

IFBA + COMUNIDADE

Virtual environment, an opportunity to learn plane geometry: A Proposal for Chapada quilombola communities and an assistance the Pre-IFBa

IFBA+COMUNIDADE

Ambiente Virtual, uma oportunidade de aprendizagem da geometria plana: uma proposta para as comunidades quilombolas da chapada e um auxílio para o Pré-IFBa

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ABSTRACT

The construction of a virtual learning environment (AVA) for educational purposes is a conciliation between education and modernity, and this resource can enhance teaching-learning through new available technologies. The ethnomathematical study associating its use in virtual environments contributes to our platform dealing with the "several mathematics" contained in a community, enhancing the studies of the users, focusing them in the insertion into the IFBA. Our current focus is plane geometry, a discipline that involves about 30% of the math test of the IFBA Selective Process (PROSEL) from the years 2012 to 2017. The IFBA + COMUNIDADE is a pioneering project in the pre-IFBA process aimed at the traditional communities of Chapada Diamantina, as well as an attempt to demonstrate a new face to classical mathematics by helping our target audience (students of quilombola communities) to understand plane geometry.

Palavras-chave: Virtual Learning Environment; Quilombola Communities; Ethnomathematics.

RESUMO

A construção de Ambiente Virtual de Aprendizagem (AVA) para fins educacionais é uma conciliação entre a educação e a modernidade, sendo que este recurso pode potencializar o ensino-aprendizagem por meio de novas tecnologias disponíveis. O estudo etnomatemático

associando a sua utilização em ambientes virtuais contribui para que nossa plataforma trate das “várias matemáticas” contidas em uma comunidade, potencializando os estudos dos usuários, focando dos mesmos na inserção ao IFBA. Nosso foco atual é a geometria plana, disciplina que envolve cerca de 30% da prova de matemática do Processo Seletivo IFBA (PROSEL) dos anos 2012 até 2017. O IFBA+COMUNIDADE torna-se um projeto pioneiro no processo de pré-IFBA voltado às comunidades tradicionais da chapada, além da tentativa de demonstrar uma nova face à matemática clássica auxiliando nosso público alvo (alunos de comunidades quilombolas) na compreensão da Geometria Plana.

Palavras-chave: Ambiente Virtual de Aprendizagem; Comunidades Quilombolas; Etnomatemática.

1. Introduction

This article was elaborated with the intention of being a completion of course work (TCC) at the Federal Institute of Sciences and Technologies of Bahia (IFBA), Seabra campus, located at about 450km from the capital Salvador, in the integrated modality of a Technician in Informatics course. The purpose of this project is to share the outcomes of two projects, an extension project called *Semente Crioula*, and a research project titled *The virtual environment as an opportunity to learn plane geometry: a proposal for the Pre-IFBA*.

The *Semente Crioula* project, funded by public notice from the Pro-Rector of Extension (PROEX), aims to strengthen the affirmative action policy on campus as a way of recognizing and valuing the subjects and knowledge of the quilombolas; offering a preparatory course for PROSEL; strengthening the academic life of students in face of the challenges imposed by the structural racism, based on the articulation of a formative space, focusing on ethnic-racial relations; and promoting students' digital inclusion.

As a proposal for intervention focused on access to the IFBA/Seabra of quilombola students from black rural communities, the project has disclosed visible changes in the faces of the IFBA classes, previously markedly representative of the violence of the Brazilian educational project, despite the recent policy of racial quotas. The historical inequality of the educational system means that access policies fail to ensure the entry of the black populations of rural communities. Although the entrants' current situation still shows us that historical inequalities do not change in the short term, the growing number of candidates approved in PROSEL 2015, from one to twelve, resulting from the intervention of the project, assures us that the extension can be a tool for change in a scenario that still lacks a series of actions with which to struggle.

Semente Crioula is one of those actions, having as a central goal, since its second edition - the first one was to survey the demands -, the accomplishment of a preparatory course for the selective process of the institute for the Integrated and Subsequent Technical Course.

The project is still committed to disclosing the action in schools the quilombolas attend, to registering and referring them to obtain the documents they are required.

Knowing the difficulty found by the students linked to the project, an IFBA teacher, at that time (2016) linked to the Seabra campus, started to outline a project to assist in mathematics teaching and learning, focused on the pre-IFBA. We centred our study on the production of the material for the students' specific difficulties in learning plane geometry.

The project: "The virtual environment as an opportunity to learn plane geometry: a proposal for the Pre-IFBA", called by us as IFBA + COMUNIDADE, was financed by the IFBA and the National Council for Scientific and Technological Development (CNPq), awarded through the public announcement 06/2016 in the modality of a Project of Scientific Initiation at High School level (PIBIC-EM).

To expand these works, an AVA was implemented aiming to assist the teaching of geometry in traditional communities, focusing on the quilombola communities of Chapada Diamantina, especially those around Seabra-BA.

The environment created to support materials for IFBA students, Seabra campus, and for projects in IFBA Seabra campus (as the *Semente Crioula*), will assist in preparing students for the IFBA Selection Process (PROSEL), which culminates with their entering this institution, in the integrated and subsequent modalities.

The exam to access integrated teaching is divided into four areas of knowledge: Portuguese, mathematics, history, geography, and argumentative essay writing. For subsequent education, a foreign language (English or Spanish) and sciences of nature (chemistry, physics and biology) are included.

Dissecting the term "virtual learning environment", we can understand an environment as everything that involves people, nature and technical objects (SANTOS, 2003). Virtual comes from the medieval Latin *virtualis*, that derives from *virtus*, that means strength, power (LEVY, 2007). As virtual, we can use as an example a seed, it has in its essence the potential to become a tree, depending on its development. Thus, taking into account the object of study of this work, the site that deals with mathematical subjects would be this seed, where it will seek to make the student understand mathematics by contextualising it in their experience. Thus, AVA can be understood as a fertile space of meaning, where human beings and technical objects interact in the construction of knowledge (SANTOS, 2003).

But why geometry? Studies by Vilas Bôas (2013) and collaborators indicate that, among the mathematics contents taught in elementary school, geometry contents are still the most neglected. This subject is often set aside, being approached as the last subject in elementary education, substandardising teaching, mainly because there remains little time to go deeper into the topics of plane geometry.

