INVESTIGATING POTENTIALITIES OF FLL (FIRST LEGO LEAGUE) COMPETITION IN SCHOOL LEARNING PROCESS OF BASIC EDUCATION STUDENTS

INVESTIGANDO POTENCIALIDADES DA COMPETIÇÃO FLL (FIRST LEGO LEAGUE) NO PROCESSO DE APRENDIZAGEM ESCOLAR DOS ESTUDANTES DA EDUCAÇÃO BÁSICA
INVESTIGACIÓN DE LAS POTENCIALES DE LA COMPETENCIA FLL (FIRST LEGO LEAGUE) EN EL PROCESO DE APRENDIZAJE ESCOLAR DE ESTUDIANTES DE EDUCACIÓN BÁSICA

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ABSTRACT:
This work addresses the use of the educational robotics as learning tools. The paper aims to evaluate the possible contributions of the First Lego League (FLL) robotics competition to develop students knowledge and required skills for good professionals. To achieve the research objective, this article presents a study that provides objective data based on the opinions of teachers and students that participated of the FLL. The data analysis strongly indicates that both teachers and students believe in FLL potential to promote school performance and the development of the skills of a good professional.

KEYWORDS: Communication; Science; Higher Education; Advertising; Government Advertising.

Introduction

With the insertion in a highly globalized and increasingly connected world, we live today the concept of the information society in which computers, cell phones and other technological items are inserted into people's daily lives, changing the way we behave, relate to each other and live in society. These changes, whether social, cultural, or technological, directly impact the school environment, bringing the need for updates in teaching processes and methodologies, demanding from schools and students themselves, future professionals, the need for training in new types of knowledge and skills

In a society where information was once restricted, professionals were required only the content (data) and logical reasoning to perform their activities. Today, a range of skills such as creativity, scientific thinking (research), problem-solving, communication, and teamwork are additionally required and, in a context in which this knowledge is available, these skills are justified by the need to perform increasingly complex activities.

The use of educational robotics has been a growing tool in basic education schools, in the same way, the discussions in the scientific community about its real benefits in the school environment and in the students' learning are increasing. In this trend, several tournaments have been trying to motivate and contribute to the students' education, promoting, through competition, the practice of educational robotics. In these tournaments, a favourable environment is created, based on real experiences and problems, for the formation of students in the creation of solutions mediated by experimentation, research, communication, and teamwork.

The First Lego League (FLL) is one of the most famous educational robotics tournaments in Brazil. It is an international competition that, through thematic problems, challenges students to develop applicable and innovative solutions using robotics, science, and technology.

The authors of this article are coaches of teams that have been competing in the FLL for at least three editions and, in this environment that blends teaching and research, they have noticed signs of improvement in the learning and development of skills and competencies (technical, scientific, social, and emotional) in their student competitors, probably driven by their participation in the competition.

After identifying the possibilities of the relation between the educational robotics competition and the competitors' school learning, this research sought to evaluate the possible contributions of the FLL competition to the school performance of basic education students and the formation of the necessary skills for these future professionals. To accomplish this goal, teachers (technicians), mentors (former students, parents, among others) and students who participated in this tournament were asked, by an electronic questionnaire, what their perceptions were about the competition, and if they perceived progress in the learning process and the formation of the competing students.

The challenge of improving education for the future of the Brazilian students' and society's

The speed of the changes that occur in today's world requires that students and future professionals develop differently. In a world where information and technological tools are abundantly available, an essentially content-based education can no longer fulfil the purposes of the educational process. We currently live in what Resnick (2007) called the "society of creativity", with professions and activities that are increasingly diversified, based especially on problem-solving, and that requires creativity. To succeed in this new reality, students must learn to think creatively, in addition to developing

communication, planning, and critical analysis skills, as well as collaboratively acting (CAMPOS, 2017).

Therefore, education must be designed to encourage students to develop abilities and acquire knowledge that will be necessary for their citizenship formation and in their respective professional paths, is important to understand (or prospect) what these skills are. Accordingly, the World Economic Forum (WEF) has listed these skills for the future: (i) innovation; (ii) critical and analytical thinking; (iii) creativity; (iv) originality; (v) initiative; (vi) complex problem solving; (vii) emotional intelligence; (viii) teamwork, leadership, and social influence; (ix) programming, systems analysis, and evaluation; and (x) technological design (SCHWAB; SAMANS, 2018). More current and appropriate methods to foster learning are therefore needed, and active learning methodologies (and derivations of these, such as project-based teaching, competency-based approach, problem-based learning, as well as scientific learning) may be the key to a more efficient education, making it possible to develop these competencies.

In American elementary schools, there is a growing interest in the teaching of engineering projects (technological design) and problem-solving. According to the New Generation Science Standards (NGSS), the technological design required for the next generations will demand from professionals the same level of development as scientific research. Therefore, scientific thinking takes a leading role in the development of these necessary skills (BYBEE, 2013).

It is in this scenario that educational robotics (RE) and robotics tournaments present themselves as viable tools to help develop these skills, and good results have been identified when inserted into the daily routine of basic education.

Educational Robotics (RE) as a tool in the learning process

For Papert (1994), the use of technology is fundamental in the teaching-learning process. According to the author, technological resources have an inherent innovation that expands the capacity for reflection and participation of the subjects involved, changing the perspectives on the teaching and learning processes. In this sense, the use of robot-based technologies as a didactic tool in the classroom, known as Educational Robotics or Pedagogical Robotics, is one of the methodological models that has been growing in academic circles, being widely used as a field of research and educational practice. César (2013) defines RE as "[...] the set of processes and procedures involved in

teaching and learning proposals that use robotic devices as mediation technology for the construction of knowledge" (p. 55, translated from the original)1.

The concept of RE can be translated as the process of producing a more attractive learning environment, through the creation of playful activities with questions to be solved by the students, who must design a robot (physically assemble it) using scrap or didactic kits, and program it to perform some tasks. These concepts are directly linked to the processes of active methodologies, which are project-based, and the culture of "learning by doing". RE also encourages transdisciplinarity and awakens the creative and autonomous development of those involved to deal with everyday situations, increasing the motivation for learning (CAMPOS, 2017).

In this way, several initiatives have been carried out to encourage RE, such as fairs, congresses, and tournaments/competitions, the latter of which have achieved greater student engagement. In Brazil, several tournaments with the RE theme are held, especially the Brazilian Robotics Olympics (OBR) and the FLL (First Lego League). In this study, the focus will be on the FLL and the next section will introduce the reader to how this competition is organized.

The First Lego League (FLL)

The FLL is an international tournament sponsored by a partnership between FIRST® and LEGO®. In the competition, teams of students ages 9 to 16 engage in research, problem-solving, coding, and engineering by building and programming a LEGO® robot that navigates missions in a robot game (FIRST LEGO LEAGUE, 2020).

