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Women mathematicians in the spotlight: A question-and-answer game to promote knowledge and representation

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ABSTRACT
The participation of women in mathematics throughout history has been developed gradually, being laborious, but important for the progress of mathematics. Despite the difficulties they faced, women mathematicians left very important marks, contributing with innovations, theories and discoveries that shaped the field of mathematics as we know it today. Women mathematicians have left a legacy within mathematics that they contribute to the advancement and diversification of mathematics, shaping its future. Currently, the situation of girls in basic education in relation to mathematics has made significant advances worldwide, although there are still challenges to be faced. In recent decades, there has been a growth in awareness of the importance of gender equality in education and in the recognition of the potential of girls in the area of mathematics. Despite the improvements, there are still challenges to be faced, promoting an inclusive learning environment is an essential step for girls to develop their full potential in this discipline and contribute to society in a meaningful way. Thus, the article brings an innovative methodology developed within the scope of the project "Mathematics is a Question of Girl Yes" of the PET Mathematics Connections of Knowledge CPPP program, which uses a game of questions and answers, in the form of a debate. The goal of the game is to disseminate information, and the importance of women mathematicians in schools, providing knowledge and awakening girls to engage in exact areas.

Keywords: Women mathematicians, question-and-answer game, representation.

1 INTRODUCTION

Gender inequality in the exact areas has been present for many years in humanity. Throughout these years female participation in fields such as mathematics, engineering and technology, was minority and related to the view that women have no ability or interest in mathematics. With the

passage of time, with the achievements of some women in the exact areas, more opportunities to work in these areas have emerged. Women such as Sofia Kovalevskaya, Hypatia of Alexandria, Mileva Maric, Amalie Emmy Noether, Katherine Johnson have made significant contributions to the field of exact sciences.

Despite advances over the years, women today continue to face challenges to participate and engage in mathematics. In the search to break gender stereotypes and encourage girls in mathematics, the present work brings a brief investigation on how is currently the inclusion of women in the exact areas, how the above women contributed in mathematics and also presents a game of Questions and Answers about the contributions of women mathematicians, with the aim of annihilating the obstacles that end up frustrating the development of girls in these areas, seeking to promote knowledge, encourage and include girls to participate and understand that mathematics is a matter of girl yes. And also motivate equal opportunities, enabling girls to be interested in exact areas.

This work is divided as follows: Section 2 presents how the participation of women mathematicians has contributed throughout history; Section 3 presents what is the current situation of girls in basic education in relation to mathematics? Section 4 presents the justification for the research; Section 5 presents the methodological proposal - The game; And finally, section 6 presents the final considerations about the present work.

2 HOW THE PARTICIPATION OF WOMEN MATHEMATICIANS HAS CONTRIBUTED THROUGHOUT HISTORY

The participation of women in mathematics as well as in the most diverse areas of exact sciences is essential for the evolution of mathematics and to encourage and encourage more girls to be part of this world of mathematics. In the course of human history some women have made important discoveries in mathematics, but have had to face difficulties to engage in areas of exactness, and to be recognized. These recognition favor to the present day for the advancement of mathematics.

As an example, we have Émilie du Châtelet, who in the eighteenth century, made contributions to the area of differential and integral calculus. Ada Lovelace who is responsible for the creation of the first software and the development of algorithms that made it possible for the machine to calculate the values of mathematical functions, even before the computer existed in a concrete way. Katherine Johnson, impacted on the improvement of science and technology, known for the precision in the calculations that successfully enabled Project Mercury and the Apollo 11 flight to the Moon. In addition, his calculations were also relevant for the U.S. to beat the Soviet Union in the space race. Maria Laura Mouzinho Leite Lopes, was the first PhD in Mathematics in Brazil, and also the first woman to become a full member of the Brazilian Academy of Sciences, in 1951.During her career she worked in institutions such as the University of Chicago, in the United States, the Federal University

of Rio de Janeiro and the Technological Institute of Aeronautics (ITA), where she was the first woman to teach geometry in the engineering course. Participated in the creation of CNPq and IMPA. Maryam Mirzakhani was the first woman to receive the Fields Medal in 2014. Ph.D. in Mathematics from Harvard University, he has taught at Princeton University and Stanford University. Among his areas of research were algebraic geometry, differential geometry, dynamical systems, probability, and low-dimensional topology.

