Revista ARACÊ
ISSN: 2358-2472

THE INFLUENCE THAT RESEARCHERS IN THE FIELD OF MATHEMATICS PROMOTE FOR THE NEW GENERATION OF GIRLS: BOOKLET PRODUCTION – POSSIBILITIES AND CHALLENGES

https://doi.org/10.56238/arev6n4-373

Submitted on: 11/21/2024 **Publication date:** 12/21/2024

Kayla Franco Silva[1], Karem Keyth de Oliveira Marinho[2], Artemízia Rodrigues Sabino[3], Francilene dos Santos Cruz[4] and Maria Eulina Araújo Cordeiro[5].

ABSTRACT

In the present research we bring as an approach the female empowerment in the exact sciences, especially Mathematics, through the production of a booklet, in order to arouse the interest of girls attending high school in the municipalities of Tabatinga and Amaturá, in the interior of Amazonas to follow this area. During the study, we highlighted the implications that the booklet brought to the ten participants of the research. In the discourse, we described the perceptions of those involved in relation to professional aspirations after reading the booklet. The investigation is qualitative and uses a questionnaire and participant observation. During the process, we verified that the material produced has the potential to become a useful tool for the school environment, with great possibilities of offering categorical and specific knowledge, giving rise to the new generation of girls to feel motivated by the personalities in the booklet and to consider the areas of exact sciences, specifically Mathematics, as a career.

Keywords: Mathematics Education, History of Mathematics, Women scientists.

[1] Specialist in Higher Education Teaching and Active Methodologies (FAMEESP) Specialist in Mathematics Teaching Methodology (FAMEESP)
Member of the Laboratory of Mathematics Education and Inclusion (LEMIn/UEA)
[2] Dr. in Science and Mathematics Education from the Federal University of Mato Grosso (UFMT)
Adjunct Professor at the University of the State of Amazonas
LEMIn Coordinator
[3] Dr. in Environmental Sciences and Sustainability in the Amazon (UFAM)
Adjunct Professor at the University of the State of Amazonas
Member of LEMIn
[4] Dr. in Society and Culture in the Amazon (UFAM)
Adjunct Professor at the University of the State of Amazonas
Member of LEMIn
[5] Master in Science and Environment from UFPA
Assistant Professor at Amazonas State University
Coordinator of the Digital Inclusion Laboratory (UEA)

Revista ARACÊ
ISSN: 2358-2472

INTRODUCTION

Dear reader, I will start this section by telling my trajectory in the universe of numbers. And for this I will use a personal writing so that you feel comfortable and interested in discovering my academic advances in relation to Mathematics until I enter the Degree course related to Exact Sciences. However, despite the use of the first person singular during the text of this study, I recognize that it was not carried out individually and had the guidance and support of other researchers. I clarify that the option for writing in this way is based on Josso (2004) when he argues about the relevance of *reference-memories* in the construction of the research object.

And so that I, a beginner researcher, feel comfortable when exposing myself, I will write as a diary the facts present in my personal and academic life that contributed to the proposition of this research. And as some diaries get a name, I will name this one after a real person, who inspires me as a woman and especially as a Math Teacher! Someone who makes me feel free to present not only my academic ideas, but my personal feelings, my professor and advisor Karem Keyth de Oliveira Marinho.

It all started in Amaturá, my hometown, a municipality in the interior of Amazonas, in 2013, when I was 14 years old and "hated" mathematics for the bad experiences I had with teachers in this area. This difficulty in interacting with the discipline may come from inadequate methodological issues, poorly qualified teachers, an insufficient school structure and/or related to students who have blockages resulting from negative experiences (Pacheco, 2018).

But that changes when I enter the 9th grade of Elementary School and come across a different math teacher. Cassian[6] was his name, a tall middle-aged man, being his student was one of the coolest things in my life. Always serious and fun, he had a lovely dynamic with the students, his explanations were always light and simple, it was incredible the way he explained and made me understand everything so quickly. It was then that I understood that it is not the subjects that are bad – and neither is the teacher – but the didactics of some teachers.

> The good teacher is the one who vibrates with the subject he teaches, knows the subject very well and has an authentic desire to transmit this knowledge, so he is interested in the difficulty of his students and tries to put himself in their shoes, understand their problems and help solve them. (Lima, 1995, p. 5)

[6] In this report, we are using fictitious names to preserve the identity of the professionals.

Revista ARACÊ
ISSN: 2358-2472

The methodology of the teacher before Cassian, for example, was too rigid and inflexible, making us go through humiliating situations, such as making an entire class put the book on their heads and making them walk in single file around the school as a form of punishment for the majority not having done the task.

> The classic methods of school torture such as the paddle and the rod have already been abolished. But can there be greater suffering for a child or adolescent than to be forced to move through a forest of information that he cannot understand, and that has no relation to his life? (Alves, 2000, p. 18)

The students did not do it because they could not understand and felt intimidated to ask their questions. Totally different from the new teacher, who encouraged us every day to want to know more and more.

Cassian asked us in a fun way about the subject, always directed himself to a student and asked what he was not understanding, so the student felt more relaxed and comfortable to present his doubts. He made us go to the board to explain our doubts and there he clarified them. All our questions were considered, it was very rare for him to fail to answer any.

And when this situation arose, he passed the doubt as homework for the whole class to study, including himself, since he was humble enough to assume that he was not understanding the issue, and in the next class he already had the resolution of the question.

> [...] when students are encouraged to view mathematical ability as something that is developed with effort – emphasizing [...] that the brain forms new connections and develops a better skill each time they perform a task – [...] this makes a difference in behavior and performance (Fine, 2012, p. 238)

I remember that when he arrived my class I complained about not being able to keep up and he told me "calm down girl, why the rush? Everyone has their time to learn, and you have a lot of potential in mathematics, you are very intelligent, you can do as much as anyone here", this was the incentive I needed to find myself in the discipline, I started to dedicate myself more and more, I was never the best student in the class in Mathematics, but I was certainly one of them.