The tournament is held annually and welcomes teams consisting of two to ten members, each team is guided by at least one coach. The teams can also include mentors, usually former competitors. The mentors, as well as the coaches, have the function of guiding the student teams and do not act directly in any of the competition stages. The students are the competitors, and this is how they will be identified in this article.

The competition is designed to contextualize current societal issues and all modalities must address these themes. For example, the theme of the 2019/2020 competition was City Shaper2, which proposed the use of technology and robotics to solve real problems arising from urbanization present in large cities around the world.

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1 From the original: "[...] o conjunto de processos e procedimentos envolvidos em propostas de ensino e de aprendizagem que utilizam os dispositivos robóticos como tecnologia de mediação para a construção do conhecimento" (CESAR, 2013, p. 55)
2 To learn more about the theme discussed in this edition of FLL, access: http://www.portaldaindustria.com.br/sesi/canais/torneio-de-robotica/city-shaper-20192020/.

The entire competition process takes about 12 months, usually starting between August and September of one year and ending in July of the following year (following the North American and European school calendars).

Divided into regional, national, and international phases, the tournaments are competed sequentially, with one stage serving as a selection for the next. The regional tournaments involve about 30 teams per region. The winning teams from the regional stages participate in the national stage (on average 50 teams). The international stage is the end of the season and takes place in different locations around the world, with the participation of the winning teams of the national tournaments, involving approximately 80 teams.

In the period between the launch of the season and the regional stage in which the team registers, there is the training and preparation period for the competition, when the teams develop the innovation project, assemble and program the robot to perform the missions on the competition table. Unlike other traditional robotics competitions, in addition to the robot challenge, FLL evaluates the teams on their innovation project, robot design, and Core Values. Each of these steps is briefly described in Table 1.

Table 1. FLL evaluation steps (reference 2019/2020)

Innovation Project/ Research	The phase of the tournament is in which teams are challenged to identify problems within the competition theme and create an innovative solution.
Robot Challenge	Team members must design, assemble, and program autonomous robots to accomplish a set of tasks and missions.
Robot Design	Stage in which the teams are evaluated regarding the construction process of the robot that will be used to meet the challenge.
Core Values	Evaluation of the values adopted by the competitors throughout the competition: teamwork, inspiration and professionalism.

Source: Elaborated by the authors

It is important to point out that in the Innovation Project/Research stage, the process of developing the solution must be carried out considering the steps of scientific methodology. This stage, therefore, makes the competitors feel like a scientist. Competitors are evaluated based on the sources of information used and the identification of existing solutions. From there, the innovations and the sharing of the solution developed by the team are evaluated.

In the Robot Challenge stage, it is important to note that the tasks and missions, as well as the competition table itself, are contextualized with the theme of the competition. The robot to be developed does not need to simply push a button or carry a block. All tasks are contextualized so that, simple activities (like carrying a block) become important actions in their relation to the theme of the season. In the 2018/2019 edition, for example, with a focus on space themes, blocks represented rocks and materials to be collected for analysis on a lunar surface.

In the Robot Design stage, the technologies applied by the team to solve the challenge are evaluated. The following subcategories are considered: mechanical design, strategy/innovation, and programming. In short, the quality and constructive functionality of the robot is evaluated, as well as the team's ability to demonstrate "what was done" and "how it was done" during the evolution of the work until its final project.

The Core Values stage is one of the main pillars of the competition, encouraging the competitors to collaborate and help others, as well as stimulating fun in the competitive process. Compared to other educational robotics tournaments, this is one of FLL's main distinctions.

The First Lego League (FLL) as a tool in the process of training the competitors

The FLL competition is shaped so that the competitors can exercise and stimulate curiosity, imagination, and autonomy. This practice has the potential to foster a fertile environment for the learning process of these students, as well as to awaken their interest in technology, engineering, science, and mathematics.

When evaluating FLL per the concepts advocated by Jacques Delors (1998), we can identify the author's ideas in the development process of the competition; at all times, the competitors are encouraged to seek information and perform the tasks in the different stages of the competition. In addition, the Core Values addressed in FLL also strengthen the coexistence and personal development of the competitor, aligned with the four basic pillars of education for the 21st century, proposed by Delors (1998): the subject must learn to know, learn to do, learn to live together, and learn to be, all of them interconnected.

In parallel, the active participation of the competitors during the stages of the competition is encouraged. At all times, the competitors are called upon to carry out experiments and group research and to develop their reasoning to solve the proposed problems. Thus, we can relate the FLL model to Piaget's studies (BRINGUIER; PIAGET, 1989).

The robotics kit (with LEGO® pieces, controller, and programming) used by students in the competition can be considered a cognitive artefact, as suggested by Papert (1994). According to the author, the competitors use these artefacts to explore and express their ideas, besides understanding that the student, using technologies, discovers and explores knowledge, overcoming the pedagogical technicism.

We can also correlate FLL with the thoughts of educator Paulo Freire (2002). According to Freire's theory, we can identify in the practices adopted by FLL a permanent care for teamwork to be based on ethics, respect for dignity, and the student's autonomy. The formation of the competitor during the stages of the competition goes beyond the simple training of the student for the performance of skills; in the competition, as proposed by the author, the critical capacity and curiosity are instigated in all stages of the tournament, demanding from the competitors an active posture towards the problems and issues posed by the event.

When evaluating the possible contributions of FLL in the students' education, in terms of evolving the necessary skills for the future (SCHWAB; SAMANS, 2018), we can highlight, for example, relevant contributions to the development of programming skills, systems analysis and evaluation, and technological design, inherent mainly in the stages of Robot Challenge and Robot Design. This progress is justified, since the competitors have the task of designing, assembling, programming, and developing a robot that can perform tasks, which makes the students practically exercise such skills.

Furthermore, creativity and complex problem solving are other skills developed in the process of designing and programming the robot to perform the tasks. In the Innovation Project/Research stage, the competitors are required to use scientific thinking to develop an innovative solution, and it is up to the competitors to do all the research using the scientific method. In this way, this stage can sharpen skills such as innovation, critical and analytical thinking, creativity, originality, and complex problem-solving.

A differential of the FLL competition is precisely the assessment of the Core Values stage. Here, the purpose is to encourage collaboration among the competitors, seeking an environment that encourages teamwork, which allows the development of leadership skills and social influence.

Methodological procedures

To fulfil the goal of this research, an exploratory and descriptive study was carried out using an online questionnaire, which was addressed to FLL participants from different teams in Brazil, containing 14 objective questions divided, preliminarily, into nine

categories. The categorization was derived from the discussions brought up by the theoretical references selected for this research, as follows:

1. students' motivation to learn;
2. development of programming concepts;
3. development of the concepts of research methodology and scientific thinking;
4. creativity development;
5. contribution in problem-solving thinking;
6. teamwork development;
7. sharing spirit and contribution development;
8. development of communication skills; and
9. contribution to the professional future.