The examples of the women above are extremely important in inspiring girls to take an interest in and participate in areas of expertise. This presence of female role models within mathematics can help break down gender stereotypes and encourage girls to get involved in these areas. According to research by Hyde and Mertz (2009), when girls have contact with women mathematicians as mentors and teachers, they are more likely to believe in their own mathematical ability and to feel motivated to pursue careers related to exacts. In addition, the study by Good et al. (2012) highlights that women mathematicians challenge the perception that mathematics is a male-dominated field, demonstrating that women can achieve success and contribute significantly in this area, which inspires girls to explore their own mathematical potential.

3 WHAT IS THE CURRENT SITUATION OF GIRLS IN BASIC EDUCATION IN RELATION TO MATHEMATICS?

Historically, Mathematics Education is demarcated by gender discrepancies, where girls face more difficulties than boys in their mathematical knowledge. Some of the factors that contribute to this are: gender inequalities, social expectations and self-confidence. Over the years, basic education has been used to provide gender equality within schools, making it a more inclusive place where girls can develop more participation within exact areas.

Some initiatives have sought to inspire and encourage girls to participate in science, technology, engineering and math (STEM) fields. These initiatives have borne positive fruit, causing more girls participate in these areas. However, there is still a large gender disparity, that is, it is still necessary to fight to achieve equality.

The goals of STEM (Science, Technology, Engineering and Mathematics) to integrate girls in these areas and promote gender equality have some actions that have been elaborated:

- · Awareness and advocacy: Promote awareness of the importance of gender equality in STEM and advocate for changes in educational and institutional policies to ensure equal opportunities for women.
- Education and mentoring: Offer education and mentoring programs that aim to encourage and support girls and women interested in STEM from infancy to adulthood. These programs help boost women's confidence and self-esteem in these areas.

- Role models and examples: Highlight and celebrate women who have achieved success in STEM fields by providing role models for future generations of women interested in these areas.
- Eliminating stereotypes: Challenging gender stereotypes that may discourage women from entering STEM fields, such as the belief that math and science are the exclusive domain of men.
- Access to opportunities: Ensure women have equal access to educational and career opportunities in STEM, including access to courses, scholarships, and leadership positions.
- Business awareness: Encourage companies and organizations to promote gender diversity in their STEM teams and eliminate barriers to women's participation.
- Incentive programs: Create incentive programs, such as competitions and awards, to recognize and reward the efforts of women in STEM.

In various parts of the world there are organizations and events with a focus on the female audience to encourage them in the exact areas. In Brazil in 2018, for example, there was the exhibition organized by USP (University of São Paulo) that had the intention of highlighting and motivating women in these areas.

4 JUSTIFICATIONS

Often not even mathematics students who spend at least four years in academia, in which they get to know some of the mathematicians who have made great contributions to the field with their theorems and research and built mathematics, are unaware of the contributions of women in the field.

Thus, it is important that not only academics know such deeds, because they are the fruit of women's struggles in their times, many were forbidden to study, had their ideas stolen and were inferiorized by society.

> Institutionalized discrimination against women continued into the twentieth century, when Emmy Noether, described by Einstien as "the most significant creative mathematical genius ever produced since women began pursuing higher studies," was denied her request to teach at the University of Göttingen. (SINGH, 2005, p.116)

Gender equality is a topic much discussed and propagated nowadays, in the area of exact sciences it is different. As has already been explained, in the area of exact sciences there is a label of male exclusivity, as well as in the area of pedagogy, for example, there is the stereotype that women have it easier. Because of this idea established in academia, it is necessary to propagate to elementary school students about this issue, so that the next generation is aware of such an incorrect perception and is less affected.

Therefore, this research brings a proposal of methodology for basic education to highlight the contributions of women in the area of mathematics, through an interactive game of questions and answers, where students will have the opportunity to meet some names of women mathematicians who collaborated in the area with their studies and research.

The target audience of the methodology is high school, because they are close to completing the stage of basic education and will be able to enter the academic environment. The proposal is to encourage students who want to enter the exact areas, showing a little of the history of women who were part of mathematics and thus show that labels do not matter, much less the pressure of society. The content of the class is not foreseen in the official documents, but given the importance of the theme can be fitted at the end of the school term, as well as in the itineraries of the new high school.

The methodology is based on a game because it is a playful way of presenting the content, the proposal is to instigate students to be active at the time of learning, facilitating the understanding of the content, making the class fluid.

> The game is a voluntary activity or occupation, exercised within certain limits of time and space, according to freely consented but absolutely obligatory rules, endowed with an end in itself, accompanied by a sense of tension and joy and an awareness of being different from "everyday life." (KISHIMOTO, 1994, p.33).