Another hampering factor for the content is the way this topic is approached, often being too closely related to algebra, which became very evident when we were participating in the classes of *Semente Crioula*, and we observed that the students understood geometry, but did not know how to solve the algebraic part.

Ethnomathematics is the science of student approach to mathematics and its particularities. According to D'Ambrosio (2003, apud COSTA, 2008), teachers need to bring discipline closer to what is spontaneous, to make the child feel at ease, propose games, distribute toffees, objects, so that the students feel comfortable. Children acquire skills for mathematics at home, in their environment, knowing that reality exerts action on the individual and that our daily life and our experiences should be the starting point for the study, so that ethnomathematics can work.

According to the review of the National Education Curriculum (CNE), it is important to emphasise that policies such as *Semente Crioula* aim at the black people's rights to recognise themselves in the national culture, to express their worldviews, to express their thoughts individually and collectively.

Affirmative policies also aim at the rights of black people, as well as of all Brazilian citizens, to attend each level of education in properly installed and equipped schools, guided by qualified teachers in the different areas of knowledge, with training to deal with the tense relations produced by racism and discrimination, sensitive and capable of leading the re-education of the relationships between different ethnic-racial groups. Although rare in schools' routine, these material conditions of schools and teacher training are indispensable for a quality education for all, as is the recognition and appreciation of the history, culture and identity of the African descendants. According to CNE review:

It is up to the State to promote and encourage reparation policies, in compliance with the provisions of the Federal Constitution, Art. 205, which stresses the duty of the State to guarantee, equally, through education, equal rights for all. Without state intervention, historically marginalized persons, including blacks, will hardly - and all statistical data reveal - break the meritocratic system that aggravates inequalities and generates multiple injustices, since it is governed by exclusion, based on racism and maintenance of privileges for the same (Brasil, 2004).

Due to the difficulties of the State to provide a quality education, projects such as *Semente Crioula* and AVA IFBA+COMUNIDADE, where our focus is on expanding the teaching and learning of plane geometry in historically impaired communities, try to help reduce some historical and cultural breaches.

Our proposal is only viable by the composition of the Federal Internet for All project, which is an initiative to make the internet available to several countryside communities. The project is an initiative of the Federal Government, through the Ministry of Science, Technology, Innovations and Communications (MCTIC). This initiative aims to distribute affordable internet in places where the right to internet has not yet been implemented. According to the *Chapada News* site, approximately 40 Seabrenses communities will benefit, with $\frac{1}{3}$ (one third) of the communities being traditional quilombolas, the target public of this work.

Therefore, our proposal aims at contemplating mathematics teaching and learning in a playful way through ethnomathematics, aimed at the students of the traditional communities of Chapada Diamantina, assisting in PROSEL, supporting the teachers of these communities and the IFBA.

2. Materials and methods

For the development of the virtual environment, we used some free and easy-to-use tools and technologies during the course of Informatics. Table 1 shows the resources and descriptions used.

tools and technologies	version	purpose	reference
Moodle	3.4.2.	Open source development tool for virtual environments.	https://moodle.org
TelEduc	4.3.2	Open source development tool for virtual environments.	http://www.teleduc.org.br
HTML	5.0	Markup language used to create web pages	https://www.w3.org/html/
CSS	5.0	Style sheet language, used for styling web pages	https://www.w3.org/Style/CSS/Overview.en.html
Bootstrap	3.3.6.	CSS Stylesheet Library	http://getbootstrap.com.br/
PHP	5.6.12 and 7.0.23	Programming language used for application creation and development	http://php.net/
JavaScript	5.0	Interpreted programming language	http://www.w3schools.com/js/
JQuery	1.9.1.	Open Source JavaScript Library	http://jquery.com/
Notepad++	7.4.2.	Development environment text editor and source code	http://notepad-plusplus.org
MySQL	5.7	Database management system	https://www.mysql.com/
TerraER	2.10	Creation of the modelling of the entity-relationship model of the database.	http://www.terraer.com.br/

MySql Workbench	6.3.9	Creating modeling of the relational model of the database and the SQL script.	https://www.mysql.com/products/workbench/
WAMP	3.1.0	Integrated testing environment	http://www.wampserver.com/en/#
PhpMyAdmin	4.1.14	To manage the MySQL database	http://www.phpmyadmin.net/home_page/index.php
Astah SysML	1.4.0	Creating and modeling diagrams	http://astah.net/editions/sysml

Table 1. Tools/technologies used

For the construction and analysis of virtual environments, we use the action research methodology, with interviews and research works and experiences inside and outside the institution, besides some referenced methods. According to Thiollent:

[...] there is a favorable context when researchers do not want to limit their research to the academic and bureaucratic aspects of most conventional surveys. They want research where the people involved have something to "say" and "do". It is not a simple data survey or reports to be archived. With action research, the researchers intend to play an active role in the very reality of the facts observed. (THIOLLENT, 2011, p. 22)

We were not limited to the data we had, and used our lived experiences (Erlebnis) and experiences (Erfahrung) obtained throughout the research and extension projects as a form of data for the development of the virtual environment.

Furthermore, we used theoretical works and diversified methods for data collection. We used Steve Krug, leading theoretician of website foundation, who produced three major ground rules for implementing websites. According to him, nothing important should be more than two clicks away" (p.11), "users do not bother with many clicks as long as none is toilsome and that they do not lose the continuous trust of being in the right way" (KRUG, 2008, p.41), and "removing half of the words is really a realistic goal" (KRUG, 2008, p. 45), which we use to analyse sites already linked to the world wide web network, also aimed at mathematics.

After this, we sought to understand from D'Ambrosio (2005) and other authors, some fundamental points to approach the students to the discipline in a playful way, drawing their attention while entertaining them. To construct the site, we collected several thoughts like the ones above and developed the idea of a platform with the identity of the target audience.

We also started to study how to implement a question form and how to use it, that is, how to organise and conduct interviews to collect the data. We understand interview according to Flick (2002, p.2), who defines it as "a form of social interaction that values the use of the

word, privileged symbol and sign of human relations, through which social actors construct and seek to give meaning to the reality that surrounds them". The interviewees were the IFBA students who came from those traditional communities.

After all this study, we began to produce and analyse our virtual learning environment, which we named IFBA + COMUNIDADE, that comes to add IFBA to the traditional communities that make up our project.