The questions sought to analyze the perception of the interviewees concerning the FLL competition and were made in the affirmative form, with the response on a Likert scale ranging from 1 to 5, as follows: 5 (totally agree), 4 (partially agree), 3 (neither agree nor disagree), 2 (partially disagree) and 1 (totally disagree).

The survey was answered by 201 people, being 41 coaches, 17 mentors, and 143 competitors. The survey was disclosed to teams participating in the last FLL tournaments, national phase in Brazil (2018/2019/2020), through contact via email, messaging apps, and social networks, and the list of teams was obtained with the organization of the event itself.

The e-mail sent by the researchers contained the formal invitation to participate in the research, the Informed Consent Form (ICF) and the Informed Assent Form (IAF), as well as the link to the online form for the participants. The questionnaire was available for responses from May 11 to 28, 2020.

The gathered data was organized and evaluated utilizing graphs from which evidence of the benefits brought by FLL to student development was identified. The next section will present the data and the analysis carried out by the researchers.


Data Analysis

To analyze the information contained in the electronic form, the categories were analyzed separately to identify possible relations between the results.

Addressing the **students' motivation for learning** category, the following statement was presented to the student competitors: *"During the competition process, I had to SEARCH FOR KNOWLEDGE IN OTHER DISCIPLINES (for example, mathematics and science in general) to improve the robot's performance and to develop the research project"*; and to the coaches and mentors: *"I noticed in my students, motivation to*

SEARCH FOR KNOWLEDGE IN OTHER DISCIPLINES (for example, mathematics and science in general) to improve the robot's performance and to develop the research project".

According to Figure 1, it can be observed that the competitors were instigated by the competition processes (either by assembling and programming the robot or in the research project) to study contents beyond robotics, and the same understanding was evidenced in the answers of the mentors and technicians. In the assembling of 201 respondents, only three said they neither agreed nor disagreed, or that they partially disagreed.

Figure 1. Percentage of responses regarding the contribution of FLL in the development of motivation for learning
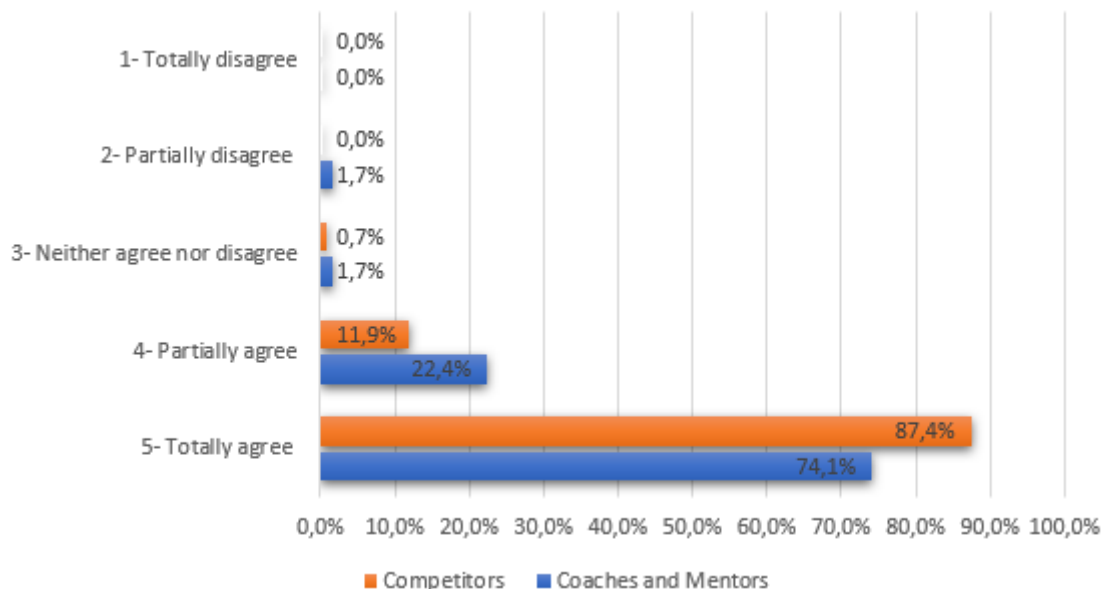
Source: Elaborated by the authors.

In order to verify the **development of programming concepts** in the students, the following statement was presented to the competitors: *"My participation in the FLL contributed for me to learn (or improve) concepts and practices that involve PROGRAMMING";* and for the mentors and coaches: *"I noticed that my students learned (or improved) concepts and practices that involve PROGRAMMING due to the competition".* Figure 2 shows the percentages evidenced by the questionnaire.

Figure 2. Percentage of responses regarding the contribution of FLL to the development of computer programming skills
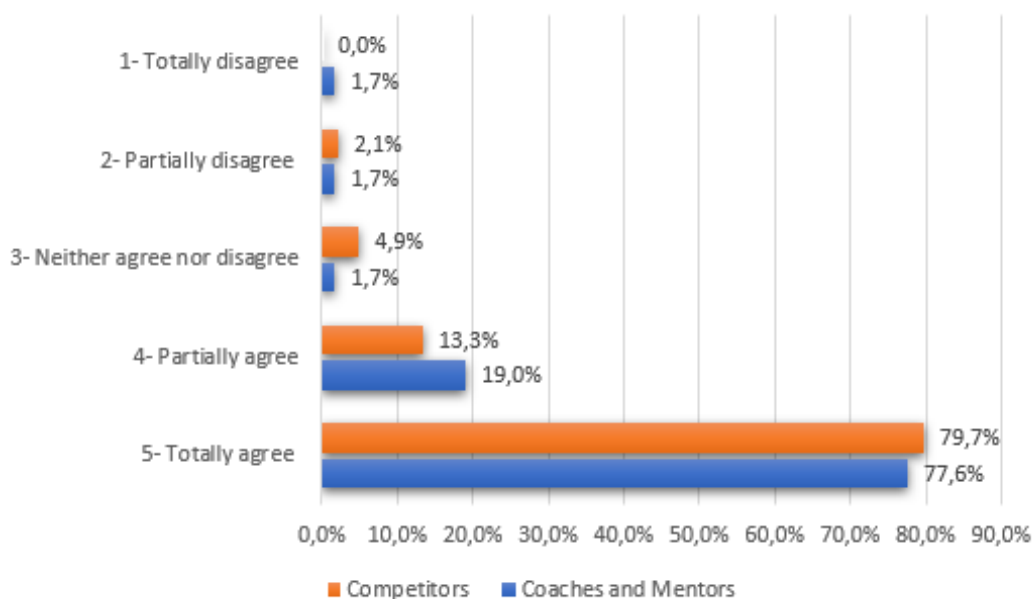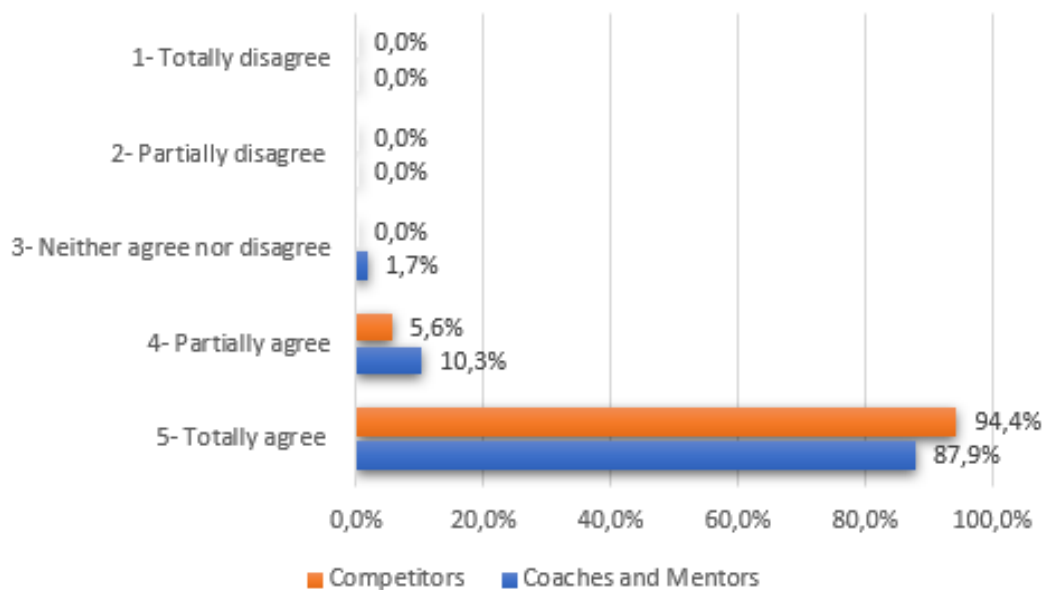
Source: Elaborated by the authors.

