

ARITHMETIC IN EXCEL: MICROSOFT'S SILENCE ON GLOBAL EDUCATION

ARITMÉTICA NO EXCEL: O SILÊNCIO DA MICROSOFT FRENTE À EDUCAÇÃO GLOBAL

ARITMÉTICA EN EXCEL: EL SILENCIO DE MICROSOFT SOBRE LA EDUCACIÓN GLOBAL

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ABSTRACT

Licensed Microsoft Excel is one of the most widely used tools in the world for calculations, financial analysis, and data manipulation. Despite its apparent precision, Excel is not infallible. There are situations where it can present arithmetic errors, especially due to internal limitations of numerical representation, rounding, and the peculiarities of its formulas. Understanding these factors is essential to avoid flawed conclusions in critical spreadsheets. Using a practical example, this article discusses the pedagogical implications of a multiplication error in Excel, highlighting how recurring inaccuracies can compromise mathematics education. Such flaws can seriously harm data analysis, leading to incorrect interpretations and decisions. Excel uses floating-point representation based on the IEEE 754 standard to store decimal numbers, which can prevent the accuracy of certain values. Although this phenomenon is not exclusive to Excel, its widespread adoption makes the effects more noticeable. For example, operations like $0.1 * 0.2$ can result in 0.20000000000000004 instead of 0.2 — a typical inaccuracy of floating-point arithmetic. Although generally not visible in the standard interface, these flaws can affect logical comparisons and chained calculations. In the pedagogical context, similar errors in multiplication operations can compromise the teaching of fundamental mathematical concepts. Errors derived from floating-point representation can occur in various software. In the case of Excel, its widespread adoption and lack of transparency make the impact of these problems even more severe, which accentuates the pedagogical risks of the uncritical use of a tool widely adopted as a reference by students and professionals.

Keywords: Mathematical Limitations. Licensed Microsoft Excel. Conceptual Errors in Multiplication. Global Mathematics Education.

RESUMO

O Microsoft Excel licenciado é uma das ferramentas mais utilizadas no mundo para cálculos, análises financeiras e manipulação de dados. Apesar de sua aparente precisão, o Excel não é infalível. Há situações em que ele pode apresentar erros aritméticos, especialmente devido às limitações internas de representação numérica, arredondamentos e peculiaridades de suas fórmulas. Compreender esses fatores é essencial para evitar conclusões equivocadas em planilhas críticas. A partir de um exemplo prático, este artigo discute as implicações pedagógicas de um erro de multiplicação no Excel, destacando como imprecisões recorrentes podem comprometer a educação matemática. Tais falhas podem prejudicar

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seriamente a análise de dados, levando a interpretações e decisões incorretas. O Excel utiliza a representação de ponto flutuante baseada no padrão IEEE 754 para armazenar números decimais, o que pode impedir a exatidão de certos valores. Embora esse fenômeno não seja exclusivo do Excel, sua ampla adoção torna os efeitos mais perceptíveis. Por exemplo, operações como $0,1 * 0,2$ podem resultar em 0,20000000000000004, em vez de 0,2 — uma imprecisão típica da aritmética de ponto flutuante. Embora geralmente não visíveis na interface padrão, essas falhas podem afetar comparações lógicas e cálculos encadeados. No contexto pedagógico, erros semelhantes em operações de multiplicação podem comprometer o ensino de conceitos matemáticos fundamentais. Erros derivados da representação de ponto flutuante podem ocorrer em diversos softwares. No caso do Excel, sua ampla adoção e falta de transparência tornam o impacto desses problemas ainda mais grave, o que acentua os riscos pedagógicos do uso acrítico da ferramenta amplamente adotada como referência por estudantes e profissionais.

Palavras-chave: Limitações Aritméticas. Microsoft Excel Licenciado. Imprecisões na Multiplicação. Ensino de Matemática em Escala Global.