3. Ethnomathematics

For many ancient peoples, mathematics was a way developed to solve problems. The Egyptians, for example, used calculations to understand the high and low tides of the Nile River, so the crops would not be lost. Lately, mathematics was placed as an academic study, but in ancient times it was used out of necessity.

Nowadays, there is sometimes a process of excessive memorisation in mathematics that does not guarantee a complete understanding of the problem, nor does it correspond to the historical processes of discovery of axioms and postulates, of the primitive propositions, after all, universally known and accepted without demonstrations.

However, there is a need for association and remodelling of this subject, and this is studied by ethnomathematics. This study guides our production in the idealisation of the construction of an environment that has one of the several mathematics of a community, associating the academic with the playful, visible. For D'Ambrosio (2001a, p. 15-33), ethnomathematics "is a discipline that eliminates inequalities, that preserve diversity".

4. Lived experience in the quilombola community

We participated as monitors in the 4th edition, in 2016, of the *Semente Crioula*, and throughout the project we observed many difficulties and problems faced by the students of the communities, such as: social and structural problems that hinder their learning process; lack of human resources, such as more qualified teachers; and material resources, such as more structured schools, transportation for students and better working conditions for teachers, among other things.

As the project extended, with classes offered to prepare students for PROSEL, there were some aspects that called our attention, as the difficulty in performing the four fundamental operations (addition, subtraction, multiplication and division), which made the process a little difficult. Those problems are clear at most Seabra public schools, indicating a weak and precarious basic education, yet in more distant regions, communities and villages are twice as affected by the various public problems. Focusing on the precariousness of teaching in the community, it is evident that they had a series of difficulties in the process of educational formation, both concerning the problem involving public education in the region and the personal difficulties that encompass the processes of structuring racism that affects them.

Another thing that caught our attention when we worked on the math topics was that they were having many difficulties, and when we changed the examples linking them to everyday events, the outcome was different. Even facing basic difficulties, by associating the subject with a closer language, with examples, and by changing the way we talked changed the feature of the classes, they liked it and interacted twice more quickly, and the subject became explicit

Due to all these primary and geographic difficulties, because of the distance between the communities and Seabra, some obstacles have been observed, such as the access and use of technologies to build knowledge.

Technology for most of the world population is very normal and easy to access, and the Information and Communication Technologies (ICT) are greatly used to reach objectives such as: researching, communicating, playing, interacting, expressing, among others. People often fail to use them because of social vulnerability, and this was a picture observed in the quilombola communities during the project, a very large digital divide regarding computing and their instruments.

5. Analysis of requirements for AVA production

To start producing our AVA, we built a document of Software Engineering, which you can see in the Appendix of this work, in which we made some decisions about the virtual environment we proposed. In this section we will talk about the functional requirements and the analysis we made to start producing the IFBA + COMUNIDADE environment.

5.1. Analysis of an online environment

We started with the analysis on some online platforms focused on mathematics, the main of which was the *Só Matemática*¹ (Only Math) [figure 1]. This choice was mainly because it was the first site suggested by an online search on mathematics.

We based our analysis on Krug's (2008) studies of usability laws, described in his book "Não me faça pensar" (Don't make me think), and the mathematical approach was made based on studies produced by Moraes (1999).

With respect to the mathematical content presented, we will analyse how and which mathematical topics are presented, aimed at the description and interpretation as essential steps of this methodology.

Content analysis is a research methodology used to describe and interpret the content of all kinds of documents and texts. This analysis, leading to systematic, qualitative or quantitative descriptions, helps to reinterpret the messages and reach an understanding of their meanings at a level that goes beyond a common reading (MORAES, 1999, p. 1)

1 <https://www.somatematica.com.br/>



Figure 1. Layout só Matemática

Source: <http://www.somatematica.com.br>, retrieved on 27/09/2016.

Thus, content-related research was done by looking at how the subject is being cohesive to the user, how the content is being proposed, the examples that are used at the end of each subject, and how well this example is true to the content addressed.

The data collected after the studies developed were the following: *Só Matemática* environment addresses a wide range of mathematical subjects, has games, which is fundamental for a playful teaching, however its website does not follow the usability highlights, because many times we feel lost in it, as some links do not explain what they do, often leading us to another site. This makes the user - who, according to Steve Krug, is not in the mood to think- not understand what happened at that time. An example is the teachers' interface, where you are directed to PRAL, a platform aimed at being a social network between teachers and students.

Another point to be highlighted is the small texts, which go straight to the student's search, what is positive, however, in the topics to develop formulas, it becomes a negative point, since they are released to the students in a summarised way. Nevertheless, the insertion of the formulas facilitates the user's understanding, showing the student how to apply them.

5.2. Interviews

To begin the entire production of the software document that is in the appendix, we use the qualitative interviews method. We divided this process into three parts: the first one is the study on the forms of interviews; the second, the implementation and production of the interviews; and the third, is the study and analysis of the data collected.

We started to study how to implement a question form and how to use it, that is, how to organize and conduct interviews for our data collection. We agree with Flick's notion of

interview (2002, p.2), defining it as "a form of social interaction that values the use of the word, privileged symbol and sign of human relations, through which social actors construct and seek to give meaning to the reality that surrounds them". In addition, we made the choice for a semi-objective questionnaire, where the questions are previously constructed, but with no fixed answers, and may undergo changes during the dialogue.

After the study, we began producing the questionnaire that would be used as a guide in this process, and which included questions such as "Do you like math?" It already had two questions in sequence regarding the respondent's answer. If the answer were *no*: " Why don't you not like this subject?" If it were *yes*: "Why do you like this subject?", among other questions, as shown in the Appendix of this document. There were also questions directly related to PROSEL and the way of study that each one used, mainly with digital materials.

From December 18 to 20, 2016, we began the process of interviews with three IFBA Seabra campus students from quilombola communities, each interviewed coming from a different community.

After this process, we reached the final stage, where the analysis of the interviews took place and several important points were taken to produce our requirements document, besides the barriers to be broken.

First, the quilombola students interviewed failed to see themselves as part of mathematics due to the great gap between our reality, of people living in the urban environment, and the reality of quilombola rural communities, which made it difficult to understand their customs and their mathematics, as we can observe in this passage of one of the interviewees.