It can be observed that in both categories, participants develop computer programming-related skills by participating in the competition. This finding is based on two possibilities: (i) the fact that many of these competitors have their first contact with something close to computer programming from the participation in existing robotics projects in schools; and (ii) the fact that they develop knowledge in the area of programming due to the need to program the robots to accomplish the missions on the competition table.

To ascertain the **development of the concepts of research methodology and scientific thinking**, the following statement was presented to the competitors: *"To develop the innovation project, I had to RESEARCH a lot about the theme, look for THEORETICAL REFERENCES in books and on the internet, as well as research about other similar solutions"*; and for the coaches and mentors: *"About the innovation project, my students had to RESEARCH a lot about the topic, search for THEORETICAL REFERENCES, as well as research about other similar solutions to propose an innovation project, developing in them the skills of Research Methodology"*. Figure 3 graphically presents the participants' answers.

Figure 3. Percentage of answers regarding the contribution of FLL in the development of the concepts of research methodology and scientific thinking
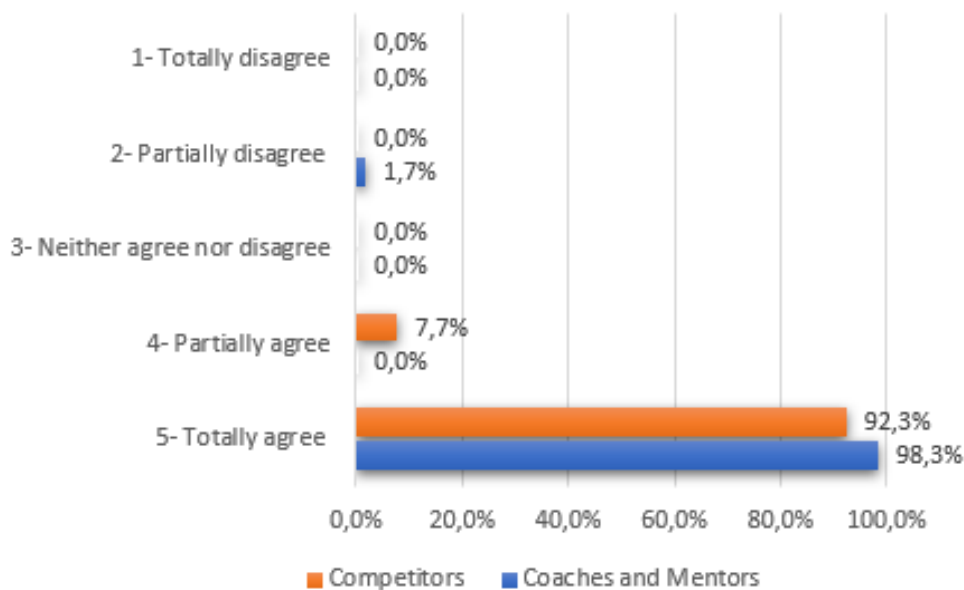
Source: Elaborated by the authors.

According to the analysis, the answers suggest that the competition format promoted by FLL, through the innovation project, makes the competitors learn and develop the methods to conduct formal research. A good FLL innovation project requires the team to delimit the problem to be solved, to search for good sources of information to validate the solution proposal, to find pre-existing solutions, and to present the costs of developing the team's proposal, among other characteristics.

To evaluate if the competition brought **creativity development** for the students, the following statements were made: for the competitors: *"I had to use my CREATIVITY to solve certain problems in the robot conception and programming stage and also in the development of the innovation project"* and; for the coaches and mentors: *"The competition encourages the students to use their CREATIVITY to solve problems in the robot conception and programming stage and also in the development of the innovation project"*. Figure 4 presents the responses obtained.

Figure 4. Percentage of answers regarding the contribution of FLL in the development of the competitors' creativity
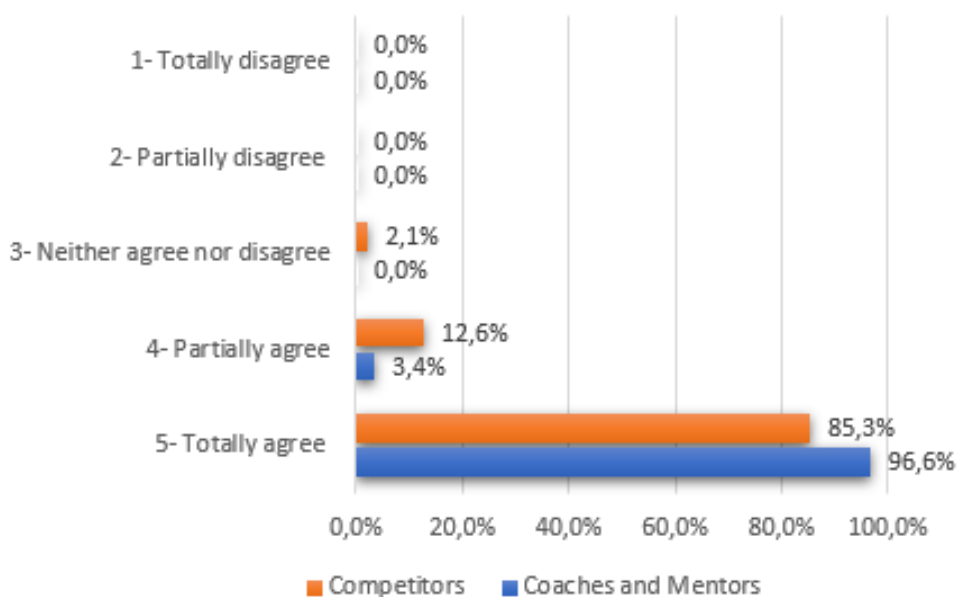
Source: Elaborated by the authors.

