

MATHEMATICS VIRTUAL PROJECT* USE OF VIDEO LESSONS IN REDUCING LEARNING GAPS

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ABSTRACT

This article presents the extension project Virtual Mathematics, developed with the aim of addressing learning gaps in mathematics and promoting educational inclusion for students in Elementary and High School. The project emerges in response to a concerning scenario of low mathematical proficiency among Brazilian students, as revealed by national and international assessments, and the high dropout rates during the transition to High School. The adopted methodology was action research, with a qualitative, descriptive, and applied approach, seeking to foster active student learning through thematic video lessons freely available on YouTube®. The lessons were designed based on essential content such as functions, progressions, financial mathematics, and statistics, accompanied by exercise lists to reinforce and apply concepts. The results indicate that the project can significantly contribute to improving academic performance and increasing student engagement by offering a flexible, accessible, and contextualized alternative to traditional teaching. In addition to directly benefiting students, the initiative also serves as a pedagogical support tool for teachers, strengthening innovative and collaborative educational practices. The study concludes by highlighting the potential of technology as a tool for democratizing education and proposes future actions to expand the reach and effectiveness of the project.

Keywords: Academic performance. Educational technology. Blended learning.



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1 INTRODUCTION

The Mathematics Virtual project emerges amid growing concern regarding the disparity in Brazil's educational results in international assessments, such as those conducted by the Organisation for Economic Co-operation and Development (OECD), which reveal an alarmingly low level of Mathematics proficiency among Brazilian students. These educational gaps highlight the need for interventions that directly address the difficulties faced in public schools, emphasizing the relevance of educational reinforcement programs focused on mathematics, where investment can translate into significant benefits for student learning (Bassetto, 2019; Santos et al., 2019).

The integration of digital technologies in Mathematics teaching offers an approach that aims not only at problem-solving but at developing the critical skills needed in the 21st century. Research indicates that the effective use of digital tools in education has shown a positive impact on student outcomes, especially in contexts where learning conditions are challenging (Cintra et al., 2022; Nunes; Lemos; Alves, 2023).

The purpose of the project is to provide additional support to students, focusing on promoting a deep understanding of mathematical concepts in an interactive and engaging way. It is believed that aligning traditional teaching with active methodologies and digital resources can increase students' proficiency and engage them in continuous learning, better preparing them for future academic and professional demands.

The implementation of this project is therefore justified by the urgent need to improve academic performance indicators in Mathematics, as well as to promote equity in educational opportunities in the country. In view of the evidence associating teacher training and experience with the quality of teaching and student learning, as shown by Barboza and Wielewski (2022) and Paula (2021), the Mathematics Virtual project also aims to serve as a support not only for students, but also for the educators involved, providing resources that enhance their pedagogical practices and contribute to quality Mathematics Education, which is essential for the cognitive and social development of Brazilian students (Uliana et al., 2023).

Data from the Brazilian Institute of Geography and Statistics (IBGE) reveal that,

in 2013, about 52% of young people between 15 and 17 years of age who dropped out of school had not completed elementary education (Bassetto, 2019). In Caçador/SC, according to the National Institute for Educational Studies and Research Anísio Teixeira (INEP, 2023), the dropout rate in High School reached 7.7% in 2019, concentrated in the 1st year. Furthermore, the failure rate was 16.2%, indicating a strong correlation between gaps in mathematical learning and school dropout (Cintra et al., 2022). These data reinforce the urgency of innovative strategies that unite university outreach and technology to support the teaching-learning process.

2 THEORETICAL FOUNDATION

Mathematics education in Brazil faces historical challenges reflected in low student performance indicators, evidenced by assessments that reveal significant learning gaps. Such difficulties are intertwined with social and structural issues, highlighting the need for strategies that promote equity in the educational process (Souza, Almeida; Madruga, 2022; Bicalho et al., 2020). In this context, the use of digital technologies in mathematics education stands out as a promising alternative. When used intentionally, these tools can provide students with access to diverse educational methodologies, making mathematics more attractive and less intimidating (Maruyama; Silva, 2023).

Action research, as a pedagogical methodology, can strengthen the integration between theory and practice, encouraging active student participation, with learners becoming co-authors of their learning (Mendes; Proença; Moreira, 2022; Mendes; Proença, 2020). This approach has shown that when students are not merely receivers of knowledge but take part in constructing it, there is significant improvement in the learning process. Student motivation is another crucial element, as resources such as video lessons and digital exercise lists enhance students' interest and offer flexibility—factors that correlate with persistence in studies and the reduction of school dropout (Gardin; Rodrigues; Teixeira, 2020; Tortola et al., 2023).