"I think it's fine, like, let me see. Something that shows people doing math is part of our lives. I mean, every day. Because every time we, since we are little, I don't know about you, but every time we are presented to math, it's very distant, so you do not have much interest in learning. For example, in Portuguese we had this, because I don't know, there is a relationship, but math seems to have no relationship at all, then we realize that it has, when we are older, then you have to show it somehow, I don't know, with video, with music, you know? To present something that is more fun, lighter "[Excerpt from interview with student L]

However, in this same passage, it becomes clear that the student seeks a more associative mathematics, where mathematics is contextualised with everyday environments in a generic way. This guided us to a path where we began to understand the way to produce the materials of our AVA.

5.3. Requirements and actors

Our next step was, then, begin assembling the software engineering document, with the understanding of the needs for the functionality of the IFBA + COMUNIDADE (functional requirements) and listing the actors and each function it produced.

It was clear that we needed to insert, edit and delete articles, topics and questions; register students, teachers and edit these profiles. Besides, there are the functions of creating a course, and enrolling students in it.

The administrator will have permission for everything, it is the function with the greatest power. They must have a high knowledge of the tool and of informatics and its instruments, because it is the major role, each change can affect the behaviour of the environment.

This function provides the materials and their management, besides monitoring the students (users) and their entrances in the environment. The administrative part of the environment can be divided into a maximum of three, the ADM (General Environment Administrator), the Manager and the Teacher.

The Teacher can be divided in two ways: the Collaborating Teacher, where they would act as an Environmental Manager, managing the technical aspects as well as the pedagogical part (it is recommended a basic knowledge in the tool and informatics and its means); and the Teacher, who only supports the pedagogical part, not using the administrative functions of managing the environment, just focusing on the course.

The User (student) is who visualises the website, contents available, question bank, forum, feedback. The user can access it all within limits, not being able to edit/delete questions, move, edit, delete topics, nor add, just reply. The student's role is simply to access and interact with the tool in the simplest way possible for a good flow.

In the development process, we thought of a simple and objective environment, where any user can develop the proposed activities, not requiring so much information technology experience to access, focusing on the usability and use of the tool as a form of studying in the simplest way.

5.4. The choice: Moodle vs TelEduc

After all data and requirements, we began working on the platform we would develop. We were divided between using Moodle or TelEduc, as both are open source and cover our needs very well in the creation of the IFBA + COMUNIDADE environment.

Moodle is a virtual distance learning environment; it is free *software* that anyone can use and modify. Version 1.0 was released on August 20, 2002, and since then it has been updated, with new versions available, adding new features and better performance. Because it is free software, it has been used by several institutions around the world and has many people contributing to the correction of errors and development of new tools as well as the discussion about usability pedagogical methodologies.

TelEduc was made available in 2001 with its first version being the first environment for EAD (distance education), as free software, both nationally and internationally. The TelEduc environment was developed with the purpose of training teachers in the area of educational computing, although it is much more comprehensive, since it has become one of the most widely used software to support distance education in many different areas.

Both Moodle and TelEduc start from the same principle of collaboration of knowledge, with pedagogical focus.

TelEduc was originally designed in a way that any user of different modules could use, even with little computer knowledge. This is because TelEduc's page structure is simple and maintains the same standard for all the features offered, menu on the left side and right-side view.

Moodle is a little more flexible, it allows adapting the needs of the institutions and the users, since it is an open source environment that, when used and modified by several people around the world, receives contributions of improvements and new ideas of functionality, helping to improve the system.

The Moodle community is a very strong point, it is very easy to find content, support materials on Moodle, forums are rich in content and are constantly updated, the community always helping from all over the world.

For TelEduc, on the other hand, the forums and help pages are confusing, and do not bring the same security as the Moodle community, although the topics are well highlighted, the usability is a bit confusing, even if we have an objective in mind, we can get lost in it.

Moodle is more flexible than TelEduc in the process of creating an environment, Moodle brings more tools and possibilities to engage developer-style codes and changes, while TelEduc has the default template, that allows fewer changes, making the development of the environment less flexible.

Considering all our research and how we had planned our model for the development of the environment, we decided to adopt Moodle as our creation tool, because it offers everything we need and a little more for possible future interventions in the project.

We started building the environment in the version of Moodle 3.4.2, which is continually updating due to the open source approach. It means that the platform is continually being reviewed and improved to meet the current and evolving needs of its users, with thousands of possibilities to be worked on, such as the implementation and own development and tool improvement.

6. Production of the IFBA + COMUNIDADE environment

After studying, analysing requirements and choosing Moodle, we started producing the virtual environment, thinking about usability topics and the perspective of a comfortable place for the user, so that they feels as if they were part of everything.

The choice of the name of our AVA "IFBA + COMUNIDADE" is directly related to the fact that IFBA is adding to the quilombola communities. This analogy was produced from the perspective of the IFBA for the student's target, the symbol + representing mathematics (by the sign of addition) and COMUNIDADE (community) as the place of origin of each

student that will use our environment. Our logo [see figure 2] is also a statement of belonging, where the silhouette is of a woman with her characteristic black hair, and the numbers a reference to mathematics.



Figure 2. IFBA logo + COMUNIDADE.

We divided the environment into an important block called IFBA questions, where all questions are kept. The production of the environment for questions and feedback in videos is a homogeneous space, where it is easy for the students to know where the questions and their respective response and comment are.

Furthermore, in the topics page there is a forum where students can solve doubts with teachers or other students. They must have an account on our site and be logged in.

After login, all users, ADM, Student or Teacher, go directly to a page of their own. For the student and the teacher there will be news about their courses. The only one registered until now is "IFBA Questions", and the course will be 1 (one) click away from the user.