We noticed a strong indication that the FLL contributes to the development of the competitors' creativity, since the majority answered the question with "Strongly agree". Out of 201 respondents, only one respondent chose "Partly Disagree". Thus, the participants consider that the FLL instigates the spirit of creativity in the participants. As seen in the competitions, this creativeness goes from the simple choice of uniforms/fantasies to the conception and development of the robot and the innovation project.

The data for the analysis related to the **development of problem-solving thinking** were obtained through the responses to the following statement: for the competitors: *"The competition helped me improve my problem-solving skills"*; and for the coaches and mentors: *"The competition encourages students to develop problem-solving skills"*. The graph containing the responses is illustrated in Figure 5.

Figure 5. Percentage of answers referring to the contribution of FLL in developing the competitors' problem-solving thinking
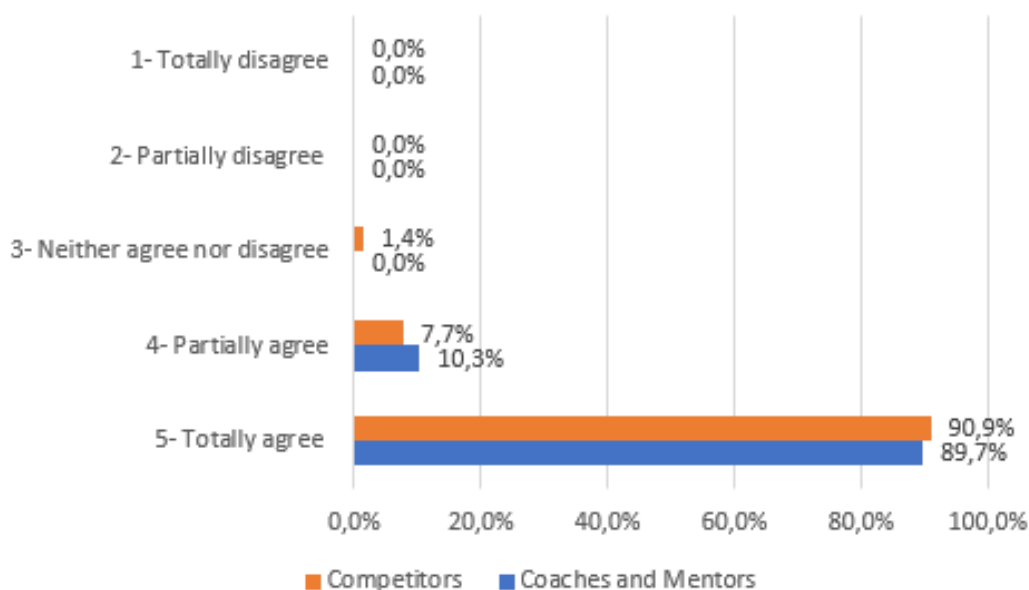
Source: Elaborated by the authors.

Similarly, the responses obtained here show strong evidence that every process inherent to FLL causes the competitors to develop different strategies to solve problems. 85% of the competitors and more than 96% of the coaches/mentors answered this question with "Totally Agree". This result is especially positive, since one of the goals of the FLL is that the competitors can make decisions and seek solutions to different problems.

The analysis regarding the teamwork skills development was done through the answers to the following statement: for the competitors: *"The competition has contributed to developing my TEAMWORK skills, dealing with conflicts of ideas, listening and accepting my teammate's opinion for the sake of the team, and actively collaborating with my teammates";* and for the coaches and mentors: *"The competition encourages students to TEAMWORK, dealing with conflicts of ideas, listening and accepting my teammate's opinion for the sake of the team, and actively collaborating with my teammates".* Figure 6 graphically presents the percentages of responses.

Figure 6. Percentage of responses regarding the contribution of FLL in developing teamwork skills
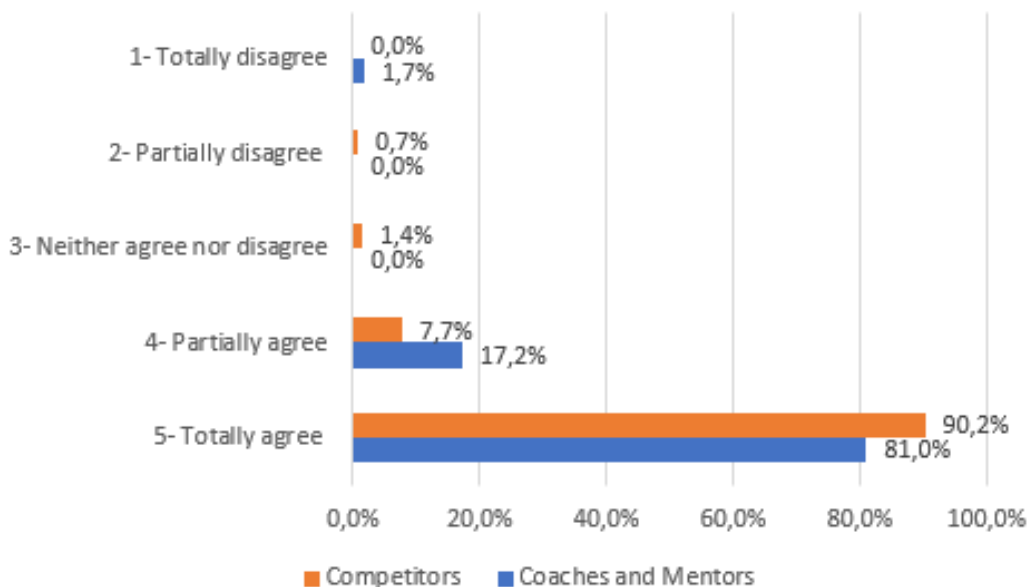
Source: Elaborated by the authors.

The data show that most of the survey participants believe in the potential of competition to develop the spirit of teamwork in the competitors. As teams are composed of people with different personalities and behavioural profiles, conflicts, and differences of opinion within and outside the team are inevitable. Therefore, the knowledge and application of good teamwork practices to manage and resolve such conflicts for the benefit of the development of all are paramount.

Regarding the **sharing spirit and contribution development**, the participants positioned themselves according to the following statements: for the competitors: *"The competition contributed to develop my skills of INTERACTION AND COLLABORATION WITH OTHER TEAMS, making me understand/ experience the spirit of collaborative competition, seeking knowledge sharing and interaction with other teams"*; and for the coaches and mentors: *"The competition encourages students to INTERACT AND COLLABORATE WITH OTHER TEAMS, making them understand/live the spirit of collaborative competition, seeking knowledge sharing and experience exchange"*. Figure 7, below, illustrates the answers obtained in the questionnaire.

