DIGITALEDUCATIONREVIEW

Exploring STEAM disciplines with robotics in the Future Classroom Lab in Primary Education

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ABSTRACT

The objective of the study was to explore STEAM disciplines through robotics within the Future Classroom Lab (FCL) spaces, which challenge the learning of mathematical knowledge in Primary Education. The method used was quantitative and descriptive, based on data obtained from the mean and standard deviation through pre-test and post-test questionnaires, using Wilcoxon's W test to analyse data, together with an educational experience with robots. The sample consisted of students (n=12) aged 11-12 years. The results and conclusions of the study showed that students have a positive perception of learning mathematical knowledge through STEAM projects. Moreover, after the experience, students prefer to use FCL spaces to work on STEAM projects rather than the traditional classroom. Finally, after the experience with robots, students increased their interest in STEAM professions.

KEYWORDS: STEAM, robotics, mathematics, Future Classroom Lab, Primary Education.

1 INTRODUCTION

The changes that classrooms have been undergoing over the last decade due to the irruption of technology, especially after the Covid-19 pandemic (Descalzo & Rodríguez, 2023; Valero et al., 2022), although they may be beneficial, must be subject to a pedagogical analysis prior to their introduction that allows us to decide whether they really serve an educational purpose (Martín & Sánchez, 2023). This educational innovation and digitisation requires studies with practical educational experiences in creative spaces such as the Future Classroom Lab (FCL) that include technologies and the perception of students, which represents an unprecedented challenge for training young people to access the increasingly digitised and globalised labour market in the future (Dúo-Terrón et al., 2022).

1.1 STEAM in education

Currently, with the increasing influence of the digital society and economy, there is a growing demand for professionals who utilize robotics (Soto et al., 2023). This demand emerges as machines progressively replace human labor, generating a need for professionals such as programmers, systems engineers, biotechnologists, laboratory technicians, and project leaders. Notably, technology fosters motivation and engagement among students as they design and develop sustainable cities through robotics, envisioning the future (Ferrada & Díaz, 2023).

Therefore, it is essential that students acquire skills in fields related to robotics and programming from an early age. In turn, it is important to integrate art and creativity in the development of skills, both in mathematics and social skills, providing an effective method for knowledge retention (Conradty & Bogner, 2020).

Technology motivates and engages students by allowing them to design and create forward-looking projects. However, the lack of qualified people in STEM (Science, Technology, Engineering and Mathematics) fields has led to the emergence of the STEAM movement in education from an early age, which seeks to integrate the “A” of art (Marín-Marín et al., 2021) as a solution to promote creative and collaborative skills in educational spaces of creation.

Education plays a fundamental role as preparation for the future of students, regardless of gender, equipping young people with relevant skills to face social, economic, political, environmental and cultural challenges (Bernate & Vargas, 2020). This educational approach should be adapted to promote a comprehensive education that combines elements of STEAM, thus preparing students for success in their professional and personal lives in an increasingly digitized world (Amaya et al., 2023).

The integration of robotics in elementary education provides students with a solid foundation for future studies and careers in STEAM fields (Flores-Caiza & Méndez-Aldás, 2023; Weisberg et al., 2024). Robotics involves skills such as problem solving (Zorrilla-Puerto et al., 2023), creativity (Llanos-Ruíz, 2023), collaboration (Del Campo et al., 2023), and critical thinking (Cerero et al, 2023; López-Carrillo et al., 2024), all of which are fundamental in the 21st century.

Research in this field has been activated due to the potential benefits of robotics together with programming for the development of mathematical content through Computational Thinking (CT) (Molina-Ayuso et al., 2022). CT consists of problem solving through abstraction, decomposition of problems into small steps and computational algorithms (Karyana et al., 2024) and is included in educational curricula in different countries in the area of mathematics, such as the spanish educational system to which this research refers (R.D. 157/2022). This is because it allows students to explore, reflect, apply and reinforce mathematical concepts, such as negative numbers, planes and coordinate axes (Monteiro et al., 2019), angles, degrees, operations and geometry (Brender et al., 2021), showing them how they apply in real world contexts.