In the 1st grade of high school I went back to my old teacher, Paulo, but it was already a different experience, although his methods remained the same I had already learned to separate things, with difficulty still, but I could see Mathematics beyond the teacher, so things were getting easier. And until my last year of high school, to my happiness, it varied from math teacher, between Professor Paulo, who presents himself as

Revista ARACÊ
ISSN: 2358-2472

the greatest authority, and Professor Cassian, who gets involved with the students, makes his position clear without abusing morals and ethics. Unfortunately, I didn't have any math teacher in my career until I entered college.

By the way, for the second stage of my life, the transition from adolescence to adulthood, the question arises "Which career area to follow?" It was so hard to choose! I really wanted to go into the health area, my mother is a nursing technician, so nursing was my right choice for a long time.

But the doubts multiplied on the eve of the entrance exams and I saw it as "stupid" to take all the entrance exams for a single area, I was afraid of risking so much and not being able to, because there was no way I could take a private course at the moment and I didn't want to lose a year of my life by indecision.

So together with my parents, after several debates and advice, I also chose the Mathematics course, not because it was an area that I dominated, but because I found it so difficult to the point of choosing it because it was challenging, I have some teachers in the family, but none of Mathematics, in fact, there was not much in whom I could be inspired, It was a lot for myself.

My mother always says that I am someone unique, different and that I like different things. So to my happiness (now I can say) I didn't go on to Nursing, but I went on to a Degree in Mathematics at the University of the State of Amazonas, in Tabatinga-AM.

Thus began my adaptation process in the city, it was and is, a very different reality from my city, it is a much bigger and more agitated place. I was very anxious about all the changes that happened, not only in the city, but in the course. I was very distressed, afraid of not liking it and disappointing my parents. It didn't take long for classes to start, I entered the room and there were more than 50 people, there were a lot of people in a room.

Seeing women growing up in this area up close, studying with them, talking about their ideas and scientific work, seeing some still studying to earn their Masters and Doctorate degrees, witnessing their battles between being the professor at the Center and the master's or doctoral student was inspiring.

And about the course it was as challenging as I imagined, but it was exciting, the subjects that take Pure and Applied Mathematics are always scary, however it is incredible when we start to learn and master them, and see how far you can go with them, how far people have already come with them. Seeing that you can teach and transmit knowledge to the student is very satisfying.

Revista ARACÊ
ISSN: 2358-2472

I started taking the Institutional Program for Teaching Initiation – PIBID in the first year. It took months to follow several classes, several students and various situations. I understood that not everything is flowers, but just having a garden that can bloom is rewarding.

And with time passing, the challenges increasing, the end of the periods coming, I realized how much the class was decreasing, especially the female presence and this opened my eyes to see how much we are still a minority. I even took a course with ten students, only two of whom were women. It was then that I realized that I wanted to study about it. I started researching many things and saw how much the female presence made history in the Exact Sciences and that many of them are unknown even to those who are in the area, I, for example, have the discipline of History of Mathematics in the course, but I did not have the opportunity to study about these women.

There is a lot of material that talks about them, but few people to talk about them. Watching one of my favorite TV series *The Big Bang Theory*, which contains a mix of scientific knowledge, technological advances, pop culture, film, comics, and science fiction, one of the characters, Amy, gives an empowering speech saying, "I'd like to take this moment to say to the girls out there who dream of pursuing science as a profession: Go for it. It's the best job in the world! And if someone tells you that you can't, don't listen!"

At that moment I thought about my course, how much women were frowned upon and murdered, yes! Murdered! Just because they love the numbers. Like Hypatia, who died a tragic death due to her high knowledge, even being accused of witchcraft by the religious intolerants, she was tortured and killed. After her death, twelve centuries passed for a woman to appear in the history of Mathematics. (Vasconcelos; Milk; Macedo, 2012) Like Sophie Germain, who was prevented from doing so because she was a woman and attended mathematics classes outside, listening through the half-open windows and doors to the explanations that the teachers gave to the boys (Garbi, 2007, p. 421).

I think about how much they have been oppressed and humiliated. I myself have been asked when I chose to talk about this in my Course Completion Work. Everyone expects that by taking a Mathematics course, even if in a Teaching Degree, you talk about numbers, Pure and Applied Mathematics, complex numbers and others, when this also involves education and in this field inclusion is also worked on, which is where I intend to act; the inclusion of girls in the exact sciences, whether in licentiate or bachelor's degrees, as long as these girls understand how far they can go from Mathematics.

Revista ARACÊ
ISSN: 2358-2472

From this thought arose the scientific problem: What implications does the production of a booklet on the trajectory of the presence of women in Mathematics, as a science, influence the female empowerment of high school students with regard to professional aspirations?

In this sense, I considered the hypothesis that, by working with a booklet that addresses the historical context of women in Mathematics, it contributes and arouses the interest of students attending high school to follow the area of exact sciences, especially Mathematics. That by presenting the female figure in Mathematics in the school environment can add both to her personal intellect, as a teaching tactic and incentive for girls to study this area.

Thus, in this work, I describe the production of this booklet, and its implications for the female empowerment of high school students, with regard to professional pretensions, with the production of a booklet.

To this end, in the next section I present the theoretical foundations of the work, in which I cite authors such as, Alves; Pitanguy (1981), Sardenberg; Costa (2002), and Japiassú (2001) who talk about the construction of feminism and the resistance to compose Women's History in society and especially in education. Next, I bring the methodological procedures that guided the research actions during the field research with the participants. Then I present the results, divided into two subsections: production of the booklet and its validation with the girls. And finally, the final considerations expose the main points seen during the research investigation, presenting recommendations for future studies.

THEORETICAL FOUNDATION

Since the first "Wave of Feminism" in the 1960s, women have been breaking social and cultural paradigms of a society marked by patriarchy. "The first generation (or first wave of feminism) represents the emergence of the feminist movement, which was born as a liberal movement for women's struggle for equal civil, political and educational rights, rights that were reserved only for men" (Narvaz; Koller, 2006, p. 649). "Feminism is a philosophy that recognizes that men and women have different experiences and claims that different people be treated not as equals, but as equivalents" (Fraisse, 1995; Jones, 1994; Louro, 1999; Scott, 1986).