Figure 7. Percentage of responses regarding FLL's contribution to developing interaction, sharing, and collaboration skills

Source: Elaborated by the authors.

It can be verified that the research participants believe in FLL's contribution to the development of interaction, sharing and collaboration. A possible explanation for this result is the fact that FLL values, applies, and demands the spirit of collaborative competition and sharing, considering such values of utmost importance for the organization of the event. Competitors are encouraged to strive for the best results; however, the desire to win the competition cannot be greater than respect for the work of the "adversary".

To address the objective concerning the **development of communication skills**, the following statements were made to the research participants: for the competitors: *"The competition helped me to develop my COMMUNICATION skills by making my public presentations to the judges and other people participating in the FLL";* for the coaches and mentors: *"The competition encourages students to develop COMMUNICATION skills by making public presentations to the judges and other people participating in the FLL".* The graph with the answers is illustrated in Figure 8.

Figure 8. Percentage of answers referring to the contribution of FLL to develop the competitor's communication skills
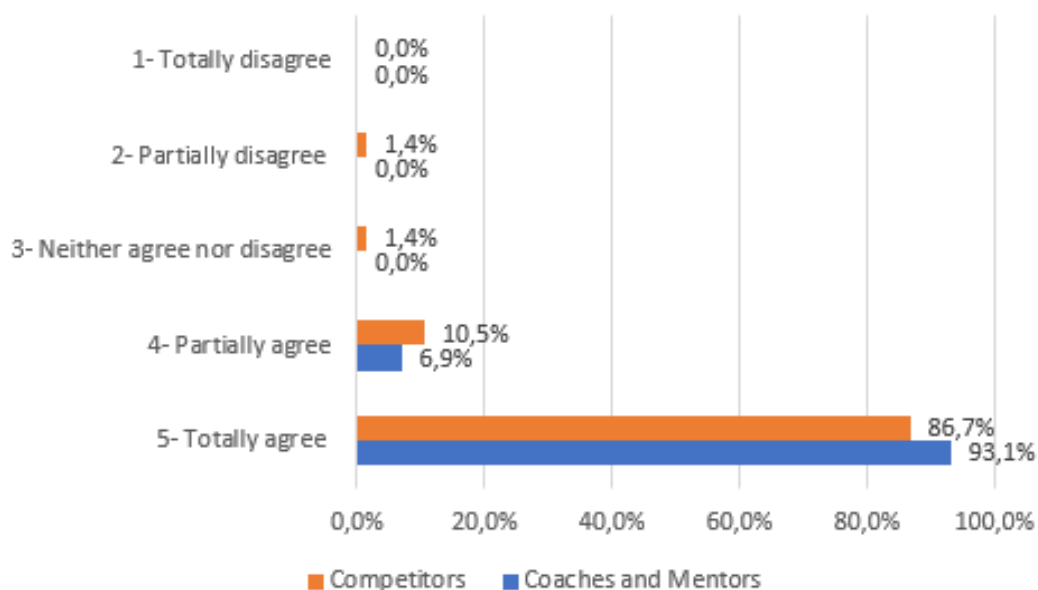
Source: Elaborated by the authors.

The contribution of FLL in the development of the competitors' communication skills is also strongly indicated by the responses obtained. One possibility for such a position may be linked to the fact that, during the competition phases, students must communicate with other teams and professionals related to the event theme, besides being evaluated in public presentations for their work. All this process inherent to the competition strengthens the communication practices of those involved.

To investigate the **contribution of FLL in the professional future** of the competitors, the following statement was presented: for the competitors: *"I believe that my participation in FLL has contributed/will contribute for me to develop and/or improve skills necessary for my PROFESSIONAL FUTURE"*; and for the coaches and mentors: *"Participation in FLL has the potential to contribute for students to develop/improve skills necessary for their PROFESSIONAL FUTURE"*. The results are shown in the graph in Figure 9.

Figure 9. Percentage of answers regarding the contribution of FLL to the professional future of the competitors
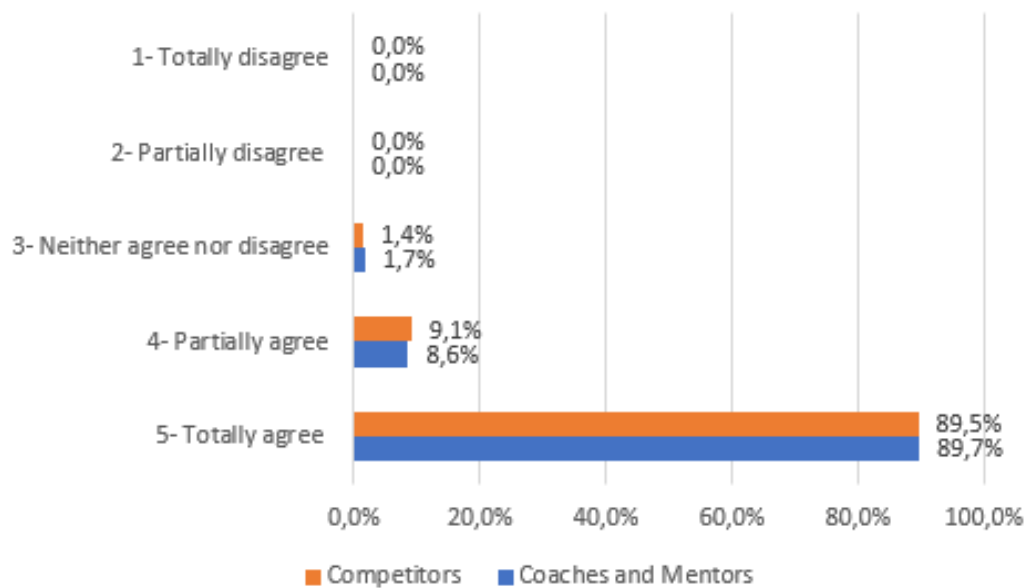
Source: Elaborated by the authors.

To quantitatively measure the respondents' answers to the statements presented (Figures 1 to 9), a scoring scheme was generated based on the number of respondents and the answer value identified on the *Likert* scale. Meaning: for each question, the number of people who answered a particular scale was multiplied by the equivalent value on the scale. For example, suppose ten people answered a question X, where six of them indicated scale 5 (strongly agree); three, scale 4 (partially agree); and one, scale 2 (partially disagree). Thus, the score for question X will be 44 out of 50 possible points.

Figure 10 shows the total points obtained, by category (Competitors and Coaches/Mentors). In both categories, the results present an average score of 97% of the possible points (4.9 on the Likert scale). Therefore, for almost all respondents, in all questions, we have a value close to that which represents the **totally agree** on the scale considered.