RESUMEN

Microsoft Excel con licencia es una de las herramientas más utilizadas en el mundo para cálculos, análisis financieros y manipulación de datos. A pesar de su aparente precisión, Excel no es infalible. Existen situaciones en las que puede presentar errores aritméticos, especialmente debido a limitaciones internas de representación numérica, redondeo y peculiaridades de sus fórmulas. Comprender estos factores es esencial para evitar conclusiones erróneas en hojas de cálculo críticas. Con un ejemplo práctico, este artículo analiza las implicaciones pedagógicas de un error de multiplicación en Excel, destacando cómo las imprecisiones recurrentes pueden comprometer la educación matemática. Dichos errores pueden perjudicar gravemente el análisis de datos, dando lugar a interpretaciones y decisiones incorrectas. Excel utiliza la representación en punto flotante basada en el estándar IEEE 754 para almacenar números decimales, lo que puede afectar la precisión de ciertos valores. Si bien este fenómeno no es exclusivo de Excel, su adopción generalizada hace que sus efectos sean más notorios. Por ejemplo, operaciones como $0.1 * 0.2$ pueden resultar en 0.20000000000000004 en lugar de 0.2, una inexactitud típica en la aritmética de punto flotante. Si bien generalmente no son visibles en la interfaz estándar, estos errores pueden afectar las comparaciones lógicas y los cálculos encadenados. En un contexto pedagógico, errores similares en las operaciones de multiplicación pueden comprometer la enseñanza de conceptos matemáticos fundamentales. Los errores derivados de la representación de punto flotante pueden ocurrir en varios programas de software. En el caso de Excel, su adopción generalizada y la falta de transparencia agravan aún más el impacto de estos problemas, lo que acentúa los riesgos pedagógicos del uso inapropiado de esta herramienta, ampliamente adoptada como referencia por estudiantes y profesionales.

Palabras clave: Limitaciones Aritméticas. Microsoft Excel con Licencia. Imprecisiones en la Multiplicación. Enseñanza de las Matemáticas a Escala Global.

1 INTRODUCTION

Arithmetic is traditionally considered the foundation of school mathematics. It involves fundamental operations — addition, subtraction, multiplication, and division — and serves as a starting point for the development of logical reasoning, problem solving, and the understanding of more abstract concepts.

In this context, Dante (2005) states that "arithmetic is the gateway to the world of mathematics, being essential for the development of logical thinking and the capacity for abstraction of students". By mastering arithmetic concepts, students build a solid foundation to advance in areas such as algebra, geometry, and statistics.

Arithmetic is not only a calculation tool, but also a means of developing important cognitive skills. This perspective is expanded by Kamii (2001), who states: "the teaching of arithmetic should promote the construction of knowledge, and not just the memorization of algorithms". This implies an approach that values the understanding of processes and the ability to argue mathematically.

A deep understanding of arithmetic is essential for the transition to algebraic thinking. When students understand the properties of operations and numerical patterns, they are better prepared to deal with algebraic expressions and equations.

Vergnaud (1990) points out that "arithmetic is the fertile ground where algebraic thinking develops, as it allows students to perceive regularities and generalizations". Thus, the teaching of arithmetic must go beyond technique and seek connections with broader concepts.

Arithmetic also plays a central role in solving mathematical challenges. By applying operations in varied contexts, students develop strategies, estimates, and verifications, which strengthens logical reasoning.

Polya (1945), in his classic work *How to Solve It*, states that "problem solving is the essence of mathematics, and arithmetic provides the initial instruments for this practice". Therefore, the teaching of arithmetic must be contextualized and focused on real and meaningful situations.

For arithmetic to fulfill its formative role, it is necessary to adopt methodologies that encourage the understanding and active participation of students. The use of games, manipulable materials, and digital technologies makes learning more meaningful.

According to Lorenzato (2006), "the teaching of arithmetic should be based on the construction of knowledge, respecting the rhythms and learning styles of students". This implies an approach that values error as part of the process and encourages investigation.

Arithmetic is much more than a set of operative rules. It is the basis on which mathematical thinking is built, and its teaching must be planned with intentionality, sensitivity and depth. Investing in a solid arithmetic education is investing in the integral mathematical training of future professionals.

As a fundamental part of mathematics, arithmetic occupies a central position in school curricula from the first years of basic education. It is responsible for developing essential skills such as number sense, logical reasoning, and the ability to solve everyday problems. The National Common Curriculum Base (BNCC), a document that guides school curricula in Brazil, recognizes the importance of arithmetic, although it does not treat it as an isolated thematic unit.

According to Localli (2024), "although arithmetic is essential for the development of logical-mathematical thinking, the BNCC does not have a specific thematic unit dedicated to it, which can compromise its appreciation in teaching".