In short, the main focus is to propagate the brave women who were part of the construction of mathematics and thereby encourage girls to pursue the careers they desire despite all the gender stereotypes in the field

5 METHODOLOGICAL PROPOSALS

Game: Getting to Know the Mathematical Women

Objective: To promote knowledge about women mathematicians and encourage the active participation of students through a game of questions and answers.

Preparation:

Start the game with a classroom discussion on the topic of women mathematicians, assessing the previous knowledge of the class. Use the material provided on the subject (attachment).

Divide the class into four groups and explain that each group will be responsible for creating 15 questions related to the information contained in the material.

Link of the material for the production of the questions: https://docs.google.com/presentation/d/1XBuLgVLANBpHVHqdTEoY9BtsK4jH7fj/edit?usp=sharing&ouid=106806910267874530501&rtpof=true&sd=true

Materials:

- Numbered roulette or deck of numbers from 1 to 15 (it is recommended to use roulette to make the game livelier).
- Papers numbered from 1 to 4 to define the order of questions and answers.

Dynamics and rules of the game:

1. Organize the classroom with the chosen material (roulette or deck) centered in the middle and position the groups around.
2. Define which group will start the game. To do this, distribute papers numbered from 1 to 4 for each group. Each group takes out a paper, determining the order of questions and answers. For example, if Group 1 takes the paper with the number 2, they will ask the question to Group 2, who in turn will ask the question to Group 3, and so on.
3. Use the roulette wheel or the deck to draw which question will be asked to the opposing group. If you are using roulette, the numbers correspond to the questions. If you are using the deck, assign a number to each card and associate it with a question.
4. The group that has the turn asks the question to the opposing group. Each correct question is initially worth 3 points.
5. If the group that should answer doesn't know the answer, they pass the turn to the next group. In this case, the question becomes worth 2 points. If the next group also doesn't know the answer, the value of the question decreases to 1 point, and so on until someone gets it right.
6. If no group gets the question right, the group that asked the question gets 1 point at the end of the round.
7. After each question, the turn to ask and answer passes to the next group following the predetermined order.
8. At the end of the class, the group that accumulates the most points will be the winner.

Observations:

- Encourage the participation of all group members by encouraging discussion and the exchange of ideas.
- It is important that all groups have the opportunity to ask questions and answer.
- If necessary, set a time limit for each response in order to keep the game flowing.
- Be available to clarify questions and provide additional information if needed.

The game "Getting to Know Mathematical Women" aims not only to promote learning about women who have contributed to mathematics, but also to stimulate student collaboration, creativity, and engagement.

6 FINAL CONSIDERATIONS

This article addressed the participation of women in mathematics throughout history and the current situation of girls in basic education in relation to this discipline. The importance of women mathematicians in contributing to the innovations, theories, and discoveries that have shaped the field of mathematics as we know it today was highlighted. Although women have faced difficulties and challenges in getting involved in the exact sciences, there have been significant advances in raising awareness of the importance of gender equality in education and in recognizing the potential of girls in mathematics.

Despite these advances, there are still obstacles to overcome. Promoting an inclusive learning environment is essential if girls are to develop their full potential in discipline and contribute to society in meaningful ways. In this sense, the article presented an innovative methodology developed under the project "Mathematics is a Question of Yes Girl", which uses a game of questions and answers to disseminate information about women mathematicians in schools. The goal of this game is to provide knowledge and arouse the interest of girls in exact areas.

The presence of female role models within mathematics, such as mentors and teachers, is crucial for girls to believe in their own mathematical ability and feel motivated to pursue careers related to mathematics. In addition, it is important to challenge the gender stereotypes that still persist, demonstrating that women can achieve success and contribute significantly in the area of mathematics.

The situation of girls in basic education in relation to mathematics has improved, but there is still work to be done to ensure equal opportunities. Initiatives such as awareness and advocacy, education and mentoring programs, highlighting successful female role models, eliminating stereotypes, and ensuring equal access to STEM career and educational opportunities are key to promoting women's inclusion in the fields of science.

In the context of basic education, the proposed methodology of using a game of questions and answers about the contributions of women mathematicians can be an effective way to arouse the

interest of students and show that mathematics is a matter of girl yes. By providing inspiring examples of women who have made great contributions in mathematics, students can be encouraged to explore their own mathematical potential and overcome any existing gender stereotypes.

In summary, it is essential to continue promoting gender equality in mathematics education, recognizing and valuing the contributions of women in this area. By creating an inclusive and inspiring environment, we can encourage girls to get involved in the areas of mathematics and shape the future of mathematics in diverse and innovative ways.

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