Figure 10. Percentage of the average score referring to the answers on the *Likert* scale
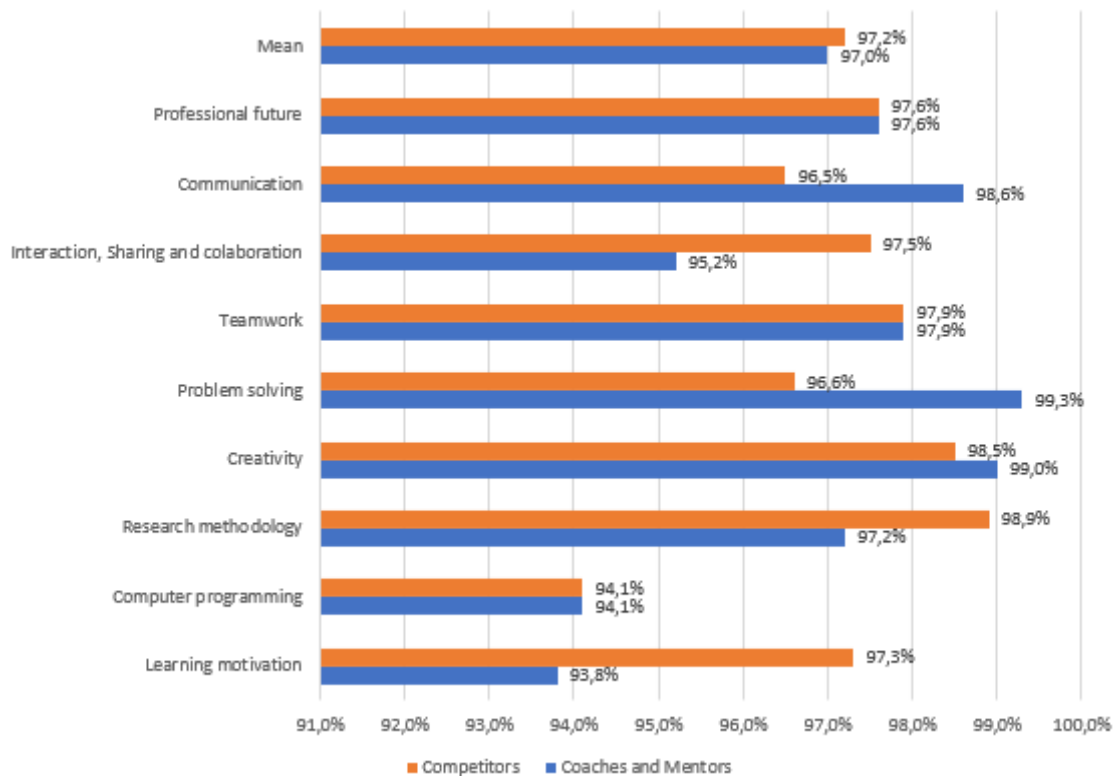
Source: Elaborated by the authors.

The statement that presented the strongest results, in the opinion of the coaches and mentors, was the **development of problem-solving thinking**. This is considered a positive indication by the researchers, because one of the FLL's objectives is to promote the autonomy and capacity of the competitors, so that they are capable of overcoming obstacles that may arise during the competition.

In contrast, it is interesting to note that the highest value obtained in the case of the competitors was for the question related to the **development of abilities referring to research methodology**. This result demonstrates the various learning possibilities in the competition, since the transdisciplinary approach of the FLL theme encourages the competitors to systematize the processes of searching for information, contact with teachers from various areas and industry professionals, and the organization of the research project. In other words, the competitors point as their greatest contribution of an expertise area "outside" the technology axis, a more structural field of the knowledge construction process.

Although it obtained more than 94% of the score, the statement referring to the **development of computer programming skills** had the lowest score, both in the opinion of the competitors and the coaches/mentors. In a way, this is a result that surprised the researchers. One possible explanation may be related to the division of the competitors

into categories, a strategy used by many teams. For example, the team can divide the competitors into two groups, where one group will be responsible for the innovation project and Core Values, and the other will be responsible for assembling and programming the robot. Since programming is a science that requires a lot of practice to develop the skill, many of the respondents may have identified the programming skill as the one in which they evolved the least.

Lastly, several statements were gathered through a discursive question from the questionnaire: for the competitors: *"Analyze the statement "FLL has had a positive impact on my learning process in class (subjects)". Do you think it is true? Why?"*; and for the coaches and mentors: *"Does the statement "FLL has a POTENTIAL for improving the student learning process in the classroom" seem true to you? Why?"*. Figure 11 displays the word cloud extracted from a single text containing all responses (mentors, coaches, and competitors) to this question.

Figure 11. Word cloud generated from the research participants' testimonies

Source: Elaborated by the authors, provided by www.wordclouds.com

In the Figure 11, the image translation (left to right, top to bottom): Classroom, science, more, abia, robot, focus, programming, work, inside, develop, math, project, learn, skills, group, development, aber, robotics, class, FLL, helped, use, idea, knowledge, did, subjects, form, team, do, students, year, life, school, day, team, learned, talk, learning, process, learning, good, better, research, got, competition, jobs, things, study, those, problems, student, base, practice, how much, studies, seek, when, areas, various.

One can notice the highlighting of several words present in the objectives of the work, such as **team, research, programming, knowledge, learning, skills**, and other words that suggest improvements for the competitors, such as **development, helped, study,**

better, among others. Analyzing the words highlighted in the cloud, together with all the analyses of the previous questions, we can consider that FLL presents possibilities of benefits to its competitors, either in school performance or in the development of the skills of a good professional.

Table 2 presents real statements from competitors to the discursive question.

Table 2. Some competitor's testimonials to the statement: *"FLL has had a positive impact on my learning process in the classroom. Do you think this is true? Why do you think so?"*

Student 1	Yes, as an example: a while ago I had a team class, where we needed to define a theme (problem) and an innovative solution, I felt extremely safe, I had an easy time doing this work, I was very shy, I didn't like to speak in public, not even to present a work to my friends; in this work, I felt confident and spoke easily. In this activity, the teacher was going to choose the best project, and my team succeeded! I felt very good that day and I saw how these competitions really cause positive changes in our lives, it is something incredible that diminished the enormous shyness I had and provided incredible and unforgettable moments!
Student 2	Absolutely, because at FLL almost all work is interdisciplinary, especially in the innovation project where we need to do research, prototyping, project validation... All these processes, plus the core values and the robot, are great allies in the learning process, both in and out of the classroom.
Student 3	Yes, in subjects mainly in Portuguese and grammar (punctuation, conjunction, among others) and mathematics because of the robot. Now thinking about the situation we are living, before I got into robotics, I did not understand/do not know how to use computer stuff, for example: Word, Google more or less, Google Scholar (actually I did not even know what it was), and now I wonder what would be of me without having learned these things in robotics. Also thinking about friendships/socializing, I joined a team at FLL that I didn't know anyone, and we became very close, like siblings, everyone helped each other, took care of each other, laughed, and we were happy. And this helps and sets a good example, not only in school but also in life. I love and will always love FLL.
Student 4	Yes, besides collaborating a lot for deeper learning of many subjects and even learning certain contents before being studied in class, FLL collaborates a lot with the development and improvement of focus, creativity, participation during classes, either by asking questions about or even expressing the knowledge already obtained, it also helps in better performances in group work and assignments that require a certain amount of resourcefulness.
Student 5	Yes, and I agree with the statement because FLL not only improves aspects of teamwork and didactics even in the classroom but also encourages the pursuit of knowledge and encourages personal improvement, which brings competitors a greater perspective of the future and broadens the view on the subjects and issues that are often considered important only in school