The BNCC organizes the teaching of mathematics into five thematic units: Numbers, Algebra, Geometry, Quantities and Measures, and Probability and Statistics. This content is mainly inserted in the **Numbers** unit, being addressed through the four fundamental operations and their properties.

According to the National Curriculum Parameters (PCN), "the learning of arithmetic must occur in a contextualized way, allowing the student to understand the meaning of the operations and apply them in real situations" (BRASIL, 1997, p. 55).

In addition, studies indicate that the teaching of numbers and operations should be integrated with the development of other skills, such as reading, writing and solving challenges. Mathematical literacy, initiated by arithmetic, is considered essential for the cognitive and social development of the child (Souza & Matias, 2020).

Despite its relevance, arithmetic faces challenges in the school curriculum, such as the mechanistic approach and the dissociation between theory and practice. Many students develop operative skills without understanding the underlying concepts, which makes it difficult to transition to algebraic thinking.

Barbosa and Silva Jr. (2020), highlight that "the dissociation between the teaching of arithmetic and algebra constitutes a limiting factor to student learning". They advocate an integrated approach, in which arithmetic and algebra coexist from the earliest years.

Localli (2024), proposes the creation of a specific thematic unit for arithmetic in the BNCC, including topics such as modular congruence and introduction to cryptography, with the aim of enriching the curriculum and connecting the contents to contemporary reality.

Arithmetic, often seen as a set of basic operations, has a much broader role in the formation of individuals. Its teaching not only develops mathematical skills, but also cognitive, social, and professional competencies that extend beyond the school environment.

According to Farias et al. (2025), "arithmetic contributes to the development of logical reasoning and plays an important role in various daily activities, such as financial planning, time organization, and decision-making".

The concept of mathematical literacy, widely discussed in the BNCC and in international assessments such as PISA, involves the ability to apply mathematical knowledge in real contexts. Arithmetic is one of the bases of this literacy.

According to the BNCC (BRASIL, 2017), mathematical literacy includes "competencies and skills to reason, represent, communicate and argue mathematically, favoring problem solving in a variety of contexts".

These competencies are essential for students to become critical citizens who are able to act effectively in society. As Soares (2003) points out, "literacy is not only the responsibility of the Portuguese language teacher, but of all educators, including mathematics educators".

Arithmetic is present in several everyday situations:

- **Personal financial management:** calculation of expenses, budget, interest and discounts;
- **Conscious consumption:** price comparison, promotion analysis and purchase planning;
- **Decision-making:** risk assessment, estimates and projections;
- **Active citizenship:** interpretation of statistical data, graphs and public information.

According to Localli (2024), he highlights that "the inclusion of topics such as modular congruence and introduction to cryptography in the teaching of arithmetic can connect school content to contemporary reality and its mathematical challenges".

Arithmetic is also fundamental for professional training. Professions such as commerce, engineering, administration, health and technology require mastery of numerical operations and quantitative reasoning.

In addition, the development of arithmetic promotes skills such as:

- **Intellectual autonomy;**
- **Argumentation skills;**
- **Critical thinking;**
- **Complex problem solving.**

These skills are valued in the job market and in life in society.

It should be noted that the observations and comparisons presented in this study are exclusively technical and academic in nature, with the objective of contributing to the improvement of digital tools used in mathematics teaching. There is no intention in this work to disparage trademarks or suggest misconduct on the part of their manufacturers.

2 THEORETICAL FOUNDATION

2.1 INCONSISTENCY IN ARITHMETIC CALCULATION IN MICROSOFT EXCEL: A GLOBAL EDUCATIONAL PROBLEM

Microsoft Excel, widely recognized as one of the most widely used tools globally for data analysis and manipulation, presents, in some contexts, inconsistencies that can induce misinterpretations of statistical data, with educational impact.

A relevant example occurs in the calculation of multiplication operations that involve empty cells or null values in multiplications, where certain formulas can return unexpected results, depending on the structure of the data and the way the function is applied.

Although Excel is a robust and versatile platform, used in sectors such as education, finance, and engineering, such particularities highlight the need for a critical approach on the part of users. Baldissera (2025) states: "Excel stands out for being an accessible, powerful, and flexible tool", being adopted by companies of all sizes to optimize processes and facilitate information management.