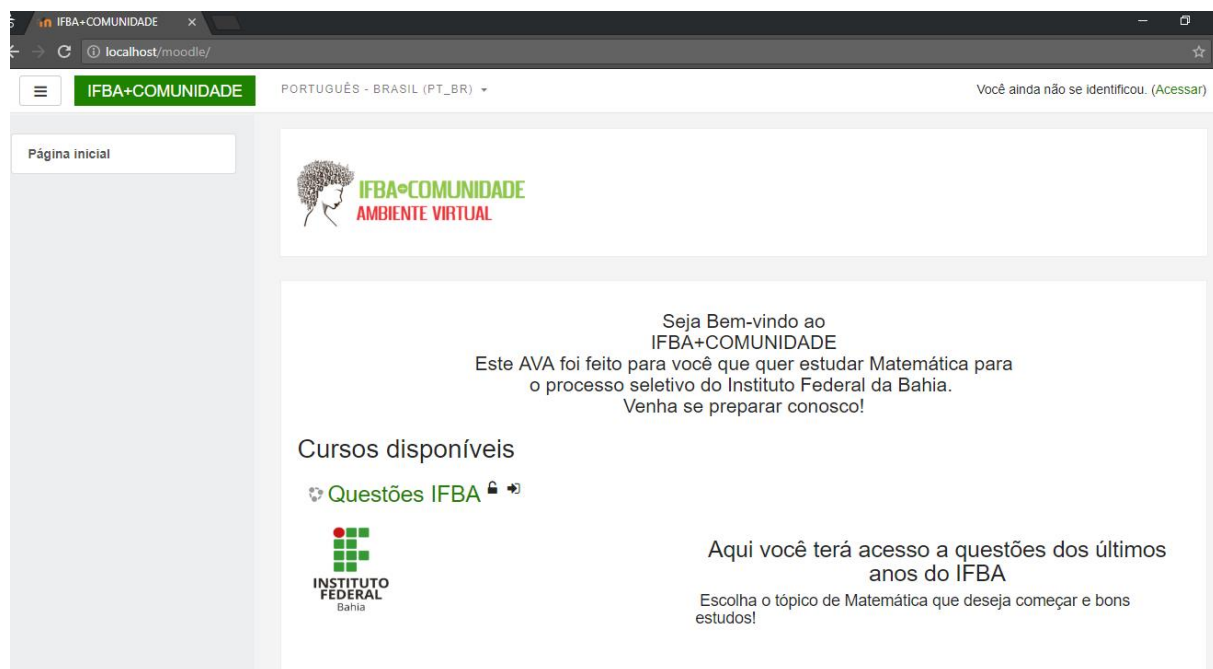


Figure 3. IFBA + COMUNIDADE layout

The video production was directly induced by the interviews. The students mentioned the video lessons very much, and we realized that this was how we would reach them. We took as base the videos of the new telecourse, where classes were associative, and were often produced in a place that is similar to the subject matter. In our case, we took the statements

of the questions and reproduced them, constructing the question and explaining previously the necessary calculations.

So, we produced an environment that was user friendly and had a unique face, that was totally interconnected with its target audience. The colours, the images, the name, all try to refer to the main focus of the students who will use them, as presented in the layout [see figure 3].

6.1. Analysis of the IFBA + COMUNIDADE environment

In the process of analysing the environment, we raised some data about it with a "general feedback" strategy to verify whether the tool complied with what we proposed and idealised. With the environment finished, we called some people to use our system, including three campus students and three off-campus people, in a total of six (6) people in this test stage.

We divided the test approach into three aspects and asked them to rank it from 0 (zero) to 10 (ten) and talk a little to explain the grades given. The first approach that we needed to verify was the usability of our environment; the second, the analysis of the didactic material; and the third, the analysis of the environment in general and the positive and negative points and suggestions.

Of these six people, three are from the IFBA informatics course and the others are from the quilombola community. We divided them into two blocks, in one we collected technical feedback from the evaluation of the students of the area, and in the other, less technical, we collected the opinion of the users of the communities who have a little less knowledge in the area, but who contributed with important suggestions.

Block 1 (one), the IT users, gave us good answers about the three aspects in a technical and succinct manner, allowing us to review and improve the work. In the first aspect, usability of the site, they ranked 8 (eight). They found it simple yet objective, easy to access, simple home screen with just the necessary, login screen and registration instruction, and visitor access, self-explanatory registration fields. In short, they found it very good. After signing in as a student, they found the interface a little simple but clean and objective, with a well-spaced side menu, simple and easy to understand. The way the materials were placed were objective, and one of them said: "I think I do not give a 10 just because you did not risk enough and stuck to simplicity". Generally, they found it good, and the average of for usability for the three kinds of users was an 8 (eight). For the second aspect, the didactic material, the average remained 8 (eight), they found the immediate feedback scheme with the videos and the questions commented good, and said: "ah, very interesting the question taken otherwise, the approach and the feedback video were interesting". The negative point raised by the three respondents was that we were only addressing a math topic and did not expand for more. For the third aspect, it was more about suggestions of improvement and continuation of the project, than for more issues and topics of disciplines. They also suggested that we improved the layout and made the environment more colourful.

Block 2 (two), with quilombola users, had a less technical approach, but with many fundamental points. The main point was how easy it was to use the environment. In short, it

was the aspect of usability. All three gave this aspect a 10 (ten), justifying that it was easy to use, and they always knew where they were. On the other hand, for the aspect of the didactic material, they ranked with an 8 (eight), justifying that all the questions have a cool and differentiated focus, but they would not assign it the highest grade because not all the videos had the contextualisation theatre. For the third aspect, they cited all the positive points mentioned above, and said that some of the negative points were that the site is focused only on geometry and there is lack of contextualisation of some questions, and these "theatres" (as they called them) were very important to understand the resolution of que question, making it easier for them to understand a subject they had not studied for a long time.

7. Conclusion

Merging the two projects described throughout the text may enhance the deepening of studies in mathematics and contribute significantly to a better understanding of the issues related to the reality of the traditional quilombola communities of Chapada Diamantina.

Since the conception of the project we knew that these materials would need an approach in which mathematics could be understood in its different cultural contexts, realising the multiplicities of this knowledge.

Whether through the examples used or the language described, there was an attempt to familiarise the materials with the culture and the needs presented by the young people of the project, since this work sought, in essence, to bring a format different from what is already registered on the web, making the IFBA + COMUNIDADE a pioneer platform in the context addressed, which can contribute to improve the standards of teaching/learning math, diversifying education and helping in the local preparatory process.

Regarding the students, in the beginning they can be challenged by the tool because it is something new and is in the network (online), but since we aim to construct a simple and objective platform, we believe that after we adapt our environment, it will become a powerful tool of knowledge, adding to the community and adding to the IFBA as a way to improve teaching.

The creation and systematisation of the project was even considered in the choice of the virtual environment as a product, to contribute to the institution and enrich other possible future works related to this theme and/or to further expand our AVA. In this way, choosing Moodle allows us this flexibility, because it is a free software, making it dynamic and continuous for the community.

Our environment today, is available at the electronic address <http://maiscomunidade.ifba.edu.br>, which is allocated in the IFBA server, with permission of access to all in their singularities.