Problem solving constitutes a central axis in mathematics learning, promoting the development of logical reasoning, critical thinking, and autonomy—skills essential both in academic life and professional settings (Proença, 2021; Proença, 2020). Approaches involving problem solving in the classroom allow students to integrate prior

knowledge with new content more effectively, which is essential for understanding mathematical concepts and for the practical application of these concepts in daily life (Proença, 2020; Viana et al., 2022).

Teacher training, in turn, is enriched by the use of digital resources that broaden didactic repertoires. Projects that integrate universities, schools, and communities are fundamental not only to strengthen student learning but also to enhance teaching practices (Lima, 2020; Nunes; Onuchic, 2020). The availability of open educational platforms and online courses democratizes knowledge, breaking geographical and socioeconomic barriers and making learning more inclusive (Maruyama; Silva, 2023).

In addition to being crucial for continuing studies, mathematics plays a central role in preparing citizens, helping young people develop analytical and critical skills that are essential for employability and personal life (Viana et al., 2022; Doneze, Proença, 2023). Teaching configurations that incorporate technologies foster interactive and personalized learning environments in which each student can progress at their own pace, taking into account individual needs (Correa; Noguti, 2020; Pontes, 2019).

Regarding Brazilian High School education, failure and dropout rates strongly correlate with difficulties in mathematics. Initiatives that use digital resources and innovative methodologies have the potential to transform this scenario, promoting a more efficient and supportive educational process (Barreira; Bicho; Manfredo, 2023; Doneze, Proença, 2023). The connection between prior knowledge and new concepts through contextualized exercises also proves to be an effective strategy for improving students' understanding and learning (Bicalho et al., 2020; Souza; Hoffmann, 2019).

A solid mathematical education is fundamental for academic success and for the exercise of citizenship. Projects that unite technology, pedagogical innovation, and university extension reveal themselves as promising paths to enhance the quality of education, preparing students for future challenges they will encounter in the job market and in society (Viana et al., 2022; Maruyama; Silva, 2023).

The implementation of innovative methodologies in mathematics education is vital to address the learning gaps identified in educational assessments. One phenomenon worth highlighting is the relationship between working memory and performance in mathematics. Studies show that working memory plays a crucial role in mathematical learning, as difficulties in this area impair students' ability to develop

necessary mathematical skills (Corso; Dorneles, 2012). Given its importance, it is essential that curricula incorporate strategies that help students strengthen this cognitive capacity, using activities that promote reasoning practice and problem solving.

Moreover, the challenges encountered in High School mathematics education cannot be ignored. Teachers and students face barriers that hinder the construction of meaningful knowledge. A study highlights that social innovation in pedagogical practices is an approach that can offer solutions to these difficulties, emphasizing the importance of theoretical and conceptual analysis in mathematics teaching (Bernardo, 2021). This analysis enables critical reflection on the roles of teachers and classrooms, which is essential to create an environment conducive to learning.

Project-based learning emerges as a promising alternative to transform mathematics classes. This stimulating approach allows students to develop practical and theoretical skills in real-world contexts (Santos, 2024). Integrating projects that connect mathematics to students' daily lives and realities is an effective strategy, as it fosters student engagement and motivation, helping them to see the relevance of mathematics in their lives. This connection facilitates learning and improves knowledge retention.

Assessment plays a fundamental role in mathematics education, functioning not only as a means of measuring student performance but also as a tool to inform and adjust pedagogical practices. A study points out that results from assessments such as the Basic Education Assessment System (SAEB) should be used to guide pedagogical planning, promoting integration between assessment and teaching (Campos et al., 2023). This practice contributes to more personalized and efficient teaching capable of meeting students' individual needs and diverse educational contexts.

Teacher training is also a critical aspect that affects the quality of mathematics education. Practical experiences during supervised internships are essential learning opportunities that can directly influence teaching practice (Sousa; Lima, 2023). Classroom observation and the application of innovative methodologies during internships allow future educators to reflect on their practices and expand their didactic repertoire. In this sense, incorporating content that promotes critical mathematics education in initial teacher training is fundamental to preparing educators equipped for

contemporary teaching challenges (Cintra et al., 2022).

