning outcomes in Mathematics are more likely to be obtained.

KEYWORDS:

- Educational robotics
- Active learning
- Educational innovation
- Mathematics learning
- Case studies

INTRODUCTION:

For a long time, human beings have endeavoured to develop new methods to perform tasks in an easier way, with the aim of doing those activities that benefit him in any area of his life faster and more efficiently. It is then that technology comes into play. Despite the fact that technology has several paths, it can be assured that each and every one of them has a common purpose: to help humanity solve some problem that is inherent in it. Information and communications technologies (ICTs) currently occupy an extremely important place in society and the economy. Their importance has been increasing enormously. The concept of ICT has emerged as a technological convergence of electronics, software, and telecommunications infrastructure. Robotics is one of the expressions of technology whose application has extended to various contexts of life.

OBJECTIVES:

The objectives of using Robotics in Mathematics education are:

- To increase student's use of visualization in problem solving and gains in understanding.
- To generate interest in students to learn mathematics and thus to cut off the most common myth that Mathematics is a dry subject.
- To motivate students in learning Mathematics.
- To apply the knowledge of Math in novel ways to real world problems developing a richer knowledge base for their Math education.
- To help the students to understand the subject matter more deeply than in traditional Mathematics instruction.

- To acquire a positive and critical attitude towards Mathematics.
- To develop skills that allow the learners to pose and solve problems while using Mathematical tools, to make decisions, and to face non-routine situations.
- To promote other cross-disciplinary skills such as; creativity, communication, collaboration, critical thinking, teamwork, innovation, the development of solutions to problems, digital skills and computational thinking.

In the educational field, it becomes a valuable resource to facilitate learning and develop general skills, such as socialisation, creativity, and initiative in students today. One of the main causes of school failure in students is a lack of interest and boredom. This is mainly due to the fact that, in most cases, the current education is not interested in generating innovative activities that favour the participation of their students. For this reason, the use of ICTs has been promoted within the classrooms. The use of new technologies allows for an incentive towards learning in students of different educational levels, and the learning of Mathematics is a very specific area. Currently, it is a necessity that Mathematics instructors find better ways of teaching; this would allow for students to be more empathic and make sense of this area of knowledge. Thus, in most classes nationwide, teachers do not improve the use of teaching materials, due to a lack of creativity, time, proper training, or planning. Hence, the importance of showing how technology allows for significant improvements in attention and motivation towards Mathematics, which, in turn, allows for an improvement in training programs and teaching practices; thus, achieving a positive impact on student learning. The principles of mathematical modelling include learning on our own; using technological devices and basic productivity tools to investigate and produce learning material in an ethical and efficient manner; and, applying numerical, algebraic, and geometric procedures for the understanding and analysis of real situations. The use of a technological platform would help to fulfil the expected objectives. Although there are already ways to incorporate technology in the classroom, it is still not very common to use robots as a support tool for lesson delivery.

Robotics in the classroom not only allows to study topics of automation and process the control in the area of technology and computer science, but it also serves as an aid in learning different areas of knowledge. The robots arouse interest in students, as they are concrete objects striking. An educational robotic proposal can be implemented under an approach that takes the learning environment, the planning of activities, resources, the time needed for the realisation of each of these, and the methodology to perform them into account. In this framework, active learning with strategies for doing, reviewing, learning and applying can be of support to contribute with the construction of mathematical knowledge. When joining these resources, one could ask oneself: What are the conditions that promote effective active Math learning with robotic support?

Mathematics is a universal language that contributes to the development of logical thinking, the ability to reason, and to face new challenges. Learning Mathematics is a subject that emphasises problem solving. If students think critically, they can solve problems effectively. Mathematical competences, according to the Organisation for Economic Cooperation and Development refer to students' abilities to analyse, reason and communicate effectively when they identify, formulate, and solve mathematical problems in different situations. Mathematical competence "implies the ability and willingness to use mathematical modes of thinking (logical and spatial thinking) and their representation (formulas, models, graphs, and diagrams)". Mathematical competences must