Feminism is nothing more than a huge desire to not only be recognized as a woman, but as a human, who thinks and acts in a meaningful way, whose actions and ideas can

Revista ARACÊ
ISSN: 2358-2472

positively influence a new generation. As Sheila Rowbotham (1973, p. 28) states, "[...] to see ourselves through our own cultural creations, our actions, our ideas, our pamphlets, our organizations, our history and our theory."

> Feminism is built, therefore, from the resistances, defeats and achievements that make up the History of Women and stands as a living movement, whose struggles and strategies are in a permanent process of re-creation. In the search for hierarchical relations between men and women, she aligns herself with all movements that fight against discrimination in its different forms. (Alves; Pitanguy, 1981, p.74).

In fact, the path for recognition and space was not pleasant at all, it was full of stumbling blocks and pain. But it brought significant achievements that everyone should value. Especially when it comes to the achievement of education, where finally, women have the freedom to study whatever they want. The beginning of a path marked by the advancement of theoretical reflections, the development of a significantly broad and fruitful field of study, which aims to produce knowledge of relevance to women's struggles. (Sardenberg; Costa, 2002)

This path was increasingly critical and unsociable, because the female "voice" was not "heard" for a cultural issue, in which women were still contemplated as submissive, at a time when science was predominantly male, which directly implies the number of women in science, especially Mathematics today. As Japiassú (2001, p. 67) states, Modern Science "was born as a markedly patriarchal institution and establishing a project of domination [...] deeply masculine-sexist".

> Mathematics is one of the oldest sciences known. Usually those who inhabit the universe of numbers are men, but is mathematical thinking easy for men to understand, because they have a natural talent for this area of knowledge and women, in turn, are incapable of doing mathematics in the same standard and quality as men? Could it be that the years of evolution of humanity and the relevant role that women have assumed in it, have only men fit for mathematics? (Vasconcelos; Milk; Macedo, 2012, p. 3131).

These questions give rise to research such as this one, in which it presents the significant role of women in the universe of numbers, showing that the intellect is developed through study, and not by gender diversity, as was culturally imposed.

> The Mathematics course since its inception has had a majority of female student participation; The students dedicated themselves diligently to their studies, demonstrating the cognitive capacity to work with abstractions, logical and inductive thinking, demonstrating that women can and are capable of entering and developing in all areas of knowledge. (Menezes, 2015)

Revista ARACÊ
ISSN: 2358-2472

It shows that women have the power and ability that go beyond domestic duties, and that they are as much a part of mathematics as men. The research provides a walk in the historical context of mathematics, presenting the first women in the history of mathematics and bringing it to the present day.

All the theorems already known are named after men, however, they can be cited: The Agnesi Curve, by Maria Gaetana Agnesi; The Cauchy-Kovalevsky Theorem, by Sonia Kovalevsky; Noetherian Rings, by Emmy Noether; Germain's cousins, by Sophie Germain and Somerville College, by Mary Somerville. (Vasconcelos; Milk; Macedo, 2012)

They are the results of important achievements, contributions from women who made history, and evolutionary changes in their respective areas of mathematics. But little is heard about these authorships. In this sense, the research also seeks to give visibility to these merits that were bravely achieved, thus pointing out to the new generation of girls paths that permeate Mathematics, with regard to professional pretensions.

METHODOLOGICAL PROCEDURES

For the methodological procedures, the qualitative approach will be used (Minayo, 2010, p. 5). And to bring this subject that is so relevant to today's high school students, a more precise involvement is needed, so the type of research will be of the participant type (Breda, 2015, p.7-8)

The production of the booklet was done after the selection of women mathematicians, tracing a timeline, bringing the stories and achievements of some of the main women in the history of Mathematics, from the registration of the first woman to those of the present day.

Due to the Covid-19 virus pandemic, which caused a gigantic impact on the world, causing the closure of companies, schools and institutions in general, public and private, not only in the state, but in the country, it was not possible to do the research in the school as desired, thus causing difficulties to access students in schools. Therefore, the booklet was prepared in a virtual format, considering the ease of access and dissemination. And to present it, a popular chat app was® used

To add high school participants to the group, I counted on the collaboration of my sister, because, during the research period, she was attending the 3rd grade of high school, in which she informally invited her classmates and some friends who were also attending high school in Amaturá. It is worth mentioning the need for this contribution, given the

Revista ARACÊ
ISSN: 2358-2472

closure of educational institutions caused by the pandemic, which made contact with students unfeasible.

The research was presented, the researcher was invited to participate, and after acceptance, the consent form was sent to the parents, and the consent form was sent to the participating students. After receiving the terms, we talked about how the research would be conducted, which would be developed through a questionnaire with 13 questions, and each day, a number of questions would be sent and would have 24 hours to be answered.

There were two weeks of interaction, the first was presentation, response to the invitation and sending of the terms, the second followed with the sending of the questions of the questionnaire and the booklet with the following dynamic:

On the first day, four questions were inserted in the group, three subjective and one multiple-choice. These aimed to obtain the initial perceptions of the research participants regarding the professional intentions and the Mathematics classes. The questions were:

1. *What are your professional aspirations? His "professional dream".*
2. *Who are you in math classes?*
   a. *The dedicated one, who is interested in classes and studies at home.*
   b. *The convoluted one, who says she will do it and doesn't.*
   c. *The quiet one, who is embarrassed to ask and interact in class.*
   d. *The disinterested one, who doesn't really care about math class.*
   e. *None of the above. Define yourself in one word.*
3. *How do you feel in math class?*
4. *What view do you have about the subject of mathematics?*

On the second day, the booklet was sent to the participants, so that they could read the work.

On the third day, three subjective questions were sent that intended to be aware of the participants' knowledge in relation to the female presence in Mathematics.