Finally, the inclusion of contemporary topics such as financial education in schools is a growing necessity, as it connects mathematics to the practical challenges students face in their daily lives. This approach not only teaches mathematical concepts but also provides students with valuable skills for managing their personal finances and for life in society (Silva; Selva, 2020). The methodology that integrates mathematics with practical education has the potential to improve students' relationship with the subject, making it more accessible and meaningful.

3 METHODOLOGY

This article describes the initial phase of the action research, encompassing the diagnosis, planning, and development of didactic materials, video lessons, and exercise lists designed to support the teaching of Mathematics. The next stage, focused on evaluating the impact of the intervention on students' learning, will be conducted at a later moment, based on quantitative and qualitative instruments currently under development. This delimitation ensures methodological rigor and clearly defines the scope of the study as an account of the development and implementation of an innovative, collaborative, and inclusive educational proposal.

The project adopts a qualitative methodology, with a descriptive and applied character, designed to understand and directly intervene in the teaching–learning process. In this sense, action research was chosen as the central strategy, as it enables interaction among researchers, teachers, and students, fostering the collective construction of solutions to challenges faced in Mathematics Education. This method values the direct involvement of students, not only as receivers of content but as active participants in constructing their own knowledge. This approach makes the process more dynamic and reflective, as it allows identifying concrete problems in the school environment and proposing immediate actions to help overcome the difficulties observed.

With the aim of promoting greater understanding of mathematical concepts, the project developed a series of video lessons focused on essential content from the Final Years of Elementary School and High School. Each video, planned with a duration of 15 to 20 minutes, was made freely available on an easily accessible platform so that

any student could use it as a study support resource. The choice of a digital, audiovisual format sought to respond to contemporary learning demands, considering that many students are already familiar with the use of the internet as a source of information and learning.

The content of the video lessons was developed to integrate explanations of the theoretical foundations of Mathematics with their practical applications in everyday life. This articulation allows students to build a solid conceptual foundation and understand the usefulness of the subject in different contexts. The methodology employed encourages active participation, supports the development of logical reasoning, and stimulates problem solving, contributing to significantly and contextually improving students' conceptual understanding and academic performance.

Another central aspect of the project is the use of problem solving as the structuring axis of the lessons. This methodology is developed in stages that involve understanding the problem statement, planning solution strategies, executing the plan, and critically reviewing the results obtained. This sequence stimulates logical reasoning, analysis, and reflection on the learning process, allowing students to participate in an active and conscious way. Thus, the project supports the development of intellectual autonomy, critical thinking, and the ability to apply mathematical knowledge in different contexts.

Complementing the video lessons, each topic is accompanied by an exercise list that reinforces learning, encouraging students to put into practice what they have studied. This resource promotes active participation, as it requires the student to mobilize the concepts presented to solve different situations, which contributes to consolidating mathematical reasoning. In addition, constant practice fosters the development of investigative skills and increases confidence in the use of content, preparing young people for new academic challenges and for life in society.

4 RESULTS AND DISCUSSIONS

4.1 Results

The main result of the Matemática Virtual project consists of the creation of a digital collection of thematic video lessons and exercise lists, hosted on a public YouTube® channel. The lessons, with an average duration of 15 minutes, address

essential content from the Final Years of Elementary School and High School, such as functions, arithmetic and geometric progressions, financial mathematics, and statistics, and are accompanied by support materials aimed at practicing and reinforcing the concepts.

The main result of the Matemática Virtual project consists of the creation of a digital collection of thematic video lessons and exercise lists, freely available on an open YouTube® channel. This collection was designed to offer students from the Final Years of Elementary School and High School an accessible, attractive, and pedagogical alternative to traditional teaching, contributing to overcoming difficulties in essential mathematical content.

The video lessons, with an average duration between 15 and 20 minutes, address structuring topics of school Mathematics, such as first- and second-degree functions, exponential functions, arithmetic and geometric progressions, financial mathematics, and statistics. Each video is organized from the theoretical explanation of the concepts, followed by the resolution of practical examples that demonstrate the applicability of mathematics in everyday situations. This structure was designed to support conceptual understanding and logical reasoning, promoting active and autonomous learning.

In addition to the video lessons, the project produced exercise lists corresponding to each topic, intended to reinforce the content studied and encourage systematic practice. The activities present contextualized problems and varied levels of difficulty, allowing students to consolidate learning and develop autonomy in problem solving. The lists can also be used by teachers as support materials in the classroom, expanding the reach and pedagogical usefulness of the project.