Considering everything that was discussed and worked on, we realised that associating mathematics teaching with an interactive and dynamic environment such as Moodle can

contribute greatly to improving the learning of community people, since this association (teaching mathematics/virtual environments) also brings concern with quality teaching and education without segregation.

In this way, projects that aim to strengthen affirmative action policies have a gigantic weight and large-scale contributions to our society. Just as the projects described in the text that culminated with our environment are necessary for an attempt to help the Chapada Diamantina communities.

Finally, we sought in this work to show that it is possible to have mathematics teaching associated with everyday subjects, adding to traditional teaching and aggregating knowledge and skills in new ways.

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APPENDIX A - Requirements Document.

Federal Institution of Education, Science and Technology of Bahia.

Requirements Document: IFBA+COMUNIDADE



Table of Contents

1. Introduction

1.1. Summary

1.2. Scope

2. Overview

2.1. System Perspectives

3. Functional Requirements

4. Non-Functional Requirements

4.1. Availability

4.2. Security

4.3. Maintenance

4.4. Other requirements

5. Actors

6. Diagrams

6.1 Diagram of cases of use

6.2 Diagram of relational entity model

1. Introduction

This document contains the specifications and requirements of the IFBA+COMUNIDADE Virtual Learning Environment (AVA), which will aim to enhance the teaching and learning of plane geometry supporting the pre-IFBA.

1.1 Summary

The study of mathematics in elementary school, especially the topics of plane geometry is very neglected. However, the subject is one of the most approached in the IFBA Selective Process (PROSEL). Our environment aims at helping students from quilombola communities to prepare for this test, which will give them the opportunity to study at the Seabra campus IFBA.

1.2 Scope

The IFBA+COMUNIDADE environment will help students from Seabra's quilombola communities to learn plane geometry, which makes up 30% of the math test of the IFBA Selective Process (PROSEL).

2. Overview

The teaching of plane geometry in elementary education is often neglected, for some reasons left as the last math subject to be approached in school. The virtual learning environment will be a support for this theme in quilombola communities, linking the IFBA campus Seabra, traditional mathematics, with the mathematics and knowledge of the quilombola communities.

2.2 Perspectives of the system

AVA will not replace the teacher but will serve as a playful support to the teacher. The IFBA + COMUNIDADE will work with a database with questions of geometry and they will have videos recorded with the resolution commented, addressing the academic mathematics and the ethnomathematics of the communities.

3. Functional requirements.

RF 1. Registration of discipline:

Description: Register of a mathematics discipline.

Input: Name.

Process: ADM or Teacher may add.

Output: Topic view on the page of IFBA questions.

RF 2. Topic Registration:

Description: Registration of a topic linked to a discipline already registered.

Input: Name; id of subject.

Process: ADM or Teacher may add.

Output: Topic view on topics page for each discipline.

RF 3. Registre of questions:

Description: Registration of a question linked to a topic and an already registered discipline.

Input: Name; text of the question; feedback; alternatives.

Process: ADM or Teacher may add.

Output: Topic view on page questions for each topic.

RF 4. Editing discipline:

Description: Editing an existing math subject.

Input: Name.

Process: ADM or Teacher can edit.
Output: Topic view on the page of IFBA questions.

RF 5. Topic editing:

Description: Editing an existing topic, linked to an already registered subject.

Input: Name; id of subject.

Process: ADM or Teacher can edit.

Output: Topic view on topics page for each subject.

RF 6. Editing questions:

Description: Editing an existing question linked to a topic and an already registered subject.

Input: Name; text of the question; feedback; alternatives.

Process: ADM or Teacher can edit.

Output: Topic view on page questions for a topic.

RF 7. Student Registration:

Description: Register in AVA student.

Input: user; password, valid email.

Process: Authentication via e-mail, filling in the form and validating the fields.

Output: View student page.

RF 8. Teacher Registration:

Description: Register the teacher in AVA.

Input: user; password, valid email.

Process: Authentication via e-mail, filling in the form and validating the fields.

Output: View teacher's page.

RF 9. Enroll Student in the course:

Description: Enrollment of the student in the courses within AVA.

Input: user.

Process: Teacher manually adds by AVA.

Exit: View the course page for the student.

4. Non-functional requirements.

4.1-Availability

The system must always be on, in the event of any failure, the maintenance should be carried out as fast as possible to maintain its availability and stability.

4.2-Security

The system should be as secure as possible to store questions and videos, this information cannot be accessed by any user, only by administrators or teachers.

4.3-Maintenance

The maintenance will be done by the students responsible for the system.

4.4. Other requirements:

The system will be a Web platform and will work in any OS and in the most used browsers.

The DBMS used will be MySQL, as it is free and easy to access.

The language used for all backend development will be PHP, for its flexibility.

The languages used for front-end development will be: HTML, CSS, JavaScript web bootstrap.

