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KHAN ACADEMY AS A TOOL FOR TEACHING MATHEMATICS: RESEARCH ON THE USE OF GAMIFICATION IN STUDENT MOTIVATION

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ABSTRACT

This study investigates the contributions of the Khan Academy platform, with an emphasis on gamification, to the motivation of basic education students in mathematics teaching. The research was carried out during a school bimester with a 3rd grade class of High School at IFPI – Campus Picos, using a qualitative approach and methods of non-participant observation and questionnaire for data collection. The data were analyzed through Laurence Bardin's Content Analysis, through the technique of thematic and categorical analysis, highlighting the relevance and positive impact of this approach in the educational context. Gamification has proven to be an effective tool to increase student motivation, creating a more dynamic and engaging learning environment, making mathematical learning more accessible and interesting. Thus, most students showed greater interest and dedication to the study of mathematics. In this way, Khan Academy demonstrates great potential to strengthen mathematics education, but it requires a collaborative effort from educators, school administrators, and policymakers to maximize its benefits, because only through a balanced and conscious integration of technologies in the educational environment will it be possible to provide quality education that motivates and empowers all students.

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INTRODUCTION

Mathematics is one of the fundamental subjects in the school curriculum, standing out for the diversity of topics and levels of abstraction that it requires from students. Given this complexity, it is necessary to adopt innovative approaches in the teaching of mathematics to facilitate students' understanding.

Technological innovations play a crucial role in this process, offering tools that make learning faster and more dynamic. The modernization of computers and *smartphones*, with specific applications and *software* , makes it possible to explore new educational scenarios, especially in the teaching of mathematics (Borba; Silva; Gadanis, 2018).

In this context, technological integration requires an adaptation in the pedagogical approach, transforming the role of the teacher from a transmitter of knowledge to a facilitator of learning. Technologies, such as those offered by *Khan Academy*, do not replace the teacher, but enrich teaching, providing personalization and greater student engagement.

The use of educational technologies, such as *Khan Academy*, has proven to be an important ally in the teaching of mathematics, especially in basic education. This platform uses interactive resources, explanatory videos, and gamification techniques to help students understand, assimilate, and retain content.

Silva (2021) states that gamification can be used to develop skills, changing behaviors and improving people's lives. Therefore, it is notorious the reasons why gamification has gained more and more visibility in the educational environment, attracting more and more people interested in its ability to motivate users to succeed in their goals.

Based on this scenario, this study seeks to investigate how gamification on the *Khan Academy platform* can contribute in the teaching of mathematics to the motivation of basic education students, resulting in a more effective and engaging teaching.

The topics that structure this study are presented below. The first topic defines and clarifies the concept of gamification, highlighting its application in mathematics teaching. In the second topic, it is discussed how gamification can enhance the motivation of students in the teaching-learning process of mathematics. The third topic focuses on the *Khan Academy* platform, exploring its features and benefits.

Next, the methodological structure of the study is detailed, including the methodological approach, the research scenario and selection of participants, the data collection and analysis procedures, and the ethical guidelines followed. Then, the analyses

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and discussions of the results obtained are presented. Finally, the study concludes with the final considerations.

GAMIFICATION IN THE CONTEXT OF MATHEMATICS TEACHING

The concept of gamification is directly related to the idea of game, but it is not about video games or board games applied in the classroom, a practice known as *Game Based Learning*. Gamification, on the other hand, uses game elements in activities that are not essentially games, applying game-characteristic mechanics and dynamics to make other tasks more engaging and motivating.

Games, naturally, attract for their ability to provide fun and entertainment. Gamification takes advantage of this attractiveness to transform non-playful tasks into activities that motivate and engage, using strategies that include competition, individual progress, and rewards, which makes learning less boring and more pleasurable.

Motivation is central to gamification, as accomplishing tasks and accomplishing goals become the reward itself. Gamification creates an environment where students feel challenged and engaged, leading to attention retention and effective learning. This explains its growing popularity in several areas, including education.

While the concept of gamification does not have a universal definition, it is commonly understood as the use of game elements to encourage participation and engagement in non-gaming activities. Deterding et al. (2011) and Werbach and Hunter (2012) define gamification as the application of these elements to motivate user participation in different contexts.

In education, gamification is not a magic bullet; Its success depends on the clarity of the objectives and the correct application of the methods. Corrêa (2021) argues that gamification can be seen both as a mechanic, focused on the benefits for teaching and learning, and as a theme, which contextualizes its historical and technological evolution.

Official documents such as the National Curriculum Parameters (PCNs) and the National Common Curriculum Base (BNCC) guide the organization of the school curriculum in Brazil and recognize the need to streamline classes to make them more meaningful. Although the BNCC does not directly mention gamification, it highlights the importance of active methodologies and the use of digital technologies in the educational process, which includes gamified approaches.

Gamification can make classes more dynamic and engaging, promoting the

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development of collaboration, problem-solving, and creativity skills. In a math class, for example, gamification can create an environment conducive to learning, making content more accessible and meaningful for students.

The gamified learning environment, by stimulating emotions and curiosity, makes the educational process more effective. Werbach and Hunter (2012) emphasize that even in serious contexts such as work or education, an environment that arouses positive emotions can significantly improve engagement and learning.

One of the great advantages of gamification is that it allows students to practice and face challenges without the fear of making mistakes. In games, mistakes are seen as part of the learning process, which can relieve pressure and encourage more active and confident participation by students.

In summary, gamification in teaching offers a methodology that makes learning more engaging and effective, while promoting the development of essential skills for student success.

GAMIFICATION AS A MOTIVATION ENHANCER

The study of learning is old, and several theories have been developed over time. One of these is heutagogy, which places the student in exclusive charge of his or her learning, encouraging the creation of motivating educational scenarios. This scenario is conducive to the use of gamified solutions in education, which, according to Alves (2014), take advantage of memory, where sensory representations are consolidated and recalled by associations with new experiences.

Short-term memory, transient, plays a minor role in learning, while long-term memory, with permanent characteristics, is fundamental. Gamification can facilitate this memory transfer by incorporating elements that the student considers relevant, such as motivation, which is crucial in the learning process. According to Alves (2014), motivation is one of the main factors responsible for the growing interest in gamification.

Motivation can be intrinsic, arising from internal motives, or extrinsic, motivated by external factors. Nevid (2012) describes motivation as the process that guides behaviors towards specific goals, involving biological, emotional, social, and cognitive forces. Intrinsic motivation involves self-satisfaction, such as reading a book for the pleasure of reading, while extrinsic motivation seeks external rewards, such as better grades.

Authors such as Huang and Soman (2013), Bussarello (2016) and Ortiz-Colón,

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Jordán and Agredal (2018) highlight that gamification in the educational context connects the intrinsic and extrinsic motivation of the student, increasing their engagement. Tavares (2023) argues that gamification, by introducing elements of healthy competition, can boost intrinsic motivation, while Moreira (2023) sees it as a tool that awakens extrinsic motivation by using external stimuli as rewards.

Burke (2015) adds that gamification, by fragmenting large goals into smaller challenges, stimulates emotional commitment, aligning the student's goals with those of the organization. Thus, gamification in education shapes behaviors, promotes engagement, and increases student motivation.

Therefore, by incorporating game elements into teaching, gamification becomes an active methodology that places the student as the protagonist of their learning, making the process more enjoyable and captivating. The motivational engagement generated by this approach contributes to the fixation of the content in long-term memory, promoting meaningful learning.

THE *KHAN ACADEMY PLATFORM*

The *Khan Academy platform*, according to Oliveira (2017), is a non-profit virtual tool that offers video classes and exercises in various disciplines, such as Mathematics, Physics, Biology and Chemistry. Unlike traditional education, where the teacher must keep up with the pace of the class, *Khan Academy* allows students to learn at their own pace, taking control of their progress.

Khan Academy is an excellent tool to support teaching-learning, facilitating learning, reinforcing content, and promoting student protagonism. The platform's methodology stimulates curiosity and autonomy, allowing students to learn at their own pace, which makes it a valuable alternative to traditional teaching, as Paulo Freire already advocated in the 1990s.

The platform monitors student performance during the learning process and stands out for its gamified approach, making the study of subjects such as Mathematics more creative and fun. Gamification, when incorporated into the platform, encourages learning through challenges, rewards, and a points system that motivates students to engage more actively with the content.

Gamification, present at *Khan Academy*, is designed to make learning fun and challenging by promoting skills such as decision-making, logical reasoning, and

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concentration. The platform rewards students' efforts with energy points and medals, positively reinforcing the time and commitment dedicated to activities, which keeps students motivated to continue.

For teachers, *Khan Academy* offers detailed tracking of student activities, allowing them to monitor both individual and collective progress. The platform allows the customization of activities, adjusting them to the needs of students, and offers immediate *feedback* to help each student's development.

Khan Academy*'s* feedback *system* is crucial to the learning process, as it allows students to identify areas of difficulty and seek to improve their knowledge. Immediate and personalized feedback, according to Zainuddin et al. (2020), promotes more effective and lasting learning.

The videos on *Khan Academy*, usually about 10 minutes long, are a key part of the learning process. They offer examples and explanations that help students solve problems, alleviating the cognitive load. The Lemann Foundation has translated many of these videos into Portuguese, making it easier for Brazilian students to access the content.

Khan *Academy* is organized to serve students from elementary to higher education, offering content aligned with the BNCC for subjects such as Mathematics and Portuguese. The platform promotes the development of skills and abilities, offering a gamified and engaging learning environment.

Khan Academy*'s interface* is designed in a gamified way, rewarding students as they progress through activities. Elements such as internal competitions, medals, and avatar enhancement encourage participation and make the learning process more engaging and game-like.

Khan Academy*'s effectiveness* in teaching depends on both the resources it offers and how it is used. It is essential that teachers are familiar with the platform's tools to conduct dynamic, creative, and safe classes, maximizing the benefits of gamification in the educational process.

The *Khan Academy* platform, by integrating technology and gamification, represents an innovative and effective approach to teaching, providing students with a flexible and personalized learning environment that promotes integral development and autonomy in the learning process.

5 METHODOLOGICAL APPROACH

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This article comes from an excerpt from a master's thesis of the Professional Master's Degree in Mathematics in National Network (PROFMAT) program. This research is classified as applied research, according to the taxonomy of Prodanov and Freitas (2013), for generating knowledge aimed at practical application, specifically in the teaching of mathematics in basic education, using gamification to improve student motivation and performance. This approach is exploratory, as it seeks to deepen the understanding of the problem and build hypotheses based on interviews and practical observations, as defined by Gil (2010).

From the point of view of technical procedures, the research is characterized as field research. This classification is based on direct observation and data collection in the environment where the phenomena occur naturally, allowing a detailed analysis of the variables under study, such as the impact of gamification on student motivation and performance. Field research, according to Gil (2010), offers more accurate and economical results, since it takes place at the site of the events and does not require special equipment.

Finally, the research approach is qualitative, since the study focuses on human relationships and their interactions with the analyzed variables, without intentional manipulation by the researcher. Qualitative research is essential to understand the social dynamics involved, structuring knowledge from behavioral observations in the educational environment, especially in relation to the use of gamification in mathematics teaching.

RESEARCH SCENARIO AND SELECTION OF PARTICIPANTS

The survey was conducted in the city of Picos, located in the Center-South of Piauí, with a population of approximately 83,090 inhabitants, according to the 2022 census. In educational terms, Picos has schooling rates and Basic Education Development Index (IDEB) below state and national averages, except in high school. The city's educational structure includes the offer of elementary education through the municipal and state networks, and high school through the state and federal networks.

The study was carried out at the Federal Institute of Education, Science and Technology of Piauí (IFPI) - Picos Campus, an institution specialized in technical and technological education. Inaugurated in 2007, IFPI offers technical courses integrated with high school, in addition to higher education. The research focused on high school classes integrated with technical education, using a practical approach in the classroom and

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accompanying students through the platform studied.

The choice of IFPI as the research scenario is due to its advanced infrastructure and the semi-full-time teaching modality, which facilitates the realization of activities at alternative times. The sample was composed of a class of the 3rd year of high school integrated with the technician in Electrotechnics, initially with 23 students, of which 17 participated until the end of the study. The selection of the class took into account criteria such as difficulties in mathematics and low academic performance.

PRACTICAL USE OF THE *KHAN ACADEMY PLATFORM*

The study used the *Khan Academy* platform as pedagogical support, using it on three main fronts: as a resource for practical classes, review of topics and homework assignments. During classes, students were encouraged to solve problems on the platform related to the day's content. At the end of the units, additional activities and tests were recommended to reinforce learning, while videos and articles were indicated as tasks to be done outside of school hours.

At the first meeting, students were introduced to gamification and using *Khan Academy*, including a tutorial on how to navigate the platform, access recommended activities, and track their progress. Each week, the students received new activities as homework, and a weekly class was dedicated to practicing the topics discussed in class. The platform was chosen for its comprehensiveness, which includes content from elementary school to higher education subjects, allowing for precise alignment with BNCC skills.

The contents initially covered included Spatial Geometry, followed by topics of Quantities and Measures, such as ratio and proportion, in addition to Analytic Geometry, even without a specific BNCC skill for the latter. The choice of content followed the guidance of the class's head teacher, with *Khan Academy* serving as a support tool, especially relevant in the context of the last two school months, when students were preparing for the National High School Exam (ENEM).

The recommended activities were monitored and, at the end of the established periods, the students who obtained the best results were awarded, using criteria such as the mastery goal, learning time on the platform and the number of skills practiced. These awards were based on the idea that rewards can motivate students to engage more in activities. These activities and awards were structured to stimulate students' extrinsic

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motivation, a strategy supported by several authors who claim that rewards can arouse interest and increase motivation for learning.

DATA COLLECTION AND ANALYSIS

Data collection is essential in qualitative research, being developed through observations, interviews and document analysis. This study used three main instruments: non-participant observation, questionnaire application, and use of the *Khan Academy platform*. The observation was carried out in the classroom, with the objective of verifying the use of the platform, the difficulties encountered by the students and their level of engagement in the proposed activities.

The questionnaire, applied via *Google Forms*, was chosen as a data collection instrument for its efficiency, speed and anonymity, allowing students to answer the questions in writing and spontaneously. Composed mainly of open-ended questions, the questionnaire sought to capture students' perceptions of gamification, what makes them like or dislike mathematics, what motivates them to study mathematics and the aspects of *Khan Academy* that interfered with their motivation.

During the application, the students answered individually under supervision, ensuring the integrity of the answers. The questions were carefully designed to align with the objectives of the survey, seeking to capture accurate data on the impact of gamification on student motivation.

Data analysis followed Laurence Bardin's Content Analysis method, which involves three stages: pre-analysis, categorization, and treatment of the results. In the pre-analysis, the answers were organized and tabulated, facilitating subsequent categorization, where significant phrases were used as registration units. This systematization allows a clear understanding of the messages and facilitates the categorization and interpretation of the data.

In the categorization stage, the answers were classified into categories, allowing the thematic analysis of the data collected. The treatment of the results involved a critical reflection on the categories, seeking patterns and comparisons that could unify different themes and concepts. This process ensures a rigorous and accurate interpretation of the results, allowing inferences relevant to the research.

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ETHICAL CONSIDERATIONS

This work, derived from a master's thesis of the PROFMAT program, followed all the ethical guidelines required by the program, although it was not appreciated by an ethics committee due to the limited time allocated to carry out the research. Measures were adopted to ensure the consent and privacy of the participants, including consent forms signed by all those involved, and, in the case of minor students, by their guardians. The identity of the participants was preserved, with the signing of a confidentiality agreement, ensuring that the data collected would be treated confidentially and the information would be disclosed collectively and if there was a need for individual disclosure, the identity of the respondent would be preserved.

Ensuring confidentiality, the participants were informed in advance when answering the questionnaire that the information entered in the questionnaire would be intended solely for dissemination in scientific media and anonymously, and it was not necessary to identify themselves when filling out the form. Considering this aspect, in a didactic way, the participants were identified as R1 (Respondent 1), R2 (Respondent 2), R3 (Respondent 3), and so on.

RESULTS AND SOME DISCUSSIONS

The tables created and exposed in this section were elaborated based on the participants' answers, using one of Bardin's Content Analysis methods, namely: Thematic and categorical analysis technique, with the organization of categories by frequency.

When asked if they like to study mathematics, 76.5% of the students said they like to study mathematics, 17.6% do not, and 5.9% have an undefined opinion. The respondents' justifications were organized into three main categories, six subcategories and 17 registration units, reflecting different reasons for their interest in the course, as shown in the following table.

Chart 1 – Reasons that lead students to like or dislike mathematics

Category	Frequency Category	Unit of record	Subcategory	Frequency Subcategory	Unit of record	Context Unit
Positive response	13	"Yes, I like it" (R1).	Understanding	1	"when I understand" (R1).	"I do like it when I understand" (R1).
		"Yes" (R2).	Everyday practice	7	"in everyday actions" (R2).	"Yes. Especially in everyday actions" (R2).

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Category	Frequency Category	Unit of record	Subcategory	Frequency Subcategory	Unit of record	Context Unit
		"Yes" (R5).			"for my whole life" (R5).	"Yes, because I will use mathematics for my whole life" (R5).
		"Yes" (R8).			"present in my daily life" (R8).	"Yes, because it is something that is present in my daily life" (R8).
		"Yes" (R9).			"it is part of our entire daily lives" (R9).	"Yes, mathematics is part of all our daily lives, improving is essential" (R9).
		"I prefer more than languages" (R10).			"It is a matter of practice and half theory" (R10).	"I prefer more than languages. It is a matter of practice and half theory" (R10).
		"Yes" (R14).			"When I succeed, *we put* it into practice [...] in my daily life" (R14).	"Yes. I like to challenge myself to understand and solve problems, especially when I can *put* them into practice in a useful way in my daily life" (R14).
		"Yes" (R15).			"it's something that we see and apply on a daily basis" (R15).	"Yes, because it involves numbers and is something that we see and apply on a daily basis and also because it is easier for me to absorb the contents" (R15).
		"Yes" (R7).	Specific conditions	2	"there are basic contents that if mastered well, you *rise* from step to step" (R7).	"Yes. Although it is complicated at a certain level, there is basic content that, if mastered well, you *rise* from step to step

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Category	Frequency Category	Unit of record	Subcategory	Frequency Subcategory	Unit of record	Context Unit
						solving increasingly complex problems" (R7).
		"Yes" (R17).			"when there is no pressure or time limit" (R17).	"Yes, but when there is no pressure or time limit" (R17).
		"Yes" (R4).	No justification	4	-	"Yes" (R4).
		"Yes" (R13).			-	"Yes" (R13).
		"Yes" (R16).			-	"Yes" (R16).
Negative response	3	"No" (R11).			-	"No" (R11).
		"No" (R3).	Difficulty	2	"I have a certain difficulty" (R3).	"No, I have a certain difficulty" (R3).
		"No" (R6).			"I suffer difficulties in making calculations" (R6).	"No, because my base is not solid I suffer difficulties in making calculations" (R6).
Undefined response	1	"More or less" (R12).	A little bit of everything	1	"we have to know everything" (R12).	"More or less, we have to know everything, right" (R12).

Source: The author (2024).

The first subcategory groups students who like mathematics because they can understand it. An example is R1, who appreciates the subject only when he can understand it. Comprehension, therefore, is a key factor in interest in mathematics.

Another subcategory includes students who see mathematics as relevant in their everyday lives. Answers such as "it is present in my daily life" (R8) and "mathematics is part of all our daily lives" (R9) highlight the importance of practical applications as motivation for the study of mathematics. Even students who did not explicitly mention everyday life, such as R5 and R10, justified their fondness for mathematics on the basis of its lifelong usefulness or its practical nature. This suggests that the applicability of mathematics in everyday life is crucial to students' interest.

This view is corroborated by Stoica (2015), who argues that mathematics teaching needs to connect theory with real-world situations to maintain students' interest, avoiding memorization without understanding the concepts.

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Official documents, such as the PCNs and the BNCC, reinforce the importance of teaching mathematics that is meaningful and applicable to the daily lives of students, suggesting approaches that include the history of mathematics, problem solving, and the use of didactic resources.

Students R7 and R17 conditioned their taste for mathematics to specific factors, such as mastery of basic content (R7) and the absence of pressure or time limits (R17), showing that autonomy and confidence in learning are important for interest in the subject.

On the other hand, some students, such as R4, R13, R16 and R11, stated that they liked or disliked mathematics without presenting justifications, which placed them in a separate subcategory, called "without justification".

For students who do not like mathematics, such as R3 and R6, learning difficulty, especially due to a weak foundation in mathematical concepts, was the main reason given. The lack of a solid foundation in mathematics is a significant obstacle to engaging with the discipline.

The concept of the "algebraist teacher" is cited as a contributing factor to students' difficulties. Teachers who focus only on pure algebra, without applying the concepts to the students' reality, make learning more difficult and less attractive. Therefore, it is essential for teachers to consider students' prior knowledge and work to fill existing gaps, facilitating advancement in mathematical learning in a meaningful way that is appropriate to each student's level.

The pedagogical approach must be adapted to the individual needs of students, promoting steady progress in understanding mathematics and preventing everyone from being treated uniformly, which can be detrimental to development.

Finally, R12, who expressed an ambiguous position about liking mathematics, highlighted the importance of having a general understanding of all subjects, reflecting a perception that the study of mathematics is necessary, even if it is not particularly pleasurable for him.

The participants' answers about what motivates them to study mathematics and the justifications for these answers were categorized into four main categories, resulting in 23 registration units, as indicated in the table below.

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Chart 2 – Factors that motivate students to study mathematics

Category	Category Frequency	Registration Unit	Context Unit
Interest and enjoyment in learning mathematics	11	"When I start to like it" (R1)	"When I start to like it, I engage in the content and study" (R1).
		"Learning" (R3).	"Learning" (R3).
		"More understanding" (R4).	"More understanding, and it is necessary in most disciplines" (R4).
		"I will need this knowledge" (R5).	"*What* motivates me the most *is that* I will use mathematics *for* my whole life, in the future I will need this knowledge" (R5).
		"to have more knowledge" (R6).	"Pass the entrance exam and go to college, in addition to having more knowledge" (R6).
		"self-interest" (R7).	"Self-interest, as it is a very interesting subject, and messing with numbers is really complex, but when you manage to get a question right, it is pleasant to know that I am improving more and more" (R7).
		"it is pleasant to know that I am improving" (R7).	
		"*why* I like it" (R9).	"My sister who has a degree in the area and also because I like it" (R9).
		"I like mathematics" (R13).	"I like mathematics thanks to the interesting methods that masters use to solve questions. That catches my attention" (R13).
		"catches my attention" (R13)	
		"satisfaction of getting the question right" (R17).	"The satisfaction of getting the question right feeds the ego and makes all the effort worthwhile" (R17).
Usefulness in everyday life	4	"Understand everyday issues" (R2).	"Understand everyday issues in a complete way" (R2).
		"I'm going to use mathematics *for* my whole life" (R5).	"*What* motivates me the most *is that* I will use mathematics *for* my whole life, in the future I will need this knowledge" (R5).
		"The fact that I am present in my daily life" (R8).	"The fact that it is present in my daily life. Including financial mathematics" (R8).
		"search for a better life" (R16).	"The search for a better life, because without it it is less likely to happen" (R16).
Academic and professional goals	5	"necessary in most disciplines" (R4).	"More understanding, and it is necessary in most disciplines" (R4).
		"Pass the entrance exam and go to college" (R6).	"Pass the entrance exam and go to college, in addition to having more knowledge" (R6).
		"Pass the exams" (R10).	"Pass the exams" (R10).
		"The proofs" (R11).	"The proofs" (R11).
		"Calculations" (R12).	"Calculations" (R12).
Skill development	3	"The challenge of solving problems" (R14).	"The challenge of solving numerical problems and expressions" (R14).
		"ease I have in absorbing the contents" (R15).	"The ease I have in absorbing the contents and the ability to solve mathematical problems" (R15).
		"ability to solve problems" (R15).	

Source: The author (2024).

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The category "Interest and pleasure in learning mathematics" reflects the answers of nine participants who demonstrate that liking mathematics and the desire to acquire new knowledge are essential factors for motivation in the study of the subject. Motivation and engagement in mathematics are, in many cases, linked to the pleasure of learning and interest in the content. R1 and R9 exemplify this relationship, where the pleasure of studying mathematics leads to greater engagement. R1 emphasizes that his involvement increases as he begins to like the subject, while R9, in addition to liking the discipline, is positively influenced by his sister trained in the area.

The teaching method also plays a significant role. R13 expresses that the interest aroused by the methods of solving mathematical questions motivates him to study. The same motivation is observed in R7, which associates the pleasure of solving questions with the feeling of personal progress, reinforcing the importance of an engaging didactic approach.

In addition, R17 highlights that the pleasure of getting questions right, which feeds the ego and rewards effort, is a motivating factor. Personal satisfaction when overcoming mathematical challenges is a recurring theme among students, highlighting the connection between interest, pleasure and motivation.

Other students, such as R3, R4, R5 and R6, also relate their motivation to their interest in knowledge and learning. R3 and R4, for example, mention learning and the search for more understanding as reasons to study mathematics, while R5 and R6 highlight the importance of the knowledge acquired for the future.

The category "Usefulness in everyday life" emerges from the perception that mathematics is useful in everyday life, which motivates students to study it. R2 and R8 point to the comprehension of everyday issues and the presence of mathematics in everyday life as reasons for their interest, while R16 associates mathematical knowledge with the improvement of life.

The third category, "Academic and professional goals," groups students whose motivations are tied to specific goals. R10, for example, is motivated to study mathematics to pass exams, and R6 sees the discipline as essential for success in the entrance exam and in college.

R11 and R12 associate motivation with good performance in tests and calculations, reflecting the importance of short-term academic goals. These students see mathematics

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as a tool to achieve their educational and professional goals, which encourages them to dedicate themselves to the discipline.

For R14 and R15, the development of skills in solving mathematical problems is the main motivation. Both emphasize that the challenge and ease of learning mathematics drive them to study, valuing the improvement of skills.

Gamification is mentioned as an effective strategy to awaken both intrinsic and extrinsic motivation in students. This technique can be tailored to each student's interests and contexts, making learning more engaging and satisfying.

Intrinsic motivation, fueled by interest and enjoyment in mathematics, is crucial for students' deep engagement. Nevid (2012) states that this motivation is linked to self-satisfaction and the pleasure of performing the activity itself, which is evident in the students' responses.

On the other hand, extrinsic motivation, which includes goals such as passing exams and good academic results, is triggered by external rewards. This type of motivation is also important, as it encourages students to achieve goals that require continuous dedication and effort.

Based on this, it can be stated that 78% of the registration units indicated that students are motivated by intrinsic factors, such as interest and pleasure in mathematical learning, usefulness in everyday life, and skill development. In contrast, 22% of the registration units showed that students are motivated by extrinsic factors, such as academic and professional goals.

The participants' answers about how much the use of the *Khan Academy* platform motivated them to study mathematics and the justifications for these answers were categorized into three main categories and eight subcategories, resulting from 22 registration units, as explained in the table below.

Chart 3 – Aspects of *Khan Academy* that interfere with students' motivation when studying mathematics

Category	Freq. of the category	Und. registration	Subcategory	Freq. of the subcategory	Und. registration	Und. Context
Very motivated	12	"Very" (R3).	Ease of learning	5	"made me see math easier" (R3).	"A lot, it made me see math easier" (R3).
		"A lot" (R5).			"I was able to absorb a lot" (R5).	"A lot, because there are many activities, I was able to absorb a

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Category	Freq. of the category	Und. registration	Subcategory	Freq. of the subcategory	Und. registration	Und. Context
						lot with the app" (R5).
		"A lot" (R6).			"interesting initiative regarding student learning" (R6).	"A lot, since it was an interesting initiative in terms of student learning" (R6).
		"A lot" (R8).			"I learned a lot about the proposed contents" (R8).	"A lot, I didn't have much time to access it, but when *I have* the *opportunity* I learned a lot about the proposed contents" (R8).
		"Very" (R16).			"make education much more accessible" (R16).	"A lot, promoting different ways of learning, in addition to making teaching much more accessible" (R16).
			Variety of features	4	"different ways of learning" (R16).	
		"A lot" (R5).			"has many activities" (R5).	"A lot, because there are many activities, I was able to absorb a lot with the *app*" (R5).
		"Very" (R15).			"enormous *variety* of exercises and classes" (R15).	"A lot, because it had a huge variety of exercises and classes" (R15).
		"A lot" (R17).			"synthesizes the contents by offering summaries, videos and justified questions in the same application" (R17).	"A lot, since it synthesizes the contents by offering summaries, videos and justified questions in the same application" (R17).
		"A lot" (R4).	Bug Fixes	1	"because of some mistakes, then it motivates more to go after the content" (R4).	"A lot, because of some mistakes, then it motivates more to go after the content" (R4).

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Category	Freq. of the category	Und. registration	Subcategory	Freq. of the subcategory	Und. registration	Und. Context
		"A lot" (R9).	Incentive and reward	2	"we get daily points and this motivates us to seek more" (R9).	"A lot, it's a cool tool to study. because in the app we get daily points and this motivates us to seek more" (R9).
		"A lot" (R13).			"*it encourages* the student to always go further and rewards them with points" (R13).	"Very much, therefore, the platform *encourages* the student to always go further and bonuses them with points" (R13).
		"Very" (R2).	Time limitation	6	"because of the weather, it was kind of unfeasible" (R2).	"A lot, but because of the time it was kind of unfeasible" (R2).
		"A lot" (R8).			"I didn't have much time to access it" (R8).	"A lot, I didn't have much time to access it, but when *I have* the *opportunity* I learned a lot about the proposed contents" (R8).
		"Very" (R10).			"due to my time I could not focus on solving the issues of the platform" (R10).	"A lot, but due to my time I couldn't focus on solving the platform's issues. After ifpi and reducing responsibilities, I will focus on studying because I will have more time" (R10).
Not very motivated	4	"Little" (R1).			"not *being able* to organize my time" (R1).	"Little, not *being able* to organize my time to solve some issues on the platform" (R1).
		"Little" (R7).			"because of the time and workload I have" (R7).	"Little, but not because the platform is bad, but because of the time and workload I have, without much time to practice on the platform, it ends up not being possible to pay
					"without much time to practice on the platform" (R7).	

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Category	Freq. of the category	Und. registration	Subcategory	Freq. of the subcategory	Und. registration	Und. Context
						attention to it" (R7).
		"Little" (R12).	No justification	1	-	"Little" (R12).
		"Little" (R14).	Relevance of the content to the objectives	2	"the content that was covered on the platform is not charged in most entrance exams" (R14).	"Little. *1°* that the content that was covered on the platform is not charged in most entrance exams. Considering that I am at the end of high school, the tendency is that it does not make a significant difference in my specific learning for daily and professional life, which justifies a lower engagement in the content" (R14).
					"I'm at the end of high school, the tendency is that it doesn't make a significant difference in my learning" (R14).	
Not motivated	1	"did not motivate" (R11).	No motivation	1	"The platform did not motivate" (R11).	"The platform did not motivate, but the teacher encouraged a lot" (R11).

Source: The author (2024).

Of the 17 survey participants, 12 indicated that the *Khan Academy* platform was a significant motivation for studying mathematics. Of these, R3, R5, R6, R8 and R16 highlighted ease of learning as the main motivating factor. Responses from these participants reveal that *Khan Academy* has made math more accessible and understandable, making it easier to absorb content and providing a more effective learning experience.

In addition to the ease of learning, R5, R15, R16, and R17 also highlighted the variety of features available on the platform as a positive aspect. The diversity of activities, exercises, and lessons offered by *Khan Academy* has contributed to keeping students engaged and interested in the study of mathematics, helping them to consolidate the knowledge acquired in a practical and interactive way.

These elements—ease of learning and variety of resources—are seen as stimulating students' intrinsic motivation. According to Burke (2015), intrinsic motivation is awakened when individuals feel autonomy and progress towards mastering a theme. *Khan*

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Academy, by using gamification techniques and breaking down big goals into smaller challenges, fosters this sense of progress, encouraging students to engage more and more in the learning process.

On the other hand, R9 and R13 mentioned that the incentives and rewards offered by the platform are the main motivating factors for them. These students feel encouraged to continue studying due to the possibility of accumulating points and receiving bonuses, characteristics of extrinsic motivation, where external rewards play a central role.

R4 presented a different perspective, stating that his mistakes during the practice of activities at *Khan Academy* motivated him to study more. The platform offers immediate *feedback* on performance, allowing students to identify areas of difficulty and seek improvement. For R4, mistakes have become learning opportunities, aligning with the view that mistakes can be a path to new knowledge.

While many students reported benefits from using *Khan Academy*, R2, R8, and R10 highlighted that the lack of time available prevented them from using the platform more effectively. These participants expressed interest in continuing to use *Khan Academy* in the future, but acknowledge that the time constraint was a significant obstacle to fulfilling the proposed activities.

R1 and R7 also mentioned that *Khan Academy* produced little motivation for the study of mathematics, mainly due to a lack of time to devote to the platform. Both recognized that the platform is not inadequate, but their daily obligations and extensive workload limited the time available to engage in activities.

This external factor—time constraints—reveals a paradox: While *Khan Academy* uses gamification to motivate students, a lack of time due to other commitments prevents them from fully benefiting from the platform's motivational techniques. Reorganizing time can be a solution for students, but *Khan Academy* could also explore additional strategies to help students better manage their time.

R14 presented another criticism of the platform, highlighting that the content covered was not relevant to his academic and professional goals. He stated that, because he was at the end of high school, the contents recommended on the platform, such as Analytic Geometry, did not make a significant difference in his preparation for entrance exams and daily life, which resulted in lower engagement with the platform.

Finally, R12 and R11 also reported that *Khan Academy* gave them little motivation, although R12 did not provide justification for their response. R11, in turn, stated that,

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although the platform did not motivate him, the teacher's encouragement was an important factor for his study of mathematics.

These reports indicate that despite the advantages offered by *Khan Academy*, the platform may not serve all students equally, depending on their goals, time availability, and learning context.

FINAL CONSIDERATIONS

This research investigated the role of gamification in the *Khan Academy* platform as a tool for teaching mathematics in basic education, with a focus on student motivation. The conclusions obtained from the results and discussions highlight the relevance and positive impact of this approach in the educational context.

The data collected showed that gamification is a powerful tool to increase student motivation, creating a more dynamic and engaging learning environment. However, the effectiveness of this tool depends on a careful and balanced implementation, which takes into account both the benefits and the limitations identified.

The analysis of the results showed that, when well applied, gamification can transform the mathematics learning experience, making it more accessible and interesting for students. When exploring the impact of gamification on student motivation, a significant increase in interest and dedication to the discipline was observed by most participants.

The introduction of playful and interactive elements in learning has managed to make the process more attractive, encouraging students to actively engage with the contents. This added motivation was crucial not only for improving academic performance but also for creating a more positive and collaborative classroom environment.

In summary, the *Khan Academy* platform, with its gamified approach, has great potential to strengthen the teaching of mathematics in basic education. However, to maximize its benefits, a joint effort by educators, school managers, and public policy makers is essential. Only through a balanced and conscious integration of technologies in the educational environment will it be possible to provide quality education that motivates and empowers all students.

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