	environments because with FLL we see applications of knowledge in practice, exercised by ourselves.
Student 6	Yes. For, it was with FLL that I learned best about how science works to solve problems in real life, not only the theoretical part of researching from reliable sources but also in practice building the robot and programming and dealing better with teamwork. Unfortunately, I could only participate for one year because of my age.
Student 7	Yes, because it improved several aspects of both my behaviour and developed technical skills, the main legacy for me is the methodological notion that it proposes to us, as a child I learned with robotics how to approach a problem and how to solve it, nowadays I can notice when comparing with colleagues at the university who unfortunately did not have this same opportunity, how important this competence stimulated since my 6th grade was. Besides inspiring me to pursue a career in technology, today I am studying software engineering, just like other members of the team I participated in went on to higher education.
Student 8	Totally. Before entering as an FLL competitor, I considered myself an intermediate student, I did not do more than what was necessary and my learning was based on absorbing what was interesting or required for the evaluation. During and after this experience in robotics, my way of thinking is absolutely different. My teamwork, concentration, curiosity, learning, and other factors that leverage any student or professional, today are completely different. I discovered that I possessed many abilities, previously blocked, but that was fundamental for me to find myself in the world. Besides, of course, all the scientific knowledge acquired along the way. I also believe that we are much more than robots. FLL is the gateway to a new perspective, qualifies your pre-existing skills, and makes you a human being fully prepared to change the world. My example is just one of thousands, I believe that anyone who is or has been a roboticist has stories and perspectives as admirable as.

Source: Elaborated by the authors.

Table 3, in turn, records actual statements of technicians/mentors to the discursive question.

Table 3. Excerpts from some of the coaches/mentors' statements to the statement: *"FLL has had a positive impact on the student learning process in the classroom. Do you consider it to be true? Why?"*

Coach / Mentor 1	Yes, the competition seeks to develop in the students' many skills that go beyond the limits of the classroom. Teamwork, solving real problems, maturity to conduct disagreements and manage conflicts, among other important skills for the development of a truly skilled professional. I really like the values pursued in the competition for both professional use and personal life.
Coach / Mentor 2	A discipline along the lines of competition works with PBL, promotes interdisciplinarity, helps both active and reflective students, develops intrinsic

	motivation, and promotes a more playful environment than the content-based formalism present in the classroom.
Coach / Mentor 3	Yes indeed, the competition is divided into 3 parts and in all of them, a broad knowledge of exact, biological and human sciences is required, since the teams have to present a good performance in communication, logic, scientific and statistical facts. To prove that both the research (on the competition's theme of the year) and the assembly and programming of the robot (for the table test) are based on facts and that the team is prepared to deal with the logistics of economic and social society, thereby bringing hope for a sustainable and educated future generation.
Coach / Mentor 4	Yes, because it is a proposal that brings a reality that many of our students don't have on a daily basis, since specifically the community in which they live is very needy and because they are in the public school system and, therefore, have fewer opportunities than their peers in the private or federal school system. Therefore, the FLL proposal becomes primordial for the teaching and learning process of these students.
Coach / Mentor 5	True without a doubt! Before being a mentor I was a competitor for three years in a row and I can say that FLL had a lot of influence in improving my learning in the classroom, from doing a group work (which involves completely different people than me) to presenting and developing a work to the class. My research has improved a lot after this contact with FLL.
Coach / Mentor 6	It has potential because I have seen it happen. Uninterested students started to want to improve in school. Students who were already good students becoming superstudents and becoming role models for other students in the class.

Source: Elaborated by the authors.

Concluding remarks

This work addressed the technological evolution of society and the necessity of adapting teaching methodologies for the academic and professional development of students in Basic Education. Educational robotics was pointed out as a promising tool for the application of active teaching methodologies, with the potential to aid in the personal and school students' development.

Aligned to this, this research sought to verify the possible contributions that the FLL robotics competition can bring to the competitors (students of Basic Education). After analyzing the participants' answers to the electronic survey, we can conclude that FLL presents itself as a powerful educational practice to bring benefits to its competitors, either in school performance or in the development of professional skills.

The research showed that, both in the opinion of the competitors and of the coaches and mentors, participation in the FLL tournament can provide gains to the competing students, motivating them to study, developing computer programming

skills, scientific thinking, creativity, problem-solving skills, teamwork techniques, the spirit of team sharing and collaboration, as well as promoting an improvement in communication skills. Certainly, these advances will contribute to the human and professional development of these young students, encouraging them to enter the world of science and technology.

The testimonials presented at the end of the analysis and discussion section show the great transformations that FLL has made and can make in people, being one more evidence of the potential of educational robotics in the teaching-learning process of students, especially in the FLL competition, locus of this research.

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RESUMO:
Este trabalho aborda a utilização da robótica educacional como ferramenta nas práticas educacionais e tem por objetivo avaliar as possíveis contribuições da competição de robótica First Lego League (FLL) no desempenho escolar dos estudantes da educação básica e na formação de habilidades necessárias para o exercício profissional. Para isso, utilizou-se um questionário online que foi enviado a técnicos, mentores e estudantes participantes da competição. As análises dos dados apresentam a competição FLL com relevante potencial para trazer benefícios aos seus competidores, seja no desempenho escolar ou no desenvolvimento das habilidades certificadas pelo mercado como sendo aplicáveis a um bom profissional.

PALAVRAS-CHAVES: Aprendizagem Ativa; Robótica Educacional; First Lego League; Educação Básica.

RESUMEN:
Este trabajo aborda el uso de la robótica educativa como herramienta en las prácticas educativas y tiene como objetivo evaluar los posibles aportes de lo campeonato de robótica First Lego League (FLL) al desempeño escolar de los estudiantes en educación básica y en la formación de habilidades necesarias para la práctica profesional. Para ello, se utilizó un cuestionario online y se envió a los técnicos, mentores y estudiantes participantes en el concurso. El análisis de los datos muestra la competencia FLL con potencial relevante para traer beneficios a sus competidores, ya sea en el desempeño escolar o en el desarrollo de habilidades certificadas por el mercado como aplicables a un buen profesional.

PALABRAS-CLAVES: Aprendizaje activo; Robótica educativa; Primera Liga de Lego; Educación básica.