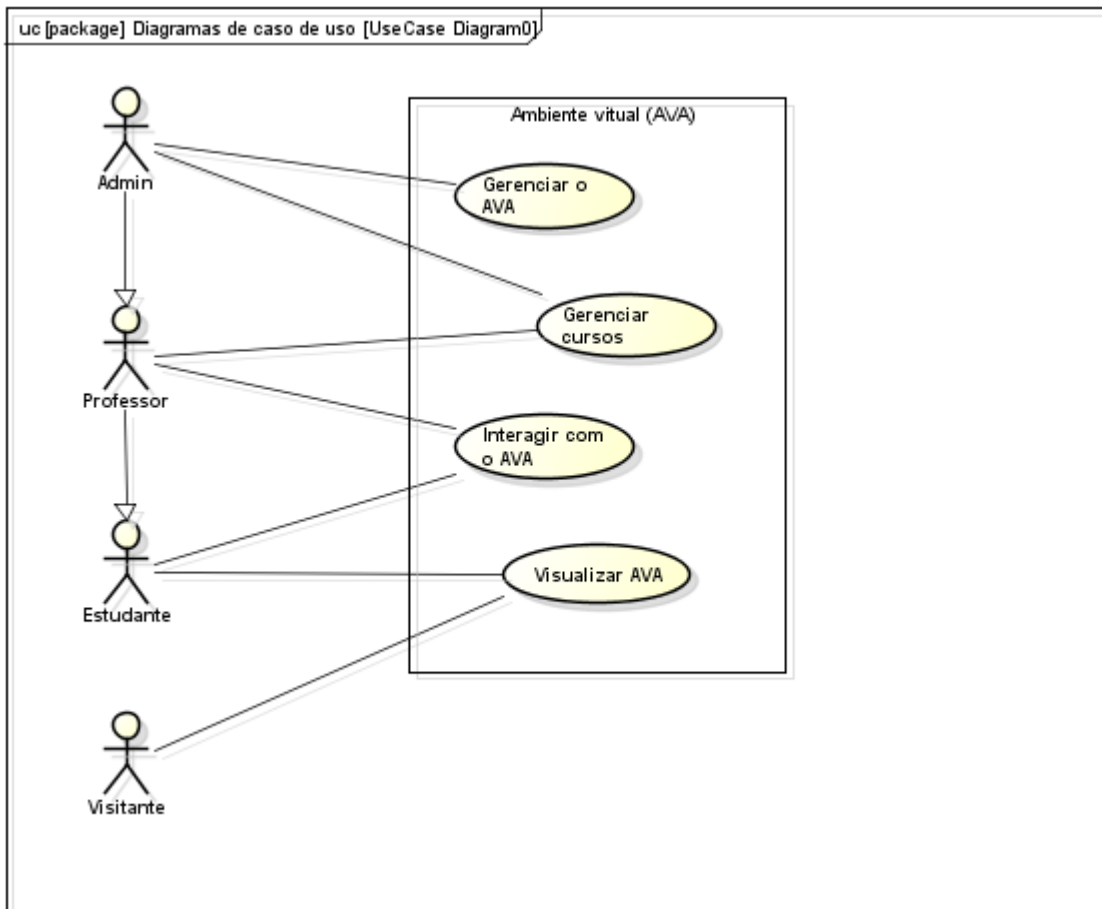
Developed in the platform Moodle, an Open Source.

5. Actors

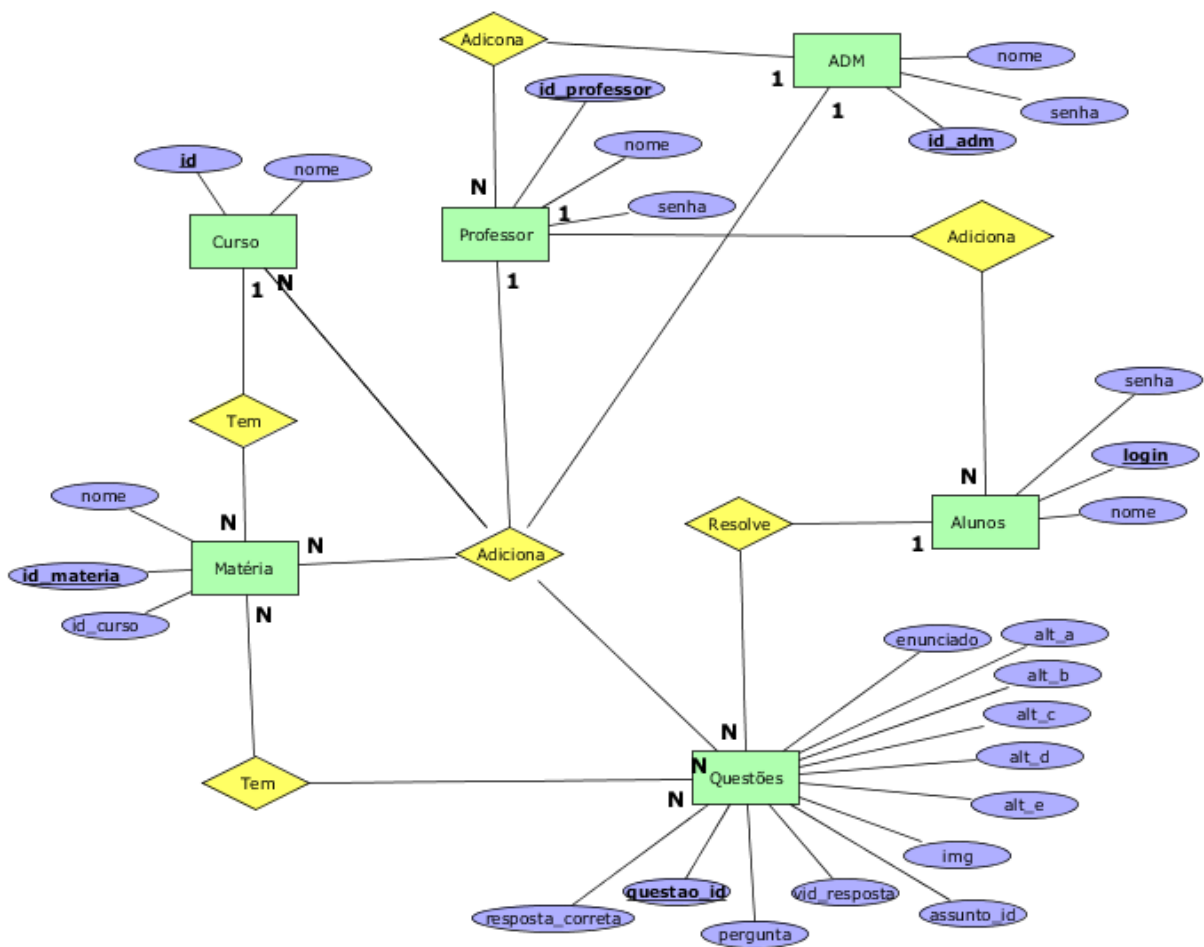
- Administrator: Modifies the environment interface, but is also allowed to exclude any unwanted users.
- Teacher: is allowed to create, modify, and delete course, as well as add students manually in the environment, and in courses.
- Student: can solve the questions and add topics in the forum, as well as answer to other students.
- Visitor: can view the environment, but does not have permission to modify anything.

6. Diagrams

6.1 Diagram of cases of use



6.2 Diagram of relational entity model



APPENDIX B - Questionnaire.