be placed as part of the key elements within learning for life. The Government of Mexico states that the general purposes of learning Mathematics are: (a) to conceive Mathematics as a social construction in which mathematical facts and procedures are formulated and argued; (b) acquire positive and critical attitudes towards Mathematics; and, (c) to develop skills that allow them to pose and solve problems while using mathematical tools, make decisions, and face non-routine situations. Thus, the profile of the preschool graduate in mathematical thinking is: "he or she counts at least to 20, reasons to solve problems of quantity, builds structures with figures and geometric bodies, and organises information in simple ways". For the primary education profile: "he or she includes concepts and procedures for solving various mathematical problems, and for applying them in other contexts". Finally, for secondary education: "he or she expands his knowledge of mathematical concepts and techniques Mathematics to pose and solve problems of varying degrees of complexity, as well as to model and analyse situations. According to the PISA report, only 1% of students performed at the highest levels of competence and 35% of students did not achieve a minimum level of competence. The obtained results continue to show a lack of competence in Mathematics. In order to achieve this, socio-educational policies search for new opportunities in order to reduce inequalities between communities, promote training in values, minimise gaps, and promote equity. The integration of technologies and, in the case of educational robotics, helps to develop various skills and promote the construction and acquisition of knowledge in general, and Mathematics in particular. If we focus on the area of Mathematics, we seek to modify the actions with innovative practices, integrating the use of technologies in teaching methodologies for learning them, and promoting the development of mathematical skills. Educational robotics (ER), which is also known as pedagogical robotics, is a discipline that aims at the conception, creation, and implementation of robotic prototypes and specialised programs for pedagogical purposes. ER is not a new concept, but, rather, it has been growing exponentially in recent years. It has a major impact on learning, and it is associated with the STEAM disciplines (Science, Technology, Engineering, Art, and Mathematics) for the development, skills, and understanding of mathematical, physical, engineering, and related concepts. Across the various faculties and universities, and in order to reduce the gender gap in STEAM careers, we have to train students in/with robotics related skills in all disciplines. Additionally, in this way, promote learning centred on the student, on his or her interests, and on the demands of society, using innovative methods; and, promoting critical training, in order to develop active and co-participating citizens in today's society. It could be defined as "an interdisciplinary discipline, which requires the construction of a technological object with a specific purpose; it aims at the pedagogical field and it develops key competences and skills for the students of the 21st century". The integration and use of educational robotics in the teaching-learning process in pre-school, primary, and secondary levels can become visible, and be a turning point, as a resource to address the diversity of the classroom, as a means to help the inclusion of all students, as well as keep them active and motivated. Additionally, it can be utilised as a tool to promote the construction of knowledge and the achievement of results.

ATAL TINKERING LAB:

In understanding the importance and benefits of robotics education in school level, the central government of India took an initiative to create an environment of scientific temperament, innovation, creativity among Indian students. For this the India government has started a network called ATAL TINKERING LAB [ATL] under the ATAL INNOVATON MISSION [AIM] which is organized by NITI

Aayog. Atal Innovation Mission is named as Atal as a tribute to the veteran leader and former Prime Minister Shri. Atal Bihari Vajpayee. This flagship initiative aims at fostering innovations and entrepreneurship among the citizens, especially youths. Atal Tinkering Lab was established with a vision "to cultivate 1 million children in India as neoteric innovators". It has an objective to endorse STEM system of education [Science, Technology, Engineering and Math], by cultivating curiosity, creativity, and imagination in the young India.

An ATAL TINKERING LAB is a workspace where young minds can give shape to their ideas through a do-it-yourself approach and inculcate skills such as adaptive learning, computational thinking, physical computing and rapid calculations among many others. Presently the total number of ATLs in India is about 6000. On January 11, 2021, the Indian Space Research Organization [ISRO] has decided to adopt 100 Atal Tinkering Labs with an aim to promote education in the field of science, technology, engineering and Mathematics [STEM], space education and space technology related innovations for school students.

CONCLUSION:

Therefore, when working with ER, apart from working Mathematics on science and technology, the aim is to promote other cross-disciplinary skills, such as: creativity, communication, collaboration, critical thinking, teamwork, innovation, the development of solutions to problems, digital skills, and computational thinking. In order to do this, teachers must have basic knowledge to be able to teach the contents with robots. Introducing students to the areas of science and technology, in the case of Mathematics, through play and constructionist learning in order to generate new knowledge, is one of the goals of the usability of ER in the classroom. Learning with robots offers students intrinsic motivation, and invites them to investigate, foster their curiosity and imagination, to ask questions, to work in teams, to overcome challenges, to make decisions, and to be responsible of their own process. There are many robots on sale, according to shape, size, function, working environment, and autonomy.

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