5. *What theme do you think the book proposes?*
6. *Do you agree with the idea that mathematics should be encouraged among women from an early age? Comment on your answer.*
7. *In school, or elsewhere, have you ever studied about women in the STEM field, specifically in mathematics?*

Revista ARACÊ
ISSN: 2358-2472

a. *On the fourth day, three subjective questions were sent that probed the implications that the production of the booklet provoked to the research participants.*

8. *Do you know of any of the women in the book? If so, can you report how?*
9. *Can you tell us if any of the women in the book enchanted you? And why?*
10. *What is your view on the subject of mathematics after reading the book?*

On the fifth day, I concluded with the last three subjective questions of the questionnaire, which investigated the influence of the booklet for the participants in relation to professional aspirations.

11. *Did the book influence you to think about pursuing a career in the exact sciences, such as mathematics?*
12. *How do you define your state of emotion now, after reading and discovering these scientists?*
13. *What is your criticism about the production of the book and its theme?*

The final evaluation of the booklet was made with the students' answers through the written questionnaire. The results of the research were described in a descriptive and reflective way, considering the students' perceptions from the moments of interaction in the conversation group during the days, and through the questionnaire.

RESULTS AND DISCUSSION

The research is related to two moments, i) Production of the booklet; which addresses the process of creation, which began with the selection of mathematical research scientists, the writing of texts and all their graphic editing until reaching their final form; and ii) The validation of the booklet with the high school students; presenting the result achieved through it.

PRODUCTION OF THE BOOKLET

For the production of the booklet, a study was made to select female scientists with specialization in the area of Mathematics, at first ten names would be chosen, I planned to make a light booklet, which could be read at any time, and perhaps overloading it with too many names would cause disinterest. I started looking for the Google scholar search

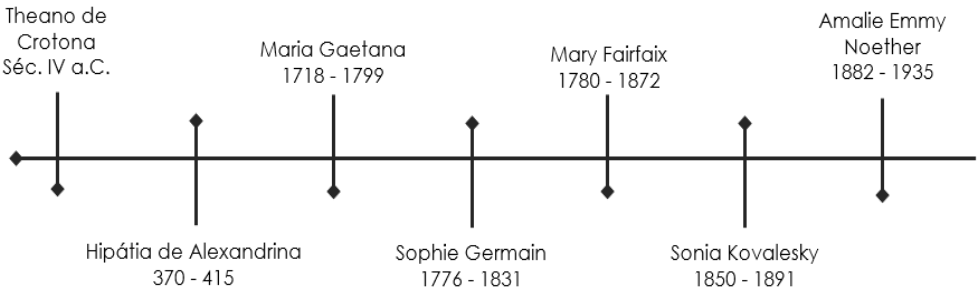
Revista ARACÊ
ISSN: 2358-2472

engine, finding who we know to be the first woman in the history of mathematics, Hypatia of Alexandria, who until then is described as a pioneer.

However, during the study, I found a digital book with the title "Women's Performance in the Universe of Mathematics: The Case of the Regional University of Cariri – URCA" (Vasconcelos; Milk; Macedo, 2012), which features 20 women in the exact sciences, and I was able to meet Theano de Crotona, wife of Pythagoras, who was already present in mathematical contributions of the time, that is, shortly before Hypatia.

Bearing in mind that the booklet has the idea of presenting women mathematicians advancing through time, then the criterion used for this selection was the years in which they were born, that is, the period of prominence of each one, some being even close, but not the same, so only a few were chosen, as there would have to be a place for more recent stories. From the book by Vasconcelos, Leite and Macedo (2012), seven women were selected (figure 1):

Figure 1 – Timeline of women in the area of Mathematics, selected to compose the booklet "Infinite Women".



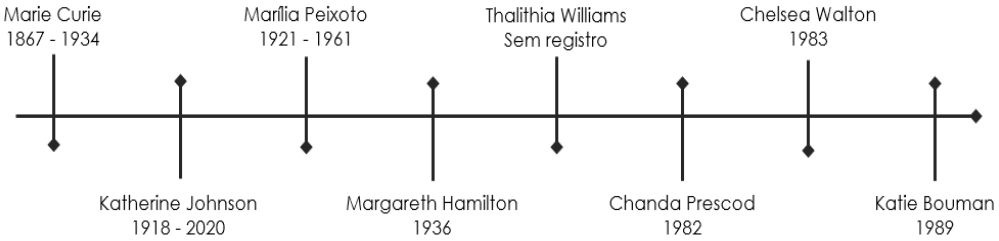
Source: Organized by Kayla Franco Silva.

In addition to these, names such as Katherine Johnson (figure 2) for a personal admiration after watching the movie Hidden Figures, Margaret Hamilton and Marie Curie, who are more popularly known, were also included. And in view of the progress of the readings and research, with more names to be added, I decided to increase the list to fifteen women.

Chanda Prescod-Weistein, was selected for being a researcher bringing a discourse of inclusion in the areas of STEM (Science, Technology, Engineering and Mathematics) especially in the mathematical sciences, Chelsea Walton and Thalithia Williams, for being professors in the Mathematics department, Marília Chaves Peixoto, for Brazilian nationality, and Katie Bouman for being young, thus closing the selection of personalities for the booklet.

Revista ARACÊ
ISSN: 2358-2472

Figure 2 – Timeline of women in the area of Mathematics, selected to compose for the booklet "Infinite Women".



Source: Organized by Kayla Franco Silva

After the 15 names defined, I started writing after reading about each personality, describing in short texts their personal and professional life trajectory, seeking to portray them in a simple, comprehensive and attractive way for the readers.

With the texts ready, I began the production phase of the graphic project, which I was able to count on the contribution of a colleague with skills in the area. In a first meeting, after a long dialogue about my preferences, which included defining the target audience, he suggested that I invite women he admired to do the illustration together with me.

I then created a group on the WhatsApp® chat app, called Infinite Women, a title that came up when reflecting on the name that would title the booklet, thinking that they are women who have marked/will mark for generations with their mathematical contributions, their achievements will be used for millennia, which make them always present in studies, so when reflecting, they become "Infinite Women".

In the group I added eight women, among them: classmates, sisters, guidance counselor and her daughter. The invitation was made after the insertion of the contacts, in which I explained the objective of the group, and they accepted to be part of the illustration process (figure 3).

Revista ARACÊ
ISSN: 2358-2472

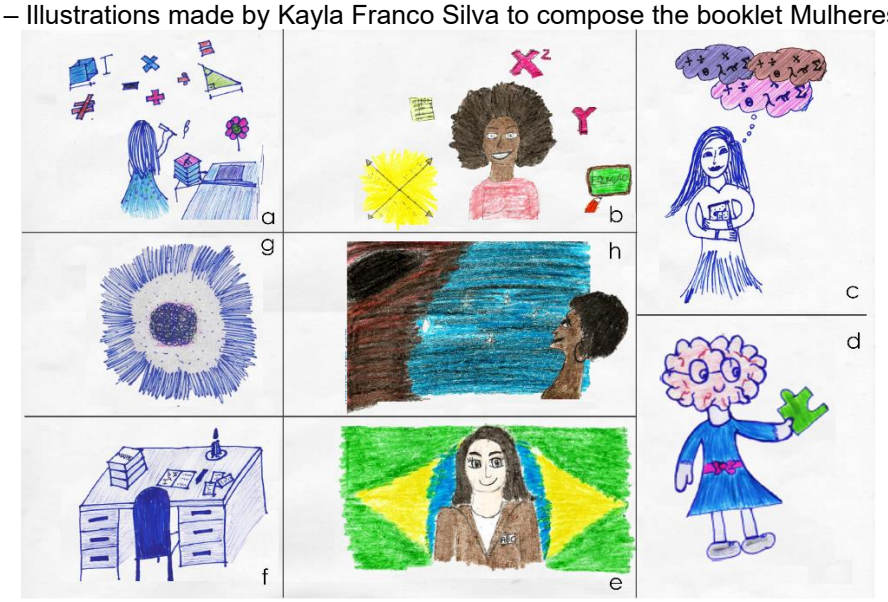
Figure 3 – Illustrations made to compose the booklet Infinite Women. Illustrations a, b and c were created by Maria Letícia; illustrations d, e, f by Sofia Anampa and illustration g by Alícia Miclhely.

Source: Organized by Kayla Franco Silva.

It is possible to observe in the image that the drawings do not follow a defined style, it was at the discretion of each illustrator to represent in her drawing the personality of the woman chosen from the booklet to also present her artistic personality. The intention of the illustrations is to bring diversity and harmony between the texts in the booklet, a way to provoke more interest in the reader when leafing through its pages, causing curiosity and the impression of a smooth reading through its illustrations. The other illustrations were my own (figure 4).

Revista ARACÊ
ISSN: 2358-2472

Figure 4 – Illustrations made by Kayla Franco Silva to compose the booklet Mulheres Infinitas.



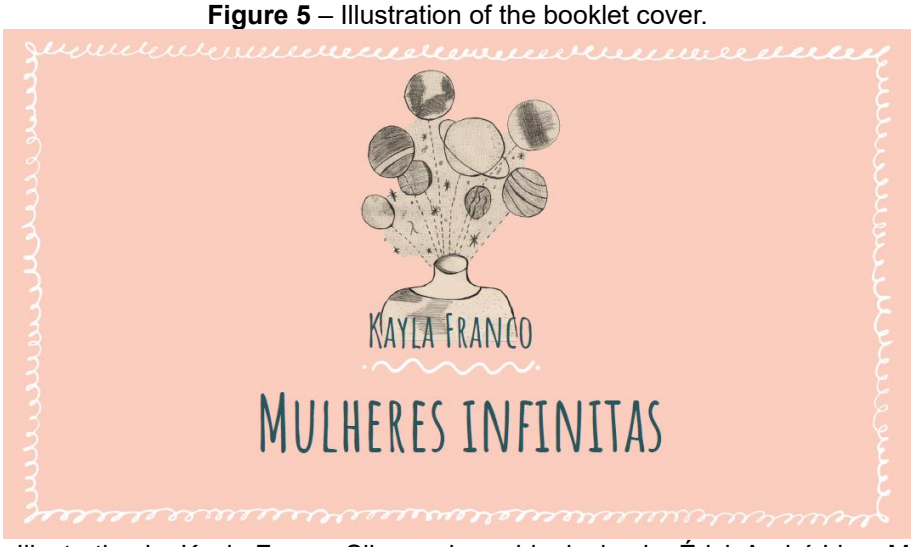
Source: Outline organized by Kayla Franco Silva

I tried to bring in my drawings the distinctive mark that I found when reading about each personality, such as, for example, when drawing Maria Gaetana (Figure 4 - image d) who was a genius since childhood, speaking several languages, and to represent her genius through humor, I drew her upper part a brain. And like Amalei Emmy (figure 4 - image f) too, who came to teach Mathematics, so to represent her reading section in the booklet I designed a table and several books to represent her profession. And with that idea I finished all the other drawings.

With the illustrations finished, the next step was to send everything to my colleague with the last guidelines, he was left to check everything and research more about the spelling of the booklet. After a while, we scheduled a second meeting for him to present some ideas and examples, and create the cover together according to my wish. And from this meeting, as planned, we were able to complete the cover of the booklet together (figure 5).

Revista ARACÊ
ISSN: 2358-2472

Figure 5 – Illustration of the booklet cover.

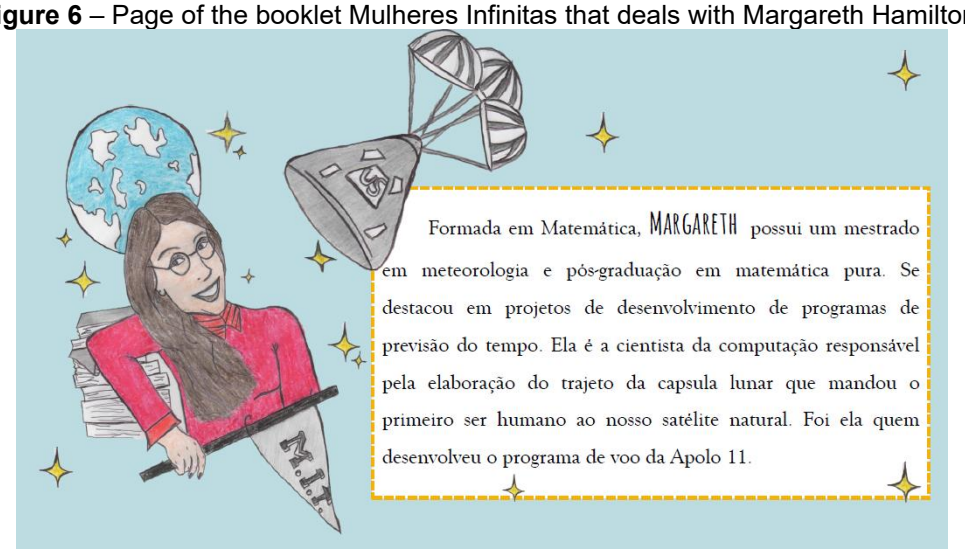


Source: Illustration by Kayla Franco Silva and graphic design by Érick André Lima Machado.

The cover of the booklet (figure 5) represents the universe that each woman has in her mind, the power of the search for Knowledge added to the erudite ideas that each researcher has, showing the connection that can be made between herself and the universe of Science.

From then on, the colleague was responsible for finalizing the graphic project and sending it to me as soon as it was finished. And in a few weeks he sent the completed work, the file was in accordance with the agreement, with the texts and illustrations in tune (figure 6).

Figure 6 – Page of the booklet Mulheres Infinitas that deals with Margareth Hamilton.



Source: Graphic design by Érick André Lima Machado.

Revista ARACÊ
ISSN: 2358-2472

For the structure of the booklet I was based on the children's book, which presents on one page the set of illustration and text representing a specific personality, I intended to add colors proportional to the content and the target audience, while still having the depth of the educational booklet that I propose. Bringing the attention of the color through cold colors, being able to give greater prominence to the text.

It didn't take a second revision, it captured very well what I wanted for the image and personality of the booklet. I sent it to my advisor, who upon reading, approved it very satisfied with all the production done. We thus completed the production stage of the booklet, and from now on we can prepare all the necessary material such as authorizations and questionnaires to do the online survey with the research participants.

BOOKLET VALIDATION

I created a group on the WhatsApp® chat application with 25 high school students from different schools in the municipalities of Tabatinga and Amaturá, both located in the interior of the State of Amazonas.

After adding them to the group, I introduced myself and exposed aspects of the research such as: the theme, objectives, and how the activities would be developed. I then invited them to participate, making it clear that they were free to refuse and withdraw at any time from the research.

Of the 25 girls invited, 18 agreed to participate in the research, showing interest, however, only ten of them remained until the end of the research. Who will be named after women mathematicians who could not be included in the booklet, as a way of protecting their privacy.

Before sending the booklet, four questions were asked, in order to know the notions they have about the area of Mathematics, to evaluate with the answers after reading the booklet. I started the questionnaire by asking their professional intentions, among the chosen careers there was a slight emphasis on Nursing and Law (Table 1).

Table 1 – Response of the research participants in relation to the professional intention they intend to follow, with the respective number (QTY) of responses.

Profession	QTY	Profession	QTY
Journalism	1	Life Sciences	1
Right	2	Nursing	2
Police	1	Nutrition	1
Agronomic Engineering	1	Psychologist	1

Source: Organized by Kayla Franco Silva based on the answers of the survey participants.

Revista ARACÊ
ISSN: 2358-2472

At first, none of the answers is related to the area of Mathematics, implying that none of the participants is interested in this area. From this information, my interest was to find out why there is no intention for this area, and if there is a way to reverse this idea.

The second question was multiple choice, to identify whether professional choices are influenced by performance in Mathematics classes. And most of the participants answered that they are dedicated students (8), who are interested and participative in the classes, Jaqueline Godoy said she is a fool (1), who ends up not doing her homework, and Kéti Tenenblat said she is disinterested (1), who really does not have much participation in the classes. With this, I verified that it is not the lack of skill in calculations that prevents most girls from pursuing a career in the area of Mathematics.

The third question had a little more depth, asking about how they feel in class, as many show aptitude in Mathematics, but do not prioritize it. As for the answers obtained, I highlight the answers of three participants:

> ***Elza Furtado***
> *When the teacher is explaining the content, there are times when I don't understand at first, then I feel desperate to be paying attention, but at the same time he's not learning anything. I get stressed and end up losing concentration. After a few minutes, I can reorganize my thoughts, really concentrate on the class, and assimilate the content.*
>
> ***Jaqueline Godoy***
> *I feel very confused, because I have difficulty learning quickly, and this ends up making me desperate.*
>
> ***Christina Eubanks-Turner***
> *I feel calm most of the time, because I find it easy to understand new and complex content.*

Even without interest or intention, I identified the participants' potential to get involved in Mathematics classes, making them perform well in their mathematical notions during the course.

Which brings the fourth question into action, about the vision they have of the discipline of Mathematics, seeking to finish the moment that I seek to know and understand the ideas and notions of the participants about what they know about the mathematical sciences. Maria and Arlete stated that:

> ***Maria Laura Mouzinho***
> *Mathematics is the subject that I find it easiest to learn. It has always been present in the life of "man" since the most remote times. The discipline of mathematics is essential, and has always had its importance in society, as it is present in small everyday things such as: shopping, bills, agriculture and fishing.*

Revista ARACÊ
ISSN: 2358-2472

> ***Arlete Cerqueira***
> *I think it is very important, because any course or subject involves it, it is the basis of anything. It is not because the subject is arts that there will be no mathematics, a drawing needs to have a place to be able to be expressed on paper, size, dimensions and so on. Everything involves mathematics.*

In this way, I deduce that the participants are competent agents to study Mathematics, which, however, do not have influences to favor their expectations in the field of exact sciences. I interpret that the professional choice is not due to lack of academic discernment, but there is a possibility that it occurs due to lack of information that provokes curiosity and encourages the desire to inquire more about the subject, making it become selective and a priority in its academic and professional options.

The following nine questions were answered after reading the booklet and, therefore, more directed to it, whether or not it influenced them to dedicate themselves more to the Exact Sciences, specifically Mathematics and the theme it proposes.

According to Jaqueline Godoy, the booklet *is a great incentive for women who want to play a role in the world of Mathematics.* I understood with this answer that the female presence is not popular in this space, so for women who already have a desire to follow this path on their own, when reading the booklet there is a possibility of feeling motivated. And as Christina Eubanks also adds*, it gives visibility to women in the universe of numbers, wants to show that brilliant women are part of Mathematics and should be valued and more present.* I noticed that the participants throughout the research assimilate the information in the booklet, and are able to interpret the importance of female presence in this space, and how much they should be recognized.

In the sixth question, all participants agreed that Mathematics should be encouraged from an early age among women, Jaqueline Godoy claims:

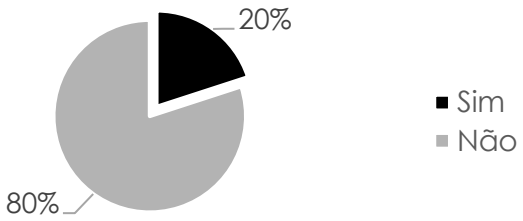
> *We women don't have that much knowledge and we are not many in the exact sciences. First of all, we don't have the same motivation as boys, we are always "pushed" to the humanities, especially literature. The lack of encouragement within the school, a figure representing women in Mathematics would certainly influence girls of X ages with training on their ideals. We don't have representation because books and schools simply don't highlight who they were. For example, I was unaware of Theano until I read the booklet.*

With this comment I was able to observe how important the booklet has been, giving content and encouraging its position when talking about, teaching and presenting to girls this reality of lack of information so present in our academic environment.

Revista ARACÊ
ISSN: 2358-2472

When asked if they had already studied the mathematical scientists in the booklet, the participants had the option of "yes" or "no" (graph 1).

Graph 1 – Percentage of participants who studied the participation of the female presence in the exact sciences before the booklet Infinite Women.



Source: Organized by Kayla Franco Silva based on the answers of the survey participants.

I observed that (graph 1) 80% of the participants had never studied about the female presence in school, which I interpret as a deficit of schools with the lack of information that the presence of women in this area of science can subject.

In the eighth question, eight participants stated that they were unaware of any of the women in the booklet, Elza Furtado said that the only one who had ever heard something was Theano, but more because she was the wife of Pythagoras, not because of her own deeds. And Ada Lovelace claimed to know Katherine Johnson from the movie "Hidden Figures". This confirms the lack of content about the history of Women Mathematicians in the classrooms, a mathematics that is more historically contextualized, in this sense. The importance of learning numerical operations is well known, but it is also necessary to present a Mathematics in its historical context, suggesting students to feel an admiration for what is being studied, so that they can identify an opportunity to explore the curious and surprising side of wanting to study exact sciences.

In the ninth question, I confirm a little more what I deal with in the previous question by asking the participants if any of the personalities in the booklet provoked them to feel admiration when reading their story, and which ones they could mention (table 2).

Table 2 – Response of the research participants (QTY) in relation to the personality they felt the most admiration, among those mentioned in the booklet Infinite Women.

Personality	QTY
Sonia Kovalesky	3
Katherine Johnson	2
Marília Peixoto	1
Sophie Germain	1
Maria Gaetana	1
Theano de Crotona	1

Revista ARACÊ
ISSN: 2358-2472

Hypatia of Alexandrina	1

Source: Organized by Kayla Franco Silva based on the answers of the survey participants.

The ten participants of the research highlight some of the personalities in the booklet (table 2), but stated that all the women mentioned in the work in its most significant trajectory left them fascinated. All the women mathematicians mentioned in the booklet carry facts that surprised them when they discovered, the pioneers mainly, because it is a very different time from the current one, in which women can now choose the area they want to work in, even if there is not much incentive for some, but the course is open. While in the past, women had to stay behind doors and windows, dress up as men, or attend clandestine groups in search of knowledge.

Following this line of reasoning, I ask the tenth question, asking them about the view they have about the discipline of Mathematics after reading the booklet. Maria Laura answers *that Mathematics becomes even more interesting, empowerment and the fight for your rights encourages us to study, and not to give up.* And Rosvita de Gandersheim emphasizes that the booklet completely changed her perspective of the curricular component often classified as masculine, *mathematics is essential for the changes and studies of all things in society, it is in fact important for a better understanding of the world.* I also observed how much the booklet went beyond what was expected, it helped to aim more at the discipline, in the now of the girls, and not only in the future as a priori intended.

Regarding question 11, the percentage of "yes" and "no" on the influence that the booklet proposed in order to change the participants' career choice were balanced, as five of the girls stated that reading the booklet made them interested in the exact sciences, now saying that there are possibilities for this area. And five of them declare:

> **Mileva Maric**
> *No, even though I know that any area I choose will always have a little bit of mathematics, but it's not my focus.*
>
> ***Rosvita* de Gandersheim**
> *Despite being very motivational, informative and interesting, I still feel that exact sciences are not my real professional vocation.*
>
> ***Elza Furtado***
> *As much as the booklet was a great help, it did not influence me to pursue careers in the exact sciences.*
>
> ***Keti Tenenblat***
> *No, exact sciences are not my focus.*
>
> ***Christina Eubanks-Turner***

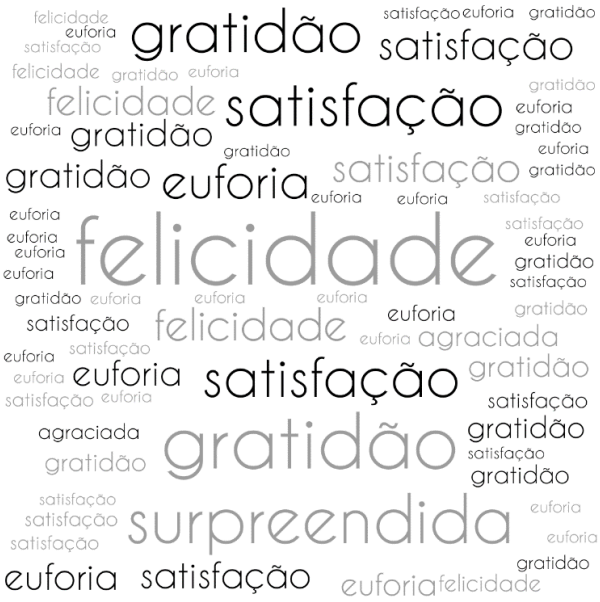
Revista ARACÊ
ISSN: 2358-2472

Not because I'm already sure of the area I want to pursue, but I can say that it would be a great influence and encouraging, if it were my area of desire.

With these answers, I noticed that the booklet had a 50% success rate in directing high school girls to the areas of Exact Sciences, especially Mathematics. And 100% success while they claim to have served as a "great help" in transmitting content and knowledge to the research participants.

In question 12, the participants were able to express their state of emotion after reading the booklet (figure 7).

Figure 7 – Word cloud representing the state of emotion expressed by the research participants after reading the booklet Infinite Women.



Source: Organized by Kayla Franco Silva based on the answers of the survey participants.

In this question I could feel a tranquility among the research participants when answering, good energies were flowing through the words spoken by them, they showed a true contentment for having been part of this experience.

And in the last question, the ten participants say they have no criticism about the production of the booklet. They present a contentment in their narrative.

With this, I found that the booklet managed to be a great means of knowledge, even though it did not influence all the participants of the research to follow Mathematics as a career, they discovered something new, as many stated during the research, that they began to appreciate the discipline more and admire those who choose to study it, especially when they are women. Going through this experience left them with marks of experiences

Revista ARACÊ
ISSN: 2358-2472

and acquired knowledge, and who knows, a seed of interest for the future, since in our youth many changes and thoughts arise.

FINAL CONSIDERATIONS

First of all, I would like to express my satisfaction in writing about this topic, I felt extremely grateful to be part of this group of women who chose numbers as their companions on the road to professional recognition. It is with great pride that I present in my speech the story that is almost, or never told, of great women mathematicians to move today's girls to the exact area, especially Mathematics as a professional option.

Throughout the research, I noticed the pleasure of the participants when reading the booklet Infinite Women, how much they let themselves be involved by the discoveries in the reading process, even influencing not only the professional choice of some participants, but also went further, by giving a new look to the discipline, because it was something they were not aware of.

So, producing the booklet was of great satisfaction, as it led them to a universe with many possibilities, arousing the interest of some and directing them to possible areas of the Exact Sciences, inspired by the careers and personalities mentioned in it.

Presenting this research is an accomplishment not only as an academic researcher, but as a woman who is also part of this universe, and who understands the importance that this discourse represents. Showing the new generation of girls that the trajectory of women in this space is generally encouraging, I feel that it is my duty to value the struggle and courage of the pioneers in this area of study, exposing their achievements and pointing out the representativeness of these Mathematical Scientists.

Thus, based on the results obtained, it is recommended that more activities like these be taken to schools, so that girls can be encouraged to study more about the Exact Sciences, especially Mathematics, and involved in this universe at an increasingly younger age.

Revista ARACÊ
ISSN: 2358-2472

REFERENCES

1. Alves, R. (2000). A alegria de ensinar (11th ed.). São Paulo: Papirus.

2. Breda, K. M. L. (2015). O que é antigo também é novo - pesquisa participante ativa. Available at: https://www.scielo.br/scielo.php?pid=S0104-07072015000100009&script=sci_arttext&tlng=pt. Accessed on: September 28, 2020.

3. Costa, A. A. A., & Sardenberg, C. M. B. (2002). Feminismo, ciência e tecnologia. Salvador: Rondor/Neim-Ffch/Ufba. Available at: https://bibliotecadigital.mdh.gov.br/jspui/bitstream/192/885/1/feminismocienciencia.pdf. Accessed on: April 7, 2020.

4. Josso, M. C. (2004). Experiências de vida e formação. São Paulo: Cortez.

5. Martins, A. P. A. (2015). O sujeito “nas ondas” do feminismo e o lugar do corpo na contemporaneidade. Revista Café com Sociologia, 4(1), January-April. Available at: https://revistacafecomsociologia.com/revista/index.php/revista/article/view/443. Accessed on: April 7, 2020.

6. Menezes, M. B. (2015). Lugar de mulher é na matemática: Percepções de professoras de matemática sobre suas trajetórias profissionais. Available at: https://www.rio2015.esocite.org.br/resources/anais/5/1438467776_ARQUIVO_textocompletoESOCITE2015.pdf. Accessed on: June 15, 2019.

7. Minayo, M. C. de S. (1992). O desafio do conhecimento: Pesquisa qualitativa em saúde. São Paulo: Hucitec/Rio de Janeiro: Abrasco. Available at: https://www.scielo.br/scielo.php?script=sci_arttext&pid=S0102-311X1992000300013&lng=en&nrm=iso. Accessed on: September 28, 2020.

8. Narvaz, M. G., & Koller, S. H. (2006). Metodologias feministas e estudos de gênero: articulando pesquisa, clínica e política. Psicologia em Estudo, 11(3), 647-654, September-December.

9. Nascimento, J. B. do. (2013). Algumas mulheres da história da matemática e a questão de gênero em ciência e tecnologia. Available at: https://www.mathunion.org/fileadmin/CDC/cdcuploads/CVgrantsIndividual/mulheres.matematica.maio..13.pdf. Accessed on: August 25, 2020.

10. Pacheco, M. B., & Andreis, G. S. L. (2018). Causas das dificuldades de aprendizagem em matemática: percepções de professores e estudantes do 3° ano do Ensino Médio. Available at: file:///C:/Users/Cyber12/Downloads/1612-4579-1-PB.pdf. Accessed on: August 25, 2020.

11. Vasconcelos, J. M., Leite, B. P. B., & Macedo, L. M. S. (2012). Atuação das mulheres no universo da matemática: o caso da universidade regional do Cariri-URCA. João Pessoa, Paraíba, Brazil.