1.2 Future Classroom Lab

The Future Classroom Lab (FCL) is a European educational initiative that emerged in 2012 (Muñoz-García, 2023; Román et al., 2023) and was promoted by the European Schoolnet (EUN), with the participation of a network of 34 ministries of education across Europe. The FCL is based on the research findings of the iTEC project, funded by the European Commission (Blahová et al., 2013), with the purpose of developing attractive educational scenarios that can be validated on a large scale and then scaled up. Belgium, with its FCL located in Brussels, together with the two Iberian countries, Spain and Portugal, are examples of how the model can be adapted to the specific needs of each nation (Tena & Carrera, 2020).

The FCL has become a project with the purpose of developing innovative and flexible spaces that are being implemented in different parts of the world (Peña, 2023). These spaces are not only designed for technological exploration, but also pose the challenge of rethinking and redesigning educational practice, encouraging research, interaction, exchange of ideas and experimentation (González et al., 2022). The spaces proposed by the FCL are characterized by being interactive, research, development, exchange, creation and presentation.

The use and application of tools and techniques in educational environments arise from teacher-directed activities rather than being imposed on learning situations (Hickman, 2016). The transformation of the classroom as a “space” where STEAM education takes place contributes to the development of practical skills, fosters creativity in problem solving, and promotes digital innovations (Chiriac, 2019; Kanematsu & Barry, 2016). In the FCL, where the development of these skills is prioritized, the integration of robotics gets students to develop and achieve these competencies effectively.

Although prospective teachers' perceptions of how to employ technology in learning may vary, they mostly agree on the need to use it effectively (Delanay, 2014). Learning projects and activities supported by technological tools such as programming, robotics, or artificial intelligence have important implications for the future (Rodríguez-Almazán et al., 2023) of classroom learning, which is no longer spatially limited or focused exclusively on textbooks (Harris, 2017). In addition, these spaces contribute to the development of CT and digital competencies of students (Dúo-Terrón, 2023).

1.3 Justification and objectives

The effective integration of STEAM projects in creative spaces such as the FCL in Primary Education requires the dissemination of experiences together with scientific evidence. This study presents learning activities with robotics in Primary School students, together with an investigation of the perception of the use of this technology for the area of mathematics. Dividing the different STEAM disciplines present in the experience:

- Science: students through observation and reasoning predict robot performances and be tested.
- Technology: through a manipulation of sensors and actuators of robots.
- Engineering: where creativity is fundamental to create simple projects.
- Art: through the creation of mandalas through loops.
- Mathematics: through the development of computational thinking skills along with numerical, algebraic, space and magnitude knowledge.

For this reason, and because there is little evidence in the scientific literature with STEAM experiences in the Primary School in the FCL, this study presents the following objectives:

(1) To analyse the perception of mathematics learning through STEAM projects with robotics in 6th grade Primary School students.

(2) To find out the influence of the spaces of the FCL on the students when carrying out STEAM projects.

(3) To compare students' future career interests before and after a robotics experience.

2 METHOD

The method used is quantitative and descriptive of the data obtained through pre-test and post-test questionnaires. Between both questionnaires, an experimental phase is developed consisting of a STEAM learning situation of robotics for the area of mathematics in the FCL in students of 6th grade of Primary Education.

2.1 Sample

The educational centre where the sample was selected has a total of 47 students in 6th grade of Primary Education (K-12) in Ceuta (Spain) in an unfavourable socio-demographic environment, classified as difficult to perform. This centre has been awarded the FCL seal by the Spanish Ministry of Education to those centres with innovative and flexible spaces that carry out STEAM projects through active methodologies (INTEF). It has resources for initiation to robotics, that is robots with linear floors that are programmed from point A to point B. For this research, the school acquired 6 programmable robots called 'Vincibot' with different sensors (ultrasound, colours, sounds...) and actuators that can be attached to LEGO like construction pieces and carry out more advanced STEAM projects. Due to the limited number of robots, 12 students were randomly selected from the total number of robots, so that they could work on projects in pairs. The research team was present at the drawing of lots for the students, also on the condition that there was parity and to reduce research bias, 6 children of different sexes were selected to ensure gender equality.

2.2 Instrument

The instrument is a validated 20-item questionnaire (Jamieson & Finger, 2009) (Appendix A) that measures students' perceptions towards the use of technological tools such as robotics through STEAM disciplines and robotics in the area of mathematics in FCL spaces. This instrument was employed before and after the experimental phase using a likert-5 scale where 1- Strongly Disagree, 2- Disagree, 3-Neutral, 4-Agree and 5- Strongly Agree. In this case, based on the levels of validation and reliability of the questionnaire adapted to students K-12, which was translated by two expert translators. Subsequently, a quantitative evaluation of the original instrument was carried out by four experts in the field of STEAM education in Spain. For this purpose, Fleiss' Kappa and Kendall's W tests were performed, which were found to be correct ($K = 0.63$; $W = 0.83$) (Landis & Konch, 1977).

To know the impact of doing STEAM robotics projects in the FCL, the following question is added in the pre-test and post-test questionnaire; Do I like changing spaces and creation classrooms to do technology projects more than being fixed in the classroom? Students have the option of answering with Yes, No, the same or similar. Likewise, each student is asked to mention up to 5 professions that they are interested in pursuing in the future.

2.3 Procedure

This research has different phases. First, authorization to carry out a robotics STEAM project was requested from a primary school in the city of Ceuta (Spain) that had the FCL seal recognized by the Spanish Ministry of Education, which is currently available in the FCL website (INTEF, s.f.). In addition, this research was approved by the ethics committee under code 4498/CEIH/2024, in accordance with the recommendations contained in the Declaration of Helsinki on good research practices.

Following this, the pre-test questionnaire, the experimental phase and, finally, the post-test were carried out. The researcher and a teacher specialised in CT and ambassador of the FCL in Spain were present throughout the process. After collecting the data, they were entered into the Statistical Package for the Social Sciences (SPSS V_{25}) database. Once the database was set up, statistical analysis was carried out to obtain the results of the research through arithmetic means (M) and the standard deviation (SD) of the total number of students. Likewise, to check the ranges obtained in the pre-test and post-test results of the same groups, the Wilcoxon non-parametric test was used, as the sample was less than 30 (Berlanga-Silvente & Rubio-Hurtado, 2012).

The experimental phase of the research was carried out during non-teaching hours, which meant that a control group could not be included due to a lack of human resources to attend to this group. This phase consists of 15 one-hour sessions that include 7 learning activities with different challenges, students linked mathematical concepts such as turns, degrees, geometric figures, divisions, repetitions... with programming blocks such as loops, patterns and color sensors, distances... to finish making and presenting STEAM projects with VinciBot robots from Matatalab and LEGO pieces that they will end up presenting to their own classmates. This experience can be found on the Scientix website (Scientix, 2023).

3 RESULTS

The results corresponding to the first objective of the study "To analyse the perception of mathematics learning through STEAM projects with robotics in 6th grade Primary School students" by means of pre-test and post-test can be observed in Table 1.

Pre-test			Post-test		Difference
Items	M^1 (n=12)	SD (n=12)	M^2 (n=12)	SD (n=12)	(M^2 - M^1)
1	4.42	.793	4.33	.651	-.09
2	3.42	.669	4.00	.739	.58
3	2.17	.718	3.92	.793	1.75
4	1.92	.900	3.58	.900	1.66
5	2.00	.953	4.33	.778	2.33
6	3.00	.000	4.25	.452	1.25
7	2.67	.778	3.75	.866	1.08
8	1.33	.651	4.17	.577	2.84
9	3.25	.452	3.83	.577	.58
10	3.00	.953	4.17	.577	1.17
11	2.92	.793	3.92	.669	1.00
12	4.00	.853	4.33	.651	.33
13	3.08	.996	4.25	.754	1.17
14	2.58	.793	4.08	.793	1.50
15	1.92	.793	2.83	.577	.91
16	3.17	.718	3.67	.888	.50
17	3.00	.739	4.17	.718	1.17
18	3.58	.515	4.08	.669	1.50
19	2.75	.754	3.58	.669	.83
20	2.67	.492	2.58	1.165	-.09