Understanding the operational limits of the software is essential to ensure the accuracy of the results and avoid mistakes in data analysis. The identification and continuous improvement of these situations contribute not only to the strengthening of the tool, but also to its evolution as a didactic and professional resource. As Brainly (2024) points out: "the

Microsoft Excel interface is designed to offer an intuitive user experience, making it easier to perform various tasks".

These operational limitations, when not recognized, can compromise educational and professional processes. By broadening the debate on these inconsistencies, it contributes to the critical use of Excel as a teaching and analysis tool.

Figure 1

Null Element Property in Multiplication

Multiplicando um número natural qualquer por 0, obtemos o próprio número 0 como resultado.

$$\begin{aligned} 5 \times 0 &= 0 \longrightarrow \text{equivale à adição de cinco parcelas iguais a 0} \\ 20 \times 0 &= 0 \longrightarrow \text{equivale à adição de vinte parcelas iguais a 0} \end{aligned}$$

Source: GIOVANNI and CASTRUCCI. 2018. p. 52.

Multiplication has several fundamental properties, among which the null element stands out.

It states that any real number multiplied by zero results in zero: **for every real number $\in \mathbb{R}$, we have: $a \times 0 = 0$.**

This rule applies to all real numbers — integers, rational, irrational, and complex — and ensures the coherence of calculations in algebra, calculus, and other exact sciences.

For example: $7 * 0 = 0$, $-3.2 * 0 = 0$, $\sqrt{2} * 0 = 0$.

Figure 2

Parenthesis: Priority in calculations

🕒 0 uso dos parênteses

Podemos utilizar parênteses ao escrever expressões numéricas a fim de organizá-las de outras formas. Quando esse for o caso, devemos inicialmente efetuar as operações no interior dos parênteses. Vamos rever a primeira situação da página anterior, agora utilizando os parênteses.

$$\begin{array}{c} \text{calcular a} \\ \text{diferença} \\ \downarrow \\ \underbrace{(30 + 7)}_{\text{ganhos}} - \underbrace{(3 + 5 + 25)}_{\text{gastos}} = 37 - 33 = 4 \end{array}$$

Source: GIOVANNI and CASTRUCCI. 2018. p. 68.

Parentheses play a fundamental role in the organization and priority of mathematical calculations.

They restructure operations, and ensure that certain expressions are resolved before others.

According to the precedence rules, calculations in parentheses are performed first, regardless of the order of the other operators.

This rule is essential in solving equations, algebraic expressions, and mathematical functions, as it ensures clarity and coherence in the results.

The correct use of parentheses avoids ambiguity and errors, ensuring that the interpretation of calculations follows a standardized logic.

2.2 SOLUTIONS AND RECOMMENDATIONS

To mitigate these issues, it is recommended to:

1. **Make users aware** of this particularity of Excel;
2. **Validate the results** in alternative software that strictly follows mathematical conventions;
3. **Include warnings** in Excel itself about this limitation.

Microsoft's correction of this behavior—or at least clear documentation about it—is essential to maintaining the integrity of calculations in educational and professional applications.

Figure 3

Inconsistency in Excel: The Challenge of Multiplying at Zero

A2

<

Source: (the author 2025).

The Microsoft Excel spreadsheet is widely used in educational and administrative contexts, being an essential tool for mathematical calculations. However, in a simple calculation performed to only one decimal place, there is a serious inconsistency in the fundamental mathematical property that any number multiplied by zero must result in zero.

A notable example of this issue is running the operation on the 8400 * worksheet (0.9 - 0.6 - 0.3). According to the mathematical properties, the operations inside the parentheses must be solved first, resulting in zero — and consequently multiplying 8400 * 0 should result in zero. However, Excel displays an unexpected result: 0.0000000000000046629367, evidencing a numerical variation that should not occur in an exact calculation.

This failure compromises the reliability of calculations in educational and administrative contexts, where mathematical accuracy is essential. Mathematics has universal properties that must be respected in any calculation system, and multiplication by zero is one of the most fundamental.

The persistence of this problem in one of the most widely used spreadsheet tools in the world deserves attention, especially due to its potential impact on teaching and data analysis. While alternative solutions such as Google Sheets correctly implement mathematical rules, Excel continues with this technical characteristic that can be considered a limitation, which leads users to adopt compensatory measures, according to (GONÇALVES and MEDEIROