Results of *playful STEM-promotion*: Software engineering career: Universidad Técnica Nacional, in 2022

Kattia Rebeca Rodríguez-Brenes[1], Ana Magali Salazar-Ávila[2] y Marielos Murillo Herrera[3]

[1] *Universidad Técnica Nacional (UTN), Villa Bonita, Alajuela, Costa Rica*
[2] *Universidad Técnica Nacional (UTN), Villa Bonita, Alajuela, Costa Rica*
[3] *Universidad Técnica Nacional (UTN), Villa Bonita, Alajuela, Costa Rica*

Abstract

Promoting equal opportunity participation in science, technology, engineering and mathematics (STEM) careers and programs in the underage population, especially at the school level, has been visible in recent years. This stimulation is fostered by the interest of institutions and by educational policies, in encouraging people at an early age, to be involved in these disciplines. To achieve this, it is necessary that the family nucleus, school, teachers and instances encourage them to aspire and choose STEM careers in the future. This paper shows the results of the execution and reflection phases of the "Playful STEM-promotion: an initiative to encourage STEM programs in primary schools", in 2022, developed by university students of the software engineering career of the Universidad Técnica Nacional (UTN), in two elementary schools located in the central valley. The results demonstrate the importance of gender sensitivity and social responsibility from elementary school with recreational activities, which would allow positive inspiration.

Keywords

Gender, educational game, social responsibility, volunteering

Actas XV Congreso de Mujeres Latinoamericanas en Computación 2023, 16 al 20 de octubre de 2023, La Paz, Bolivia

krodriguezb@utn.ac.cr (A.1); asalazara@utn.ac.cr (A.2); mmurilloh@utn.ac.cr (A.3)

ORCID: 0000-0002-7684-5769 (A.1); 0000-0003-1775-8689 (A.2); 0000-0001-6809-6780 (A.3)

1. Introduction

The issues of gender equality and opportunity in disciplines categorized as STEM (science, technology, engineering and mathematics) have been much more encouraged in recent decades, both locally and regionally [1], [3], [4], [5], with an emphasis on the underage population [2], [9]. In this sense, the approach of STEM careers allows the different areas of knowledge to be used [7], in promoting critical thinking in learners and simulating daily life, so that problems require to be confronted with different knowledge or fields of knowledge in order to find a solution. The last can be done by contextualizing training in skills such as creativity, adaptability, self-confidence, teamwork and decision-making [11]. Thus, it is possible relax the application of learning strategies in different areas, such as through games [8] and, then, for students to experience learning in a fun way by meaningfully and interactively understanding knowledge [12]. Those are spaces with equal opportunities for children [28] and their expression of isolated ideas (multidisciplinary) or integrated into the process of solving real problems (interdisciplinary and trans disciplinary) [13].

Studies indicate that despite efforts to reduce gender equity and opportunity biases in the choice of majors and professions [14], a marked underrepresentation [15] and inequality continue to be observed, mainly in the female population when compared to the male [16] and more so when choosing to study a major/career associated with STEM [20]. It has been shown that the existence and magnitude of these gaps often depend on gender stereotypes associated with specific situations and contexts [21]; that is, they are not natural differences: rather they are caused by external conditions [19]. These are situations that are framed from an early age in girls, and that are replicated over time, often due to prejudices, beliefs, and even cognitive ability factors [9].

As an example, the different types of leadership applied by men and women were analyzed, so that, while qualities such as autonomy or independence are considered requirements for leadership, for women with these characteristics, it can be observed that they are penalized for "transgressing" [22] the feminine stereotype of warmth and conciliation. This reinforces the need for more proposals to universalize access to education and promote equity for equal opportunities for students [23]. It is an opportunity to reach and maintain acceptable levels of learning [24], an initiative such as those proposed in the International Frameworks for Action, which emphasizes the application of strategies for equality in education, as well as proposals for change in the attitudes and practices inside and outside schools around maintaining an equal opportunity. [26]. As well as, at the same time, comparing with the policies developed in Latin America [18],[25], which potentiate the strategies and actions to reduce the gaps of gender inequality. [27]

This refers to the enhancement of work in equality and freedom because the teaching contents analyzed indicate that equity will only be achieved when women can access spaces traditionally labeled for men [6]. We must create awareness in that everyone (men and women) enjoy the same rights and, therefore, the same opportunities to build their professional future.

This study the real scope of the initiative of primary school children to participate in equal opportunities in the selection of STEM majors/careers, the strategies proposed through games and teaching activities that support their application and eventual benefits [17], the reflection on social work awareness and strengthening of skills in student volunteers [10] of the software engineering career at Universidad Técnica Nacional (ISW-UTN)

The structure of this article is as follows: session II identifies what has been worked on according to the implemented phases and explains the methodology applied to carry it out. In session III, the implementation of each of the activities carried out in each school is detailed. In session IV, the discussion of results is established. Session V marks the conclusion.

2. Proposed Methodology

The case study methodology includes: observation, questionnaires, interview and analysis. It favors putting into practice the selection of the group of university volunteers and their schools (primary school where some of the volunteers graduated), suggested by these same people, in order to apply the research.

The research consists of six phases, which has allowed, from the outset, the planning to determine that the promotion of STEM careers was through recreational activities, executed and directed by the ISW-UTN volunteer students themselves, and applied in two moments, each one in a different week. The methodology is also implemented based on Playful STEM-promotion [9].

Therefore, a convenience selection of schools and class groups was carried out. The young volunteers give back to their schools (preselected), what they learned during their training in higher education, creating and implementing activities with the children who are in the II Cycle of Costa Rica´s General Education. Figure 1 represents the process:

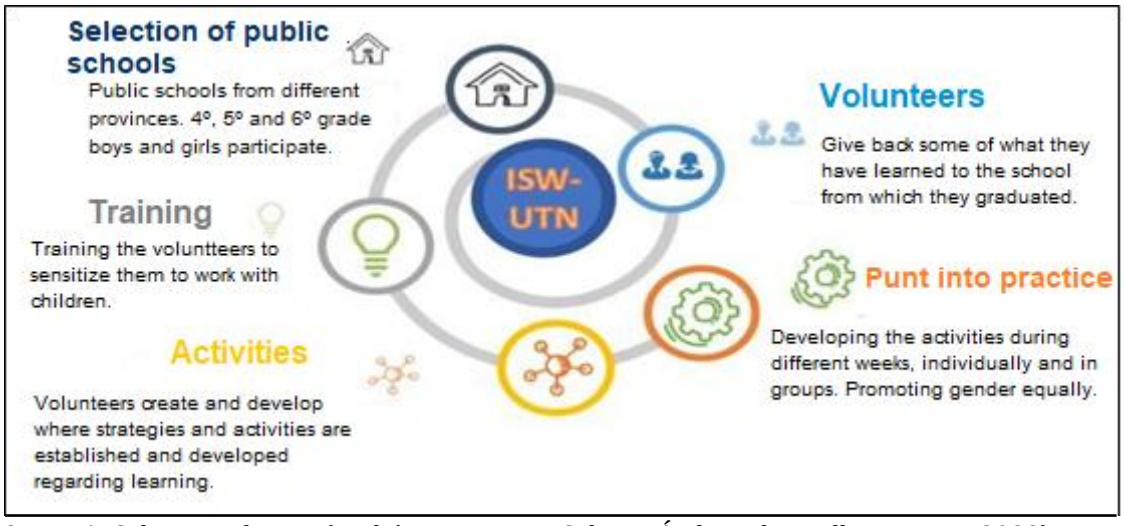


Figure 1: Selection phases. (Rodríguez-Brenes, Salazar-Ávila and Murillo-Herrera, 2023)

A description of how the entire process was developed to achieve the objectives of the research follows:

2.1. Participation of schools

The participating public schools are located, geographically, in Alajuela and Heredia; on this occasion, remote rural area schools were not chosen to further facilitate access, given the health provisions generated after the COVID-19 pandemic. A group has been chosen in each of the schools: both at sixth grade level, since it is necessary to read and write to understand and carry out the activities. At least two girls must also participate in the development of the second activity, which is carried out in teams separated by gender.

The corresponding request to carry out the activities in schools is in charge of the volunteer university students because they are going to present the proposal of the initiative and will deliver the documents issued by the UTN ISW major direction, to the direction of the school for its formalization and delivery. The schools´ administration is responsible for selecting the participating groups and the time to carry out the activities, taking into account the time of the strategies created by the volunteers in the two planned recreational activities.

In the same way, the teachers of the selected groups sent communications to parents or guardians of the students to inform them about the initiative to be implemented by the volunteers of ISW- UTN, within each school. With this, one of the points of the investigation is fulfilled, since it also considers involving parents or caregivers of minors to support the idea and give their children the possibility of thinking about studying a STEM career in the future.
Regarding the materials to be used in the different activities, it was coordinated with ISW-UTN staff. From the beginning it was arranged that most of the materials for the different activities be recycled, promoting what the university maintains in its statutes as an ecological university. Each group of volunteers developed a schedule of the different recreational activities for a better use of time and space. It is highlighted that when the activities were carried out, the country still maintained some sanitary restrictions due to the COVID-19 pandemic, such as distancing and the use of face masks. The volunteers who showed up at the schools complied with what was established in the different schools, such as: showing up 15 minutes before the class, reporting to the security guard at the gate, showing their ID, signing a record book for the time of entry and exit from the school, as well as hand washing and use of alcohol gel.

To ensure the confidentiality of the school, we will call them “School A” and “School B”, without indicating their geographical location, beyond the province (already specified).

2.2. Volunteer participation

In order to recruit student volunteers, several actions were carried out. The groups of students were visited in the classrooms/class laboratories, at different times, with the endorsement of the ISW-UTN management and the faculty to encourage them to participate in the schools that they attended. In order to meet the objective, some of the visits were virtual (platforms). A newsletter was shared, which was distributed through the institutional mail to the students of the career; in addition, the major´s social network was used and pamphlets were posted on the major´s information board.

The newsletter included a QR code, which redirected them to a digital registration form to expedite their registration. In it, they were asked about: opinion of the desire to participate as a volunteer and the possibility of returning to their own school a part of what they have managed to learn in public higher education, the responsibilities and obligations of being part of volunteering at the University, gender equality and equal opportunities, social responsibility, the dynamics with the children and why they chose to study a STEM career. The importance of the availability of time and the commitment required with the activities and the collection of information for the investigation must be emphasized.

At the same time, the ISW-UTN major direction also managed the official documentation necessary for the formalization and assurance of the commitment of the volunteering students, as well as the responsibility for the use of the information collected. In the end, the groups of volunteers were made up of two women and two men; some were finishing their diploma and others their bachelor´s degree, all between the ages of 23 and 27. Three of the volunteers were working in companies directly related to software and one was in the process of being recruited. All showed empathy with gender equality and opportunity, affinity for working with school children, volunteer work and their commitments.

Likewise, all of them participated in a prior training that was given on the dynamics of working with children, as well as the execution of playful activities in which STEM careers are promoted. The training was developed outside of work and university classes of the volunteers, for two weekends.

2.3. Trainers´ participation

In order to develop the training, three professionals (two women and one man) specialists in working with school age children and knowledgeable of STEM-STEAM strategies (the second group adds the academic discipline of Art) participated. Similarly, the trainers offered their work voluntarily. They shared teaching materials, interactive presentations, and dynamics for developing to exemplify how to work with children and recommendations for certain points of Costa Rican Law pertaining to minors, enforced in our country. In response, the participation of the volunteers was very active and they were very committed to the knowledge acquired thanks to the trainers over two weekends.

2.4. Development of activities

For the creation and organization of the activities, the volunteers had several weeks, as well as the support of the researchers, if required. Every activity created was reviewed and evaluated, in order to ensure compliance with the necessary characteristics indicated during the training. These were kept in custody, in order to strengthen the investigation. During the development of the activities in schools by the volunteers, one of the researchers was always present, in order to support, accompany and advise if necessary, without intervening in the dynamics, respecting the interaction and development of the activities, the collection and recording of the desired aspects of the investigation.

3. Implementation of activities

3.1. School A: first activity

The school is located in Alajuela. The focus group has 30 students, all children between 11 and 13 years old. The day the first activity is carried out; only 26 are present. Regarding the collection of study data and its analysis, they were obtained through: observation, application of questions to the focus groups, and materials developed in the playing activities by the children. The purpose was to recognize what they knew about STEM careers.

The organization established by the volunteers for the first session of activities was as follows:

1. Formal presentation of the volunteers: the teacher of the group introduces the volunteering student and comments that they were students at this particular school a few years ago and that they returned to do recreational activities, which invites to a moment of relaxation among everyone.
2. An activity to start the interaction with the children regarding the STEM topic: as an initial activity, they are asked: "What is STEM-STEAM?" At that time, the children "had no idea of the meaning," according to one of the volunteers. Therefore, the blackboard was used to broadly explain the acronym. Students are asked to recognize some people (family, friends or acquaintances) who work these careers. As well as being asked if they recognize an "influential" person who is recognized for having worked in one of these disciplines. There is real participation by indicating which family members work in certain professions. To better identify if the children understand what careers or professions are identified within those STEM-STEAM letters, they are requested to fold a blank sheet of paper into six parts. Each part will contain a letter of the acronym and a drawing like the one shown in figure 2, which represents one of the indicated careers. The details are noted on the blackboard:

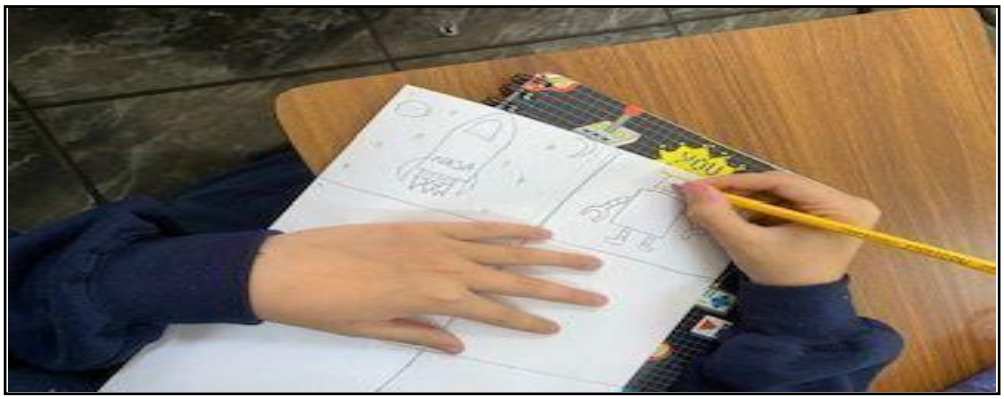


Figure 2: Activity: "Drawing STEAM careers". (Rodríguez-Brenes, Salazar-Ávila and Murillo-Herrera, 2023)

For this sample, it can be said that the children mentioned 9 careers. At the end, the volunteers comment that the drawings are quite accurate about careers or professions that are related according to each of the corresponding initial letters. Many of them are very skilled. It was possible to observe likes in careers of all kinds, both in women and in men. From being a musician, artist and designer, software engineer, mechanic, doctor and astronomer. In addition, the talent for drawing, communication, creativity, reasoning, and even the ability to entertain others are highlighted.

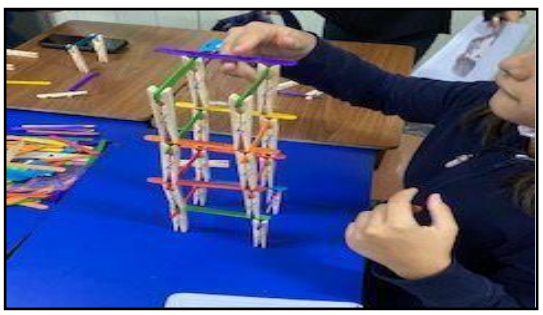
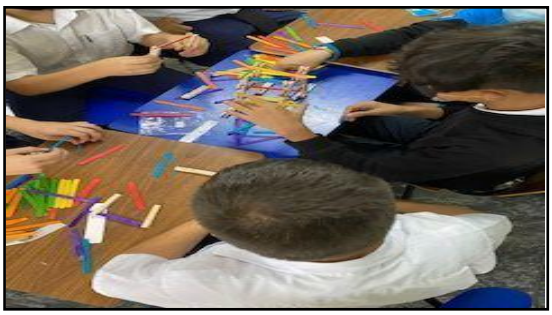
3. Activity to develop geometric shapes: the activity is presented with figures or 3D geometric shapes made on paper, in which a challenge to be solved with the figures is defined. For this, the theoretical concepts of figures are reaffirmed. They are told that they have different materials to assemble the figures and with time to complete the challenge. Subsequently, each of the children is given a figure and step-by-step instructions. Then, the volunteers indicate that the children were attentive to the explanation and showed curiosity in discovering how to resolve the situation presented. It stands out that the whole group found a solution with ease and complying with the established time; highlighting that the creativity of the students to find more than one solution was equitable.
4. Closing activity of the first session: with the closing activity, a space for reflection and conversation is generated, in which the volunteers ask the children to write, on a piece of paper, the majors of their interest. The papers were collected. Among what stands out about the girls is that there is a greater affinity with careers in health sciences, such

as medicine and its branches such as surgery, dentistry, nursing, pediatrics and veterinary medicine, in addition to wanting to be nannies. As well as in other areas such as fashion, graphic design, drawing, criminology, science, acting, investigation detective and music. As for boys, the most prevalent careers are engineering, such as industrial or software, technology, electronics, electrical and civil. And others like: mechanics, chefs, athletes, musicians, astronomers, geologists, lawyers, actors, doctors, designers and zoologists. More than 20 professions are counted, a figure that exceeds what was thought of at the beginning of the activity. It is clear, then, that the aforementioned majors and careers do not belong to a gender as such and that both a man and a woman can study any career with a STEM approach.

3.2. School A: second activity

For the second activity, as planned and developed by the volunteers, a small socialization activity is carried out and, later, groups of women and men (separated) are formed. The objective of the activity by gender is to identify the behavior of girls in this type of challenge.

1. Activity "The tallest and strongest tower": consists of each group developing a structure or "tower" made with wooden pallets. They will have to use clothes pins to support and join the pieces to the structure, as shown in figures 3 and 4, in which both groups work on the design of the tower. Each group was given the materials and instructions to create the tower. The tallest structure is the winner. In the same way, the importance of collaborative work is explained to them, as well as that each group participant assumes a different function. In this activity, the volunteers highlighted that the participation was equal between girls and boys, and that the competitiveness between them was noticeable, taking a look from afar or even up close, sometimes. The initiative that one of the girls in a group took when managing to build the tallest tower stands out, while her women classmates supported her in putting piece by piece in carefully. (Figures 3 and 4):

Figures 3 and 4: Groups (girls and boys separately) working on the design and construction of the tower. (Rodríguez-Brenes, Salazar-Ávila and Murillo-Herrera, 2023)

2. Closing activity: for the conclusion of this second activity, a time is given for opinions regarding teamwork, as well as sharing computational and critical thinking when developing activities. It is clear for the children that anyone is capable of developing any career or profession, whether male or female. In addition, the constant participation of the teacher in the school group is highlighted. She motivated and highlighted the talent of each child, and the importance of pursuing dreams: she encouraged them to improve themselves to become great people and professionals in the future.

3.3. School B: first activity

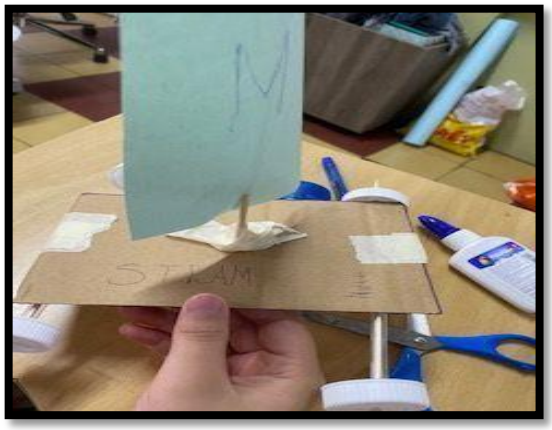
This school is located in Heredia. The focus group is also in sixth grade, made up of 32 children. At the time of the activity, there are 29 students (16 are men and 13 are women).

The organization established by the volunteers for the first session of activities was as follows:

1) Formal presentation of the volunteers and starting the interaction with the children regarding the STEM-STEAM theme: the teacher introduces the volunteers and comments that they were students from that same school and that they studied a career called software engineering. One of the children recognizes one of the volunteers, since they live in the same

community. The children ask them what they do in that major and a time is also given to explain what STEM-STEAM means. The volunteers begin the proposal by asking a question about what they would like to do when they grow up.

2) Activity on the challenge called "Car propelled by wind": it consists of formulating a situation or problem to be solved, in which the children must provide a solution. To clarify the idea, the volunteers explain some concepts such as: force, speed, distance and time to refresh important concepts of the activity. In addition, the rules and conditions of the proposal are established, each of the children is given the materials to be used and instructions are explained regarding the time to develop the challenge. The proposal consists of the development of a car propelled by wind, as shown in figures 5 and 6. The object must be transported from point "A" to point "B" without manipulation by children; only through the wind. When the cars are ready, each child will put their vehicle in a starting line and compete with the others to choose the fastest car:



Figures 5 and 6: Manufacture of the "car" propelled by wind. (Rodríguez-Brenes, Salazar-Ávila and Murillo-Herrera, 2023)

3) Closing activity: at the end, a conversation space opens in which the volunteers explain the relationship between the creation of the "vehicle" and the careers that are involved in the creation of real vehicles; for example, naval, software, mechanical and mechatronic engineering. Then, the children are asked if they know that the professions mentioned during the activity do exist. The purpose is for them to identify more possibilities of STEM careers to study in the future.

The group of volunteers left an extra activity: take the wind-powered car home to find out what their family members or caregivers think about STEM careers and, for the following week or second activity, to bring down the name of a woman and a man who stands out for his/her work in a STEM career.

3.4. School B: second activity

For the second activity, the socialization space is planned first. Subsequently, the volunteers request the assigned activity. The children should read the names of women and men who they consider have excelled in a STEM career, either in the national or international field. In turn, they are asked about the opinion of their relatives regarding the car propelled by wind and, spontaneously, they comment on what their relatives told them. They are told to work in groups (according to gender) to explain the indications of the activity.

1) Activity in groups of boys and girls: each group is given some colored cardboard to draw a person who reflects one of the careers within the STEM acronym. They are asked to draw a person with all the instruments that they consider necessary, as well as all the clothing that corresponds to the chosen profession, according to what each child considers appropriate. Subsequently, they are asked to show the drawing and to comment on the profession and if they consider that a woman can perform the same tasks that they proposed in the drawing. Thus, a reflection conversation is generated to find out what the children think.

2) Activity "Costa Rican women developing in STEM careers": in each of the groups, the volunteers show a dynamic and interactive presentation about Costa Rican women developing in STEM careers. Then, once the volunteer tells them what these women do as professionals,

among all children must try to guess, first of all, the name of the person.

3) Closing Activity: For the closing activity, questions are posed regarding equal opportunity to pursue STEM careers. In the group of girls, each one is asked to write a letter addressed to her for when she is older. The question, for everyone, is: "What would you like to say to the girl from the future?" Finally, a space for "brainstorming" is proposed since they already know better what STEM careers are and how they think they could help other girls fulfill their dreams of studying. The volunteers collect all the materials and evidence made by each of the children to analyze the responses together with the project researchers.

4. Discussion of results

Regarding gender equality and opportunity to study a STEM major, it was essential to know the points of view of the children through playing activities, the environment and the socioeconomic and demographic situation of the schools, and the opinion of the volunteers and teachers as promoters of positive inspiration:

- Regarding the number of children, there is a sample of 55 of them between the two schools, aged between 10 and 13 years old. Although the sample is less than 0.03% of the public schools that currently work in our country, it could be said that it reflects a part of the general situation of the schools, in which, by majority, groups of male students predominate over female students.
- Regarding the playing activities to promote STEM careers in schools, the most important is to plan socialization spaces ahead of time for when starting to work with these children. With this, positive causalities are achieved among all the members, which generate assertiveness with the children, according to their age characteristics.

Similarly, it is vital to establish from the beginning, the rules and the dynamics of each of the activities, including resources, places and times for their development. It is also essential that the activities present situations or problems similar to real life to generate the construction of knowledge and the expression of skills (see figure 7):

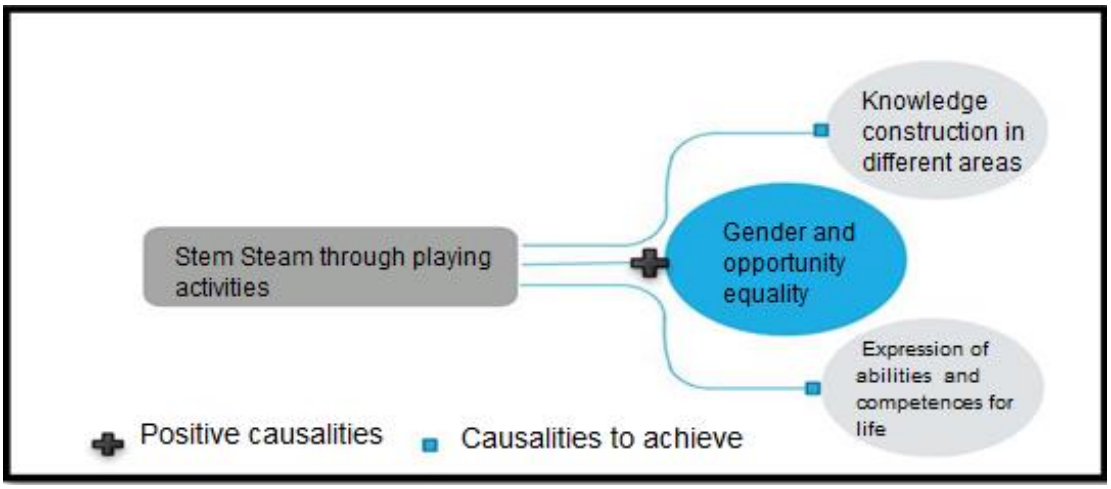


Figure 7: Positive causalities to be achieved. (Rodríguez-Brenes, Salazar-Ávila and Murillo-Herrera, 2023).

In the activity proposed at the beginning and at the end of the first session, it was suggested to mention STEM careers, as well as exemplify such disciplines. For example, commenting on relatives, friends or acquaintances who work in one of these professions. At the beginning, the result was between nine and twelve careers, but in the closing consultation, the disciplines associated with STEM in both schools doubled (from 20 to 24). Thus, the final perception is that both men and women can study majors in different fields of science, technology, mathematics and engineering.

The careers mentioned are in different areas, but in the case of girls, there was a 47% lean towards health sciences, technology and social sciences. Among men, careers related to engineering, technology and natural sciences predominated (53%) (See figure 8):

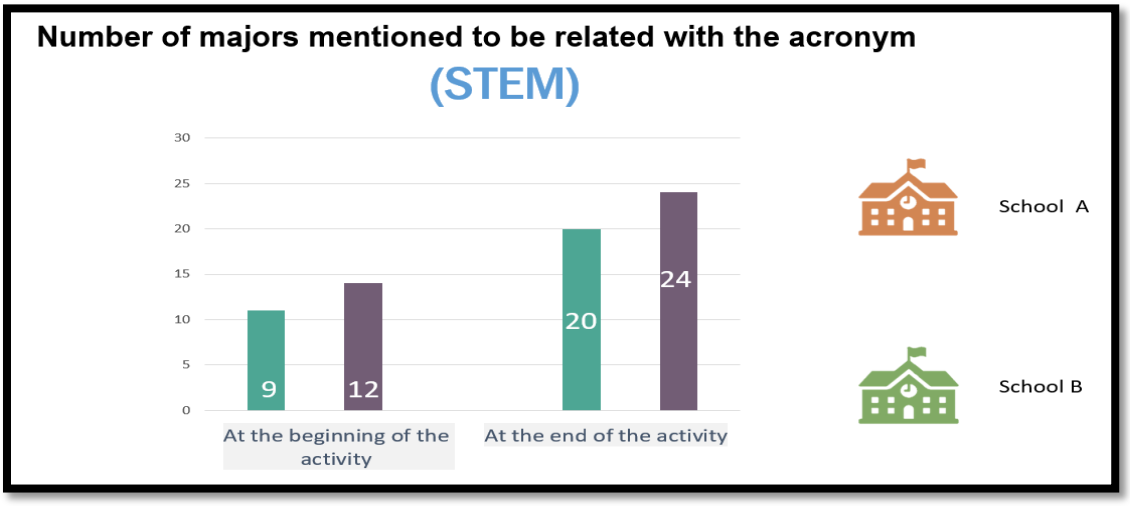


Figure 8: Number of STEM careers mentioned (initial and final activities) (Rodríguez-Brenes, 2023)

- Regarding the perception of gender equality and opportunity by children, during leisure hours outside the classroom (recess time), there was a small separation when playing because the boys played among themselves, just like girls. But inside the classroom the dynamic was different: when developing the first and second activities: in the group dynamic (men and women) there was a low level of participation of the girls from School A, who showed some uncertainty or waited to start participating. Even so, a high level of curiosity and interest in the proposal was denoted. As for School B, women showed, from the beginning, a high level of participation, they were more competitive and, at times, they assumed a leadership position when carrying out the activities. It must be emphasized that the number of women was less than that of men in both schools.
- Men considered that their classmates, just like them, can study any profession or major they like. Some of the girls still confessed to feeling fragile or weak, compared to their male peers; but, in the future they hoped to become strong and brave females.

Likewise, certain prejudices were manifested, perhaps unconsciously or traditionally and socially programmed from within the home (roles). Therefore, it is important to note that these type of activities allowed school-age children to know more about the multiple options to choose professions from and not only those that are usually or exclusively promoted for one gender or another (see figure 9):

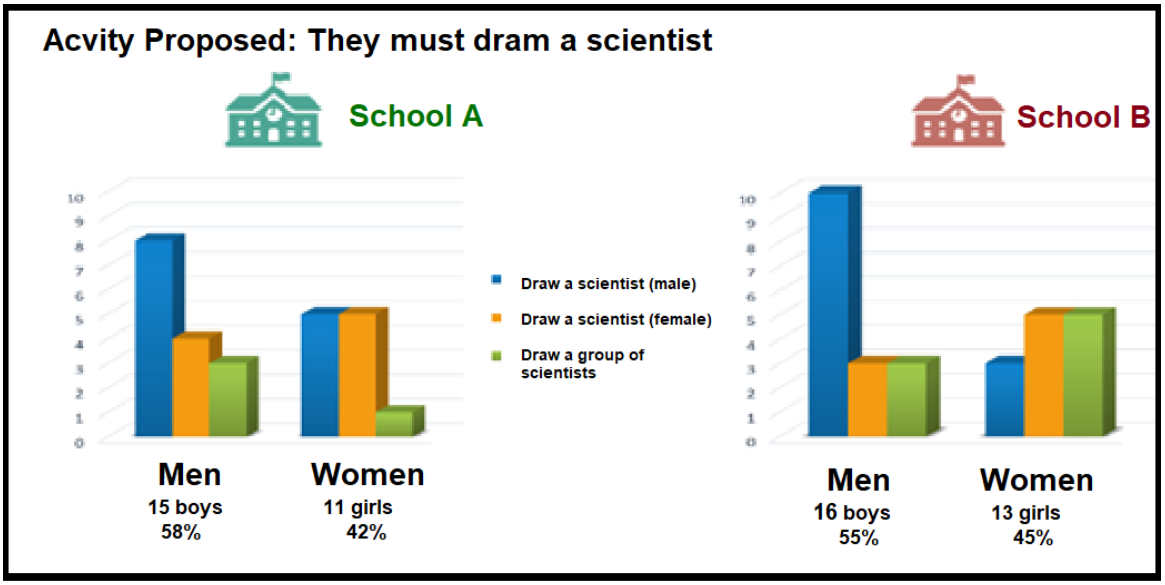


Figure 9: Results of the proposed activity (Draw a male scientist- motto in masculine, intentional) (Rodríguez-Brenes, 2023)

As can be seen, in the activity of drawing a male scientist (the slogan was intentionally

indicated in masculine), for School A, half of the boys and girls (13 out of 26) drew a (male) scientist, compared to those who drew a woman scientist or a woman and a man (the other 50%). It should be taken into account that in School A there are 3 fewer students (26) than in School B (29).

In the second group, the girls drew fewer male scientists than School A; but, taken together, men and women from School A (13) and from School B (13) outlined the same number of male scientists; again, consider that in School A there are 26 students and in School B there are 29.

It is noteworthy; however, that in the second school, all those who drew included more female scientists and professionals of both genders than in the first educational center. In addition, it is striking that in School B, the drawings of female scientists; both individually and within female-male pairs, correspond to 45%.

- Concerning the environment and socioeconomic and demographic situation of the participating schools, both are located in urban areas and in different provinces. School A is located in an area classified as medium-high, while School B is in a highly competitive area, economically speaking. Therefore, a discussion was generated in terms of analyzing that the location or the infrastructure could determine the forms of interaction of children when beginning to learn by playing.

- Referring to volunteers and teachers, as transmitters or motivators of gender sensitivity and social responsibility, and as promoters of positive inspiration, it is possible to affirm the following:

First of all, the volunteers indicated to have enjoyed the whole process, from the training received, the planning and implementation of the activities and the interaction with the children, as well as the fact of returning to the school from which they graduated. It could be considered that for the volunteers it comprises two processes: the symbolic and the affective one. The first is mainly linked to returning to the schools from which they graduated (place or site of their childhood) and to the classrooms they passed through, which represents a moment of joy and nostalgia. The affective process happens when being recognized by school personnel, teachers and by some children. The volunteers show a sense of satisfaction and being representatives or examples for those children, strengthening the importance of their projection before the community and society. They also commented that designing the activities did not cause them any difficulty since they were precisely looking for practical exercises related to the STEM concept and associated majors that would allow them to work on computational thinking or analysis from children

Secondly, in the same way, teachers and volunteers affirmed that the experience is important, for the community, society and institutions, since individuals are needed with the desire to make some positive change in the present or proposed communities because it is basically to have the opportunity to give back a little without expecting anything in return and helping others. Certainly, it is an experience that many in the university community and other institutions should live: a projection to society. Through volunteering, you influence society; and stereotypes and erratic biases can be fight against both about girls and boys, but especially about girls. Additionally, the experience stimulates the study of STEM careers, both in men and women, from an early age; finally, it is a channel to guide them to rethink the criteria for choosing a profession or trade in the future.

5. Conclusions

Next, the conclusions deal with: the perception of children, the participation and experience of the volunteers, the opinion and experience of the teachers of the schools, as well as the point of view of the researchers.

Regarding the perception by children, they do not show differences in the gender issue, in that, in the same way, they openly state that everyone can develop in the activity or profession that they like. In the activity in groups separated by gender, they showed being unaware of all the Costa Rican women presented in the activity; but the professions they performed seemed interesting to them, once the volunteers explained to them some of the achievements of these

women. This demonstrates the importance of disclosing and disseminating many more professions with their corresponding activities, which are possible professions to choose in the future.

Likewise, the girls commented that in movies or television series, the main character is always a man. The group of boys expressed that girls can carry out activities equal to them; a student stands out, who said that, sometimes, they wait for their classmates to join them in the activities to achieve them. That is to say, they do not show significant gender differences related to the activities carried out, beyond those that stand out to be perceived in the media or from their own daily life.

Regarding the participation and experience of the volunteers, the positive effect on the schools from which they graduated, the adjacent communities and society stands out. They stated that they felt useful and motivated by giving back to their school part of their knowledge. They also recognize how essential it is to strengthen the culture of social responsibility and encourage specific actions within the university community by developing as mentors.

Regarding the activities, they manifest the incidence of generating spaces "that make them think in a fun way", giving them a space for recreation and learning, which resonated more with the girls by enhancing their interest in accessing these STEM disciplines. Regarding the work developed for the investigation, they emphasize that it is essential to maintain communication and support with the researchers and the authorities of the major, which was fulfilled in this case and was decisive in the planning, implementation, and final review of the proposal.

Now, from each of the schools, both teachers, from their opinion and experience, agree that it is essential to promote environments that stimulate scientific careers and multiple areas of performance, both for boys and girls. In addition, they highlight the importance and the collateral and direct positive effects from the implementation of this type of activities, in the sense that there is also an approach of former students to their old school classrooms, but already as professionals in training, at the same time that they motivate the children and invite them to reflect on their futures. In addition, they point to the need to generate more environments free of prejudice or sexist behavior by the teaching groups, since they are the people closest to children in schools.

Regarding the point of view of the researchers, they agree with the teachers and the volunteers that many benefits are obtained thanks to this type of initiative, both for children and for student volunteers. The teachers have been struck by the fact that recreational activities favor aspirations for STEM-STEAM careers, particularly in girls, so it is transcendental, in the opinion of the teachers, to eliminate stereotypes in terms of developing activities, majors, careers, professions and even hobbies, exclusively according to a supposed gender determination that is patriarchal. At a general level, it should be clarified that the teachers identify and endorse a strong influence on the interest towards STEM careers for all people, men and women.

Undoubtedly, the execution of this type of academic initiatives demands time, planning, strategies, communication and logistics, since all aspects must be considered, such as: volunteer recruitment, the selection of schools, documentation for the applications and permits by the University and the schools. It means that this kind of initiatives means a great joint effort since it can be considered that of a total of 35 members of the major´s faculty, 9% have been concerned with developing volunteer activities to encourage SEM careers. Therefore, among the students, the participation and interest of young people in considering the project as part of their academic training have been paramount.

We must also add the sanitary restrictions that at a historical moment were being experienced in the world as a result of the COVID-19 pandemic and that limited, to a certain extent, activities in open areas.

Finally, a series of recommendations for future studies is established. Thus, in addition to the perception by children, volunteers, faculty and researchers, the knowledge and opinion of other specialists in pedagogy, psychology, guidance, educational administration, etc. could be integrated, for example.

It would be possible to question whether the conception of gender differentiation is established or fixed before, during or after the school stage. It would also be valid to delve into the degree of influence exerted by the media and entertainment, as well as social networks,

virtual reality or the environment in which children operate.

Regarding the academic area, it is possible to replicate the Playful STEM-promotion associated with STEM disciplines, both locally and regionally, and complement the playing activities in the classroom with exercises, since the new reality is the current coexistence in the global post-pandemic context, of course always respecting basic and complementary sanitary measures in schools, if applicable.

Research should continue to be promoted in fields of knowledge that are different from or complementary to education and Playful STEM-promotion, associated with gender equality and opportunity in STEM disciplines (science, technology, engineering and mathematics), increase interest in them, understanding that everyone, without distinction or negative discrimination of any kind, can choose to be and participate.

References

[1] Brecha de género en ciencia, tecnología, ingeniería y matemáticas (STEM): conocimientos actuales, implicaciones para la práctica, políticas y direcciones futuras. https://pubmed.ncbi.nlm.nih.gov/28458499/ (Gender Gap in Science, Technology, Engineering, and Mathematics (STEM): Current Knowledge, Implications for Practice, Policy, and Future Directions).

[2] UNICEF. La nueva agenda universal de desarrollo sostenible 2030. https://www.unicef.es/sites/unicef.es/files/triptico_ods_2015_imp.pdf, 2015.

[3] Arias, M., & Rodr, I. (2019). Experience of the I Workshop Women in Tech Occidente-Costa Rica. (WITO 2019): a study of undergraduate students. In Memorias de Congresos UTP (pp. 33-41).

[4] Andrea Delgado, Aiala Rosa, Claudina Rattaro, Andrea Viscarret, Lorena Etcheverry, Raquel Sosa, Mercedes Marzoa, and Ewelina Bakala. Promoviendo carreras de TICS en adolescentes de secundaria en Uruguay. In Congreso de la Mujer Latinoamericana en Computación (LAWCC-CLEI)-JAIIO 46 (Córdoba, 2017).

[5] Botella, C., López-Iñesta, E., Rueda, S., Forte, A., De Ves, E., Benavent García, X., & Marzal, P. (2020). Iniciativas contra la brecha de género en STEM. Una guía de buenas prácticas.

[6] Pallarès Piquer, M. (2019). Conquistar la igualdad: la coeducación hoy. Tendencias Pedagógicas, 34, pp. 1-4. doi: 10.15366/tp2019.34.001.

[7] Yakman G. (2008) Annual Proceedings: STE@M Integrated Science, Technology, Engineering, Arts and Mathematics. Curriculum published in Teaching Methods Website.

[8] Tejedor, Santiago; Recoder, María José y Pulido, Cristina. En Transformando la educación a través del conocimiento, José María Esteve Faubel, Aitana Fernández-Sogorb (Eds.) 2022.

[9] Rodríguez, I. Arias, M., Rodríguez, K., Coto-Sarmiento, L., & Murillo- Herrera, M. (2020). "Playful STEM-promotion": an Initiative to Encourage STEM Programs in Primary Schools.

[10] Saz-Gil, I., Gil-Lacruz, A., & Gil-Lacruz, M. (2021). El voluntariado universitario en el marco de la Responsabilidad Social Universitaria. Estudio de un Campus, Universidad de Zaragoza. Revista de la educación superior, 50(197), 41-58.

[11] Bustelo, M. & Vezza, E. (2020). Banco Interamericano de desarrollo BID. Habilidades del siglo XXI: Una oportunidad para la igualdad de género. https://publications.iadb.org/es/habilidades-del-siglo-xxi- una-oportunidad-para-la-igualdad-de-genero.

[12] UNICEF (2018). Aprendizaje a través del juego. Reforzar el aprendizaje a través del juego en los programas de educación en la primera infancia. Sección de Educación, División de Programas 3 United Nations, Plaza New York, NY 10017. https://www.unicef.org/sites/default/files/2019-01/UNICEF-Lego-Foundation-Aprendizaje-a-traves-del-juego.pdf

[13] Hsu, YS y Fang, SC (2019). Oportunidades y desafíos de la educación STEM. Prácticas de enseñanza STEM de Asia-Pacífico: de los marcos teóricos a las prácticas, 1-16.

[14] Sáinz, M.; Fàbregues, S.; Solé, J., y S. García (2018b), "Secondary school teachers' attitudes towards boys' and girls' achievement and study choices", Irish Journal of Educational Studies (en revisión).

[15] Ahlam Lee (2020) La asociación entre la educación en informática de las estudiantes femeninas y la selección principal de STEM: modelado de ecuaciones estructurales multinivel, computadoras en las escuelas, 37: 1, 17-39. doi: 10.1080/07380569.2020.1720553.

[16] Sáenz, C. (2021). Los sesgos de género siguen entorpeciendo que las mujeres se dediquen a ámbitos STEM. Universitat Oberta de Catalunya. https://www.uoc.edu/portal/es/news/actualitat/2021/270-STEM-genero-empleo.html.

[17] Ata Aktürk, A. y Demircan, H. O. (2017). A review of studies on STEM and STEAM education in early childhood. Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi (KEFAD), 18(2), 757-776.

[18] Brecha de género en ciencia, tecnología, ingeniería y matemáticas (STEM): conocimientos actuales, implicaciones para la práctica, políticas y direcciones futuras. https://pubmed.ncbi.nlm.nih.gov/28458499/ (Gender Gap in Science, Technology, Engineering, and Mathematics (STEM): Current Knowledge, Implications for Practice, Policy, and Future Directions).

[19] UNESDOC. (2022) Cuestionar los sesgos y estereotipos de género en la educación y a través de ella. Equipo del Informe de Seguimiento de la Educación en el Mundo [935], UNESCO [65950]. Código del documento:ED/GEM/MRT/2022/FS/G/1. https://unesdoc.unesco.org/ark:/48223/pf0000380827_spa.

[20] Hom, E. (2014). What is STEM education? Live Science. http://www.livescience.com/43296-what-is-stem-education.html.

[21] Arredondo-Trapero, Vázquez-Parra y Velázquez-Sánchez (2019). STEM y Brecha de género en Latinoamérica. https://www.scielo.org.mx/pdf/rcsl/v9n18/1665-899X-rcsl-9-18-137.pdf.

[22] Bustelo, M. (2020). Brecha de género en las habilidades del siglo XXI. Banco Interamericano de Desarrollo BID. Habilidades del siglo XXI: Una oportunidad para la igualdad de género. ¿Empatizas o compites? https://blogs.iadb.org/igualdad/es/habilidades-para-el- mercado-laboral-siglo-xxi/.

[23] Sáinz, M., Meneses, J. (2018) Brecha y sesgo de género en la elección de estudios y profesiones en la educación secundaria. Panorama Social Número 27 (primer semestre). https://www.funcas.es/wp- content/uploads/Migracion/Articulos/FUNCAS_PS/027art03.pdf.

[24] UNESDOC. Dakar framework for action, education for all: Meeting our collective commitments. Technical report, World Forum on Education, 2000. https://unesdoc.unesco.org/ark:/48223/pf0000121147_spa.

[25] Alicia García-Holgado, Amparo Camacho Díaz, and Francisco J. García- Peñalvo. 2019. Engaging women into STEM in Latin America: W-STEM project. In Proceedings of the Seventh International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'19). Association for Computing Machinery, New York, NY, USA, 232–239. https://doi.org/10.1145/3362789.3362902.

[26] Rae Condie, Alastair McPhee, Christine Forde, Jean Kane, and George Head. Review of strategies to address gender inequalities in Scottish schools. Technical report, Scottish Executive Social Research, 5 2006.

[27] Políticas de educación y equidad de género: estudios sobre políticas educativas en América Latina UNESCO Office Santiago and Regional Bureau for Education in Latin America and the Caribbean [162], Laboratorio Latinoamericano de Evaluación de la Calidad de la Educación.

[28] Ministerio de Ciencia, Tecnología y Telecomunicaciones. (2017). Política Nacional para la Igualdad entre mujeres y hombres en la formación, el empleo y el disfrute de los productos de la Ciencia, la Tecnología, las Telecomunicaciones y la Innovación 2018-2027. https://www.micitt.go.cr/wpcontent/uploads/2022/04/pdf.pdf.