Table 1. Assessment of STEAM in education
*Note. M= Means; ST= Standard deviation

Table 2 shows the results obtained in the pre-test and post-test of the participants (n=12) in the 20 questions, where no significant differences are observed, so it can be assumed that both groups are equivalent.

(n)	Pre.test	Post-test	Difference	Range
1	2.85	3.45	-0.60	2
2	2.55	3.55	-1.00	6
3	3.20	4.05	-0.85	5
4	2.85	3.65	-0.80	4

5	3.45	3.85	-0.40	1
6	2.35	4.25	-1.90	12
7	2.55	4.10	-1.55	11
8	2.70	3.85	-1.15	7
9	2.95	3.70	-0.75	3
10	2.85	4.10	-1.25	9
11	2.90	4.05	-1.15	8
12	2.90	4.35	-1.45	10

Table 2. Summary of hypothesis tests

After performing the Wilcoxon signed-rank test on the pretest and posttest results, a bilateral significance <0.05 is observed (Table 3), therefore, it is established that there are no differences between the measures of the scores.

	Null Hypothesis	Test	Sig.	Decision
1	The median of the differences in Pretest and Posttest is equal to 0	Wilcoxon signed-rank test for related samples	,002	Reject the null hypothesis.

Table 3. Summary of hypothesis tests

The results in Table 1 shows how the pre-test and post-test results improve considerably except for items 1 “The use of technological tools awakens my interest in the class” and item 20 “The implementation of technological tools offers me different ways of interacting with the teacher”, in which there is a slight decrease of 0.09 in both cases.

In addition, item 8 “The way in which technology is implemented in the classroom helps me to integrate the contents of the mathematics subject” is the item with the greatest difference of 2.84 points. Another item that exceeds 2 points in both tests is item 5 “The use of technology in this subject promotes my participation in the proposed activities” with a difference of 2.33 points.

Considering exclusively the results of the post-test, the items best valued by the students with 4.33 points are items 1 and 5 described above and item 12 which corresponds to “Technology helps me to prepare myself for my professional future”.

Only two items appear with an average rating below 3 points, which are item 15 with an average rating of 2.83 points “As a student I can select the technology that I think is most interesting or best suited to the subject matter” and item 2, previously described and the one with the lowest rating with an average of 2.58 points.

In order to know the results of the second objective “To find out the influence of the spaces of the FCL on the students when carrying out STEAM projects”, Table 4 shows that changing spaces had no influence on 8 of the 12 students to carry out projects, including 1 student who stated that he preferred the fixed classroom. At the end of the experience, 10 of the 12 students responded that they like to switch to the FCL spaces to carry out projects, only 2 students stated that they find these spaces the same or similar to the fixed classroom.

Do I like changing spaces and creative classrooms to do projects better than staying in the same classroom?	Pre-test (n=12)	Post-test (n=12)
Yes	3	10
No	1	0
Same or similar	8	2

Table 4. Question about projects in the FCL

The results obtained to answer the third objective “To compare students' future career interests before and after a robotics experience” can be seen in Table 5.

(Pret-test)	(Post-test)
STEAM Professions (n=5)	STEAM Professions (n=10)
Medical (n=3), Veterinary (n=2), Airline pilot (n=2), Engineer (n=1), Nurse (n=1).	Computer scientist (n=3), Doctor (n=2), Programmer (n=2), Architect (n=1), Engineer (n=1), Airline pilot (n=1), Veterinarian (n=1), Mathematician (n=1), Pharmacist (n=1), Scientist (n=1).
Non-STEAM professions (n=16)	Non-STEAM professions (n=12)
Police officer (n=9), Teacher (n=9), Firefighter (n=6), Cook (n=4), Military (n=4), Vehicle mechanic (n=3), Footballer (n=2), Interior designer (n=1), Painter (n=1), Stewardess (n=1), Fisherman (n=1), Cashier (n=1), Clothing designer (n=1), Lawyer (n=1), Ballet teacher (n=1), Waitress (n=1).	Police (n=5), Footballer (n=4), Cook (n=2), Military (n=2), Teacher (n=2), Gardener (n=1), Influencer (n=1), Singer (n=1), Nanny (n=1), Vehicle mechanic (n=1), Interior designer (n=1).

Table 5. STEAM and Non-STEAM professions interest.

After the experience, students' interest in STEAM professions increases in 5 professions, however, Non-STEAM professions decrease. Analysing each of them, before the experience the highest interest in professions were police, teacher, firefighter, military, cook, that is, Non-STEAM. The STEAM professions most valued before the experience were doctor (n=3) and veterinarian and airline pilot (n=2). After the experience, changes are observed, an increase in interest in STEAM professions, highlighting those that did not appear before the experience such as computer scientist, programmer, architect, mathematician or scientist, although a lower number of Non-STEAM professions such as policeman (n=5) or footballer (n=4), in this case the results are doubled.

4 DISCUSSION

Integrating from an early age STEAM projects through robots in the area of mathematics with learning activities in the FCL plays a crucial role in the transformation of traditional education by developing essential skills for the 21st century. This allows working on projects that interest and excite young people, which is aligned with innovative methodologies that promote more personalized and learner-centered learning to face the challenges of accessing the labor market in the future.

In relation to the first objective of the study “To analyse the perception of mathematics learning through STEAM projects with robotics in 6th grade Primary School students”, the results of this study at a general level determine that STEAM projects generate a greater appreciation by the students after the experience with basic knowledge in the area of mathematics using robotics, This is in line with the study by Ferrada & Díaz (2023) who also postulate programming and robotics as a motivational element for the learning of mathematics in students in the 6th grade of Primary School.

In the experience of this study, students use CT skills and abilities to program robots and perform specific mathematics tasks, which involves analysing situations, assimilating the complexity of the content, breaking down problems into smaller steps, identifying patterns and developing algorithms as seen in items 7 and 11, in line with the studies of Chiriac (2019), Kanematsu & Barry (2016) and Karyana et al, (2024), which consider these practices as a process that develops practical skills, fosters creative thinking in problem solving and promotes digital innovations in the teaching-learning process.

Items 5 and 8 of this study show that technology generates greater interest in participating in meaningful and formative activities proposed by the teacher and helps students to integrate mathematical content, despite the difficulty noted by Brender et al. (2021) in determining the alignment of educational robotics learning activities with the learning outcomes expected by the curriculum in K-12 students. However, the school where this experience took place had prior basic knowledge of CT, which could be a factor in item 1, where it did not elicit a greater degree of interest in the use of technology, with a brief decline after the post-test. This contrasts with the study by Sanchez et al. (2020) which points to the motivation that technology generates in students in this experience.

On the other hand, the way of implementing technology with robo- tics in the classroom helps students to use the knowledge acquired in the subject of mathematics in learning situations as shown in item 17, in accordance with the study by Molina et al. (2022) conside-ring that there is a significant improvement in CT skills after working with visual programming blocks similar to Scratch and it is considered a valuable resource for developing computational skills and innovative methodologies in Primary Education in the area of ma-thematics.

In relation to the second objective of the study, creative spaces influence students' tendency to carry out teaching-learning activities with technology, as Sánchez et al. (2020) point out. While the traditional classroom is the most known and used by students as seen in the assessment before the experience. In line with Blahová et al. (2013), the results of this study corroborate the fact that the FCL spaces are considered more attractive for students to carry out STEAM projects compared to traditional classrooms because these spaces are designed to encourage collaboration, creativity and the use of advanced technology, making students more involved and motivated in the activities offered to them as shown in the experience. But we must take into consideration González et al. (2022) who states that these spaces should not only be focused on technological exploration, but also present the challenge of reimagining and transforming educational practice, promoting interaction, experimentation, exchange of ideas and research.

If teachers lack skills and training in the pedagogical and curricular use of tools such as programming, robotics or artificial intelligence, this will have implications for students' future access to STEAM disciplines, as argued by Harris (2017). Similarly, as pointed out by Dúo-Terrón (2023), the use of makerspaces such as the FCL contribute to the development of integrated CT in the area of mathematics and digital competences of students working cooperatively and collaboratively. Therefore, the facilitated experience with robotics in this study offers a manipulative and hands-on approach in mathematics in the FCL. For the author, this fact provides an environment where students can learn by doing and involves multiple STEAM disciplines that promote interdisciplinary, motivating and playful learning according to Romero-Rodríguez et al. (2023).

In relation to the third objective of the study, the results of this study show that students have little knowledge and interest in occupations where STEAM disciplines play an important role. Professions such as programmer, engineer, architect, mathematician and scientist related to STEAM disciplines are included among the students after the experience. Likewise, it is worth highlighting the greater interest in occupations such as footballer, which could be due to external factors during the research, since access to and motivation generated by technologies vary according to the age, gender and socioeconomic environment of the students, the technological resources of the school and the training of the teaching staff, as pointed out by Dúo-Terrón et al. (2022). These results are aligned with the study by Bernate and Guativa (2020) and Marín et al. (2021) who point to learning situations that integrate STEAM disciplines, CT and teamwork as a fundamental training that promotes digital innovations that translate into a broader vision towards professions unknown to students and face the challenges of accessing STEAM fields.

Educational robotics allows students to discover and train students in a comprehensive way in their professional and personal lives in an increasingly digitised world as Amaya et al (2023) point out. The authors agree with the contributions of Espino et al. (2015) and García-Holgado et al. (2019), which indicate that the factors that influence the choice of science and technology careers can be identified and enhanced from an early age through STEAM disciplines.

5 CONCLUSIONS

Currently, and due to the influence of society and the digital economy, there is a growing need for professionals specialized in the STEAM field, in response to the progressive replacement of human labor by machines. This generates a growing demand for profiles such as computer scientists, programmers, systems engineers, project leaders... where mathematics is the basis for acquiring this knowledge. This approach through technology and specifically robotics, not only enriches the experience in the teaching-learning process in Primary Education, but also develops STEM and STEAM competences through the CT that students will need throughout their lives.

In relation to the first objective of the study, the conclusions extracted from the study are that working on STEAM projects with robotics has a positive influence on the perception of 6th grade Primary School students to work on basic mathematical knowledge. At the end of the experience, the students' assessment determines a greater significance between the learning of mathematical concepts through robotics with learning situations that they consider more attractive and favourable and that help them to show the knowledge acquired experientially in the subject of mathematics (items 13, 14 and 17). There is also a better perception of collaborative work among peers where the teacher acts as a guide. In relation to the second and third objectives, the use of spaces in the FCL to carry out STEAM projects with robotics in a transversal way influences the concerns and interests of students in accessing professions that are unknown to them, such as computer science, programmers, mathematicians, scientists or engineers. In addition, most of the students at the end of the experience consider that it is not the same to work in the traditional classroom as it is to work in transversal FCL spaces and with collaborative STEAM projects with technology, which generate greater interest among the sample. These spaces teach students to solve problems in teams, and to be critical and creative thinkers.

The limitations of this research on the application of robotics in FCL in Primary Education are that the sample is small, with 12 pupils without the existence of a control group. Moreover, this study focuses on a specific unfavourable socio-demographic context. While it is true that the learning situation is developed with an FCL ambassador, an expert in STEAM and educational robotics at this stage, specific resources and prior teacher training are necessary if this shared experience is to be replicated. Some schools and teachers may show resistance to change and to the incorporation of new technologies in the classroom due to a lack of familiarity or confidence in their effectiveness. Likewise, this study shows students' perceptions of a methodology with robotic resources used to work on mathematical content, without evaluating their academic results at the curricular level.

In this sense, future lines of research are related to the creation of specific learning assessment instruments to determine their impact on students at the curricular level. In this way, a quality teaching-learning process is guaranteed in accordance with the educational curriculum, which integrates CT in the area of mathematics in the Primary Education stage, with the aim of carrying out robotics tasks in the FCL that can support this experience and cannot be considered attractive results due to the novelty of the experience. On the other hand, to incorporate innovative methodologies that incorporate CT in the creative spaces should firstly focus on adequate teacher training in the spaces of the FCL. The methodology should integrate a progression of activities related to robotics and STEAM areas, that is, from the basics with unplugged activities to projects with programmable floor or construction robots that incorporate a variety of mathematical concepts.

Therefore, educational administrations should consider teacher training in STEAM disciplines in creative spaces such as the FCL due to the fact that these methodologies not only provide fundamental skills and competencies increasingly important in the digital society, but also prepares students for jobs in STEAM fields to access the labor market.

This is crucial in Primary Education in the framework of an Education Act that seeks to prepare students for an ever-changing world. Integrating these spaces, methodologies and educational resources prepares students not only with theoretical knowledge, but with practical skills that are valuable in the labor market and in everyday life.

ETHICS DECLARATION

This research was approved by the ethics committee under code 4498/CEIH/2024, in accordance with the recommendations contained in the Declaration of Helsinki on good research practices

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EXPLORANT LES DISCIPLINES STEAM AMB ROBÒTICA A L'AULA DEL FUTUR EN EDUCACIÓ PRIMÀRIA

L'objectiu de l'estudi va ser explorar les disciplines STEAM a través de la robòtica dins dels espais del Future Classroom Lab (FCL), que desafien l'aprenentatge de coneixements matemàtics en Educació Primària. El mètode utilitzat va ser quantitatiu i descriptiu, basat en dades obtingudes de la mitjana i la desviació estàndard a través de qüestionaris pretest i posttest, utilitzant la prova W de Wilcoxon per analitzar les dades, juntament amb una experiència educativa amb robots. La mostra estava formada per estudiants (n=12) d'11-12 anys. Els resultats i conclusions de l'estudi van mostrar que els estudiants tenen una percepció positiva de l'aprenentatge de coneixements matemàtics a través de projectes STEAM. A més, després de l'experiència, els estudiants prefereixen utilitzar els espais FCL per treballar en projectes STEAM abans que l'aula tradicional. Finalment, després de l'experiència amb robots, els alumnes van augmentar el seu interès per professions STEAM.

PARAULES CLAU: STEAM, Robòtica, Matemàtiques, Aula del Futur, Educació Primària.

ESTUDIO DE DISCIPLINAS STEAM CON ROBÓTICA EN EL AULA DEL FUTURO EN EDUCACIÓN PRIMARIA

El objetivo del estudio fue explorar las disciplinas STEAM a través de la robótica dentro de los espacios del Future Classroom Lab (FCL), que desafían el aprendizaje de conocimientos matemáticos en Educación Primaria. El método utilizado fue cuantitativo y descriptivo, basado en datos obtenidos de la media y desviación estándar a través de cuestionarios pre-test y post-test, utilizando la prueba W de Wilcoxon para analizar los datos, junto con una experiencia educativa con robots. La muestra estaba formada por estudiantes (n=12) de 11-12 años. Los resultados y conclusiones del estudio mostraron que los estudiantes tienen una percepción positiva del aprendizaje de conocimientos matemáticos a través de proyectos STEAM. Además, tras la experiencia, los estudiantes prefieren utilizar los espacios FCL para trabajar en proyectos STEAM antes que el aula tradicional. Por último, tras la experiencia con robots, los alumnos aumentaron su interés por profesiones STEAM.

PALABRAS CLAVE: STEAM, robótica, matemáticas, aula del futuro, Educación Primaria