The production of the materials involved collaboration between the supervising professor and scholarship-holder students, who participated in the stages of planning, recording, editing, and publishing the video lessons. This cooperation broadened the formative character of the project, integrating teaching, research, and extension in an articulated way. The involvement of students provided practical experiences in producing educational content and using digital technologies, strengthening their pedagogical and communication skills. In addition, this interaction brought the university closer to the school community, consolidating the institution's role as an agent of transformation and dissemination of innovative practices in Mathematics

Education.

Figures 1 and 2 present examples of the products resulting from the project, highlighting the didactic format of the video lessons and the exercise lists developed.

Figure 1: Example of video lesson

MATEMÁTICA VIRTUAL

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Exemplo 2
Em uma PA de razão 5, cuja soma dos 50 primeiros termos é 6625, qual é o 50º elemento?

$r = 5$
 $S_{50} = 6625$
 $n = 50$
 $a_n = ?$

$a_n = a_1 + (n-1) \cdot r$
 $a_n = a_1 + (50-1) \cdot 5$
 $a_n = a_1 + 49 \cdot 5$
 $a_{50} = a_1 + 245$

$S_n = \frac{(a_1 + a_n) \cdot n}{2}$
 $6625 = \frac{(a_1 + a_{50}) \cdot 50}{2}$
 $6625 = (2a_1 + 245) \cdot 25$
 $6625 = 2a_1 \cdot 25 + 245 \cdot 25$
 $6625 = 2a_1 \cdot 25 + 6125$
 $6625 - 6125 = 2a_1 \cdot 25$
 $500 = 2a_1 \cdot 25$
 $500 = 50a_1$
 $a_1 = 10$

Uniarp

Source: Hupalo (2024).

Figure 2: Example of exercise lists

Lista de Exercícios de Fixação

QUESTÃO 01 **UNIM**
A respeito da seguinte proposição: "Se x é um número real, então $x^2 \geq 0$ ". Qual das alternativas abaixo é verdadeira?
a) Falsa.
b) Verdadeira.
c) Não é possível determinar.
d) Não se aplica.

QUESTÃO 02 **UNIM**
Seja $f: \mathbb{R} \rightarrow \mathbb{R}$ uma função definida por $f(x) = x^2 - 4x + 5$. Qual o valor de $f(2)$?
a) 1.
b) 2.
c) 3.
d) 4.

QUESTÃO 03 **UNIM**
Um triângulo retângulo tem hipotenusa de 10 cm e um dos catetos de 6 cm. Qual o valor do outro cateto?
a) 4 cm.
b) 5 cm.
c) 6 cm.
d) 7 cm.

QUESTÃO 04 **UNIM**
Seja $f: \mathbb{R} \rightarrow \mathbb{R}$ uma função definida por $f(x) = x^2 - 4x + 5$. Qual o valor de $f(2)$?
a) 1.
b) 2.
c) 3.
d) 4.

QUESTÃO 05 **UNIM**
Seja $f: \mathbb{R} \rightarrow \mathbb{R}$ uma função definida por $f(x) = x^2 - 4x + 5$. Qual o valor de $f(2)$?
a) 1.
b) 2.
c) 3.
d) 4.

QUESTÃO 06 **UNIM**
Seja $f: \mathbb{R} \rightarrow \mathbb{R}$ uma função definida por $f(x) = x^2 - 4x + 5$. Qual o valor de $f(2)$?
a) 1.
b) 2.
c) 3.
d) 4.

QUESTÃO 07 **UNIM**
Seja $f: \mathbb{R} \rightarrow \mathbb{R}$ uma função definida por $f(x) = x^2 - 4x + 5$. Qual o valor de $f(2)$?
a) 1.
b) 2.
c) 3.
d) 4.

QUESTÃO 08 **UNIM**
Seja $f: \mathbb{R} \rightarrow \mathbb{R}$ uma função definida por $f(x) = x^2 - 4x + 5$. Qual o valor de $f(2)$?
a) 1.
b) 2.
c) 3.
d) 4.

QUESTÃO 09 **UNIM**
Seja $f: \mathbb{R} \rightarrow \mathbb{R}$ uma função definida por $f(x) = x^2 - 4x + 5$. Qual o valor de $f(2)$?
a) 1.
b) 2.
c) 3.
d) 4.

QUESTÃO 10 **UNIM**
Seja $f: \mathbb{R} \rightarrow \mathbb{R}$ uma função definida por $f(x) = x^2 - 4x + 5$. Qual o valor de $f(2)$?
a) 1.
b) 2.
c) 3.
d) 4.

Source: the authors(2025).b

Up to this point, the Matemática Virtual channel gathers a growing number of views and interactions, which demonstrates the interest of students and teachers in the published content. The project has been consolidating itself as a complementary pedagogical resource that encourages engagement and supports the consolidation of mathematical learning, representing an important contribution from the university to strengthening regional basic education.

4.2 Discussions

The analysis of the results in light of the literature indicates that the use of open digital resources enhances engagement and meaningful learning (Mendes; Proença; Moreira, 2022). The Matemática Virtual channel, by freely providing contextualized content, contributes to the democratization of access to knowledge and to strengthening the relationship between the university and the community (Uliana et al., 2023).

The analysis of the results allows reflection on the pedagogical and social potential of the Matemática Virtual project. The initiative shows that the use of accessible digital resources can significantly contribute to addressing learning gaps, especially in contexts of educational vulnerability, as argued by Mendes, Proença and Moreira (2022) and Maruyama and Silva (2023).

The use of open video lessons represents a form of democratizing knowledge, as it enables access to quality content regardless of students' geographical location or socioeconomic conditions. This perspective aligns with the view of Uliana et al. (2023), who highlight the role of university extension in integrating university, school, and community, promoting innovation and inclusion in teaching.

Furthermore, the adopted format supports active learning and student motivation, aspects considered decisive for educational success (Paula, 2021; Huang; Zhang, 2021). By combining conceptual explanations with practical examples and applied activities, the video lessons strengthen students' self-confidence, reducing the anxiety often associated with Mathematics and promoting greater engagement with the subject.

The project also reinforces the importance of problem solving as a structuring axis of mathematics teaching (Proença, 2020; Gardin; Rodrigues; Teixeira, 2020). This approach stimulates critical thinking, autonomy, and the ability to apply knowledge in different contexts, competencies essential for students' academic and professional development.

Although the quantitative impact on student performance has not been measured at this stage, the preliminary results indicate a positive reception and a transformative potential of the initiative. The production and dissemination of digital content in Mathematics contribute not only to individual learning but also to

strengthening scientific and technological culture within the school community.

Finally, Matemática Virtual reaffirms the role of universities as agents of educational innovation. Extension projects that combine technology, active methodology, and social commitment represent effective pathways to address structural challenges in Brazilian education, such as school dropout and low proficiency in Mathematics (Bassetto, 2019; Nunes; Lemos; Alves, 2023). Thus, the experience reported confirms that the integration between teaching and extension is capable of producing lasting impacts on the quality of learning and on the formation of citizens better prepared for the challenges of the twenty-first century.

5 FINAL CONSIDERATIONS

The Matemática Virtual project demonstrates its relevance as an effective strategy for addressing learning gaps in Mathematics, especially among high school and higher education students. Through accessible video lessons that cover fundamental content clearly and with practical application, the project contributes to educational inclusion, expanding access to mathematical knowledge for students in different social and geographical contexts.

The use of open-access technologies such as YouTube® allows the content to reach a broad and diverse audience, surpassing the physical barriers of traditional classrooms. This democratic nature of the project enhances its contribution to reducing school dropout rates, as it offers students complementary learning resources that can be accessed at any time and place, promoting autonomy and student protagonism in the educational process.

Furthermore, the project reaffirms the importance of innovative pedagogical practices in Mathematics teaching, valuing methodologies that dialogue with the real needs of students and the contemporary challenges of education. By investing in the production of high-quality digital content, the Matemática Virtual project directly contributes to the formation of citizens better prepared for the job market, for the continuation of their studies, and for active participation in society.

Despite the positive results, the project still faces challenges. Among its weaknesses, the need for systematic evaluation of the impact of the video lessons on student performance stands out, as well as the expansion of dissemination among teachers and schools—especially in the region covered by the university to which the

project is linked—along with the production of more personalized content for different learning levels. As suggestions for continuity and improvement, it is recommended to: (1) establish partnerships with educational institutions for curricular integration of the videos; (2) conduct evaluation studies with students and teachers; and (3) expand production to other areas of Mathematics and related Sciences, ensuring constant updating of the collection. These actions can certainly strengthen even more the role of the project as a transformative tool in Mathematics Education.

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