1. Do you like math?
 - 1.1. If you have any difficulty, what is your greatest difficulty with math?
2. How did you study for PROSSEL?
 - 2.1. If you used a website, which one did you use?
3. How was it for you to do the PROSSEL, what was your impression with the way the math questions are presented?
4. Do you remember any PROSSEL question? Do you remember how you solved it?
5. Do you remember any questions addressing geometry?
6. Do you remember how many questions you got right in math?
7. What was your difficulty during PROSEL in math questions?
8. How do you study mathematics subjects when you are at home?
 - 8.1. If you use websites, which one do you use?
9. Have you felt any difficulty in geometry matters?
10. Can you imagine what your problem with your learning in math is?
11. What would help to facilitate your understanding?
12. What would be the way to assist students in your community so that you do not suffer so much from these difficulties?
13. Do you think a website would help others with less difficulties than yours to be better at math and PROSSEL?

Subtitles:

M; interviewer.

L; interviewed.

J; interviewed.

APPENDIX C - Interviews.

Interviewee L, Agreste.

M: Do you like math?

L: If I like math? It's a bit contradictory question, because, you know, I do not like it, when I do not understand the subject, I do not like it, but when I get the hang of it, I start to understand, I like it, it's more for yes and no, depends on the subject, if I understand it, I like it, then if I don't understand it, I don't like it.

M: And what do you think is your greatest difficulty in understanding math?

L: Well... After I joined IFBA here I think it's because of the very basis of the public schools from where I came. I think understanding the questions, there are many rules, many formulas, many business that involve formulas, you know? Do those rule-of-three things, they are simple, but there are other things, solve LCD (lowest common divisor), they are very complex things, I find it very difficult to deal with numbers.

M: And do you remember the way you studied for PROSSEL?

L: PROSSEL? To enter the IFBA, I mean. It was through Semente Crioula, that we were having, people who were giving math classes, if I'm not mistaken it was Adilson, he taught us math, Adilson was teaching math and then Jamille too, but Jamille broke his foot at the time, and it seems that then Adilson took over.

M: And do you have internet in the community you live?

L: No, there is no internet. It seems that now they are going to install it here, you know? But it just is not so sure whether they will.

M: So you did not study by any means on the internet.

L: No, it was really just through the classes.

M: And after you've joined the IFBA here, how do you study math?

L: I study online for video lessons, I attend the assistance, there was also the maths basics I went to, and when I'm at home in the students' residence, I study on the internet, through the books, I mean.

M: And do you have a favorite site to study?

L: No, I open YouTube, whatever comes (laughs). I also study through brasil escola, so, this kind of things, this kind of sites.

M: And what do you find most difficult at these sites?

L: The biggest difficulty in these sites? I think they don't, there is, there is a site that, there is a video lesson that they go from the beginning, I mean, show the half of it, they don't show how to do it, it doesn't show the starting point, I mean.

M: And what do you like the most in these videos lessons?

L: What do I like the most? Because they often put it, it's... Examples of daily life, I think that, sometimes some are not so good, others are good, some are easier to understand, others are harder to understand.

M: Have you ever wondered what would the solution to this math problem for the people in your community be?

L: I think that, to end this problem we could implement some math projects, I think, in the communities, always, you know? Always, I think that would be it, because maths, I think it's a crazy deal (laughs,) it's hard to talk about.

M: What would you think of a site linking math to the community everyday life for you to study?

L: It would be very, very interesting, it would be more attractive to people, it would be more attractive for people in the community, I think it would create more interest for people to study math in the community.

M: Thank you.

L: You're welcome.

Interviewee(a) J.

M: Do you like math?

J: No.

M: And why don't you like math?

J: Because since I was a kid, I always found it very difficult, you know? I felt a lot, I felt a certain impotence, all the subjects, I said: "it's ok". When it came to mathematics, it seems that I got stuck.

M: And do you remember the way you studied for PROSSEL?

J: I didn't study mathematics for PROSSEL, I studied all other subjects except math.

M: And why didn't you study math?

J: I'm kind of putting off, you know? So, I don't know, something like, it is since I was a kid, I think that because I did not get it, it stayed in me, always when I have math, I put it off, I study history, geography, and I leave math aside.

M: And you remember how you felt about doing the PROSSEL, do you remember any math questions?

J: No, I don't remember. I mean... I did all and left math last, then I started checking.

M: And what was your impression when you saw those math questions? What did you feel?

J: I though, I felt very, I don't know, it was very difficult, the questions just for you to understand, you had to know math well, you had to have seen a lot of the subject, one subject included other subjects, my God, very long.

M: Do you remember any questions on plane geometry, or any geometry in the test?

J: No, I don't remember any, but I know I did have, it had several things like, before you are told what is going to be asked and so on.

M: Don't you remember any questions, or do you remember any?

J: What kind, math is a trauma to me.

M: What was the biggest difficulty you felt in those questions?

J: Interpretation, because mathematics always has that thing of ah less than, so I get confused, that thing of greater minor, until today I don't understand that right, I have first-grader difficulties.

M: Now, when you are at home, how do you study math?

J: Oh, I study through the video lesson.

M: And do you like a certain website?

J: Let me see, a teacher, he's very good, I forgot his name.

M: What is his differential?

J: Oh, he makes things fun, you know? Because all the math teachers I had, well, before here from the IFBA, they did math in a very boring way, they didn't, you know? It didn't seem like it was a thing of my life, it's a really boring thing, like, ah, I did that plus that, it very far from what I used to live, so I didn't like it. He brings to the everyday life, he makes some jokes that relax you, because mathematics is difficult in itself, and when a person does it very seriously, it gets very boring.

M: Do you feel any difficulty currently in geometry?

J: I do.

M: And what's your biggest difficulty in geometry?

J: I think interpreting the same questions, I find it difficult, mathematics, even for me, the interpretation of mathematics is difficult, the other subjects are not so much, but mathematical itself, I don't know what it is saying there, the terms, what is that?

M: Going back to where you live. What do you think would help people start to understand math?

J: I think it's good, well, let me see, something that shows people that math is part of our lives, I mean, the everyday situations, because every time, since we are little, I do not know about you, but every time math is presented for us, it is very distant, so we are not very interested in learning, for example, it happened with Portuguese, because, I don't know, there is a relationship, but mathematics seems to have no relation at all, then we realize that it has, when you're older, so it had to show somehow, I do not know, with video, with music, you know? Make things more fun, lighter, math is very heavy, very heavy.

M: So, for you the external medium that can assist in understanding mathematics is to have some interconnection...

J: Our reality, our day to day, with math, people having access to it, they will start to like it more.

M: That's right, thank you.

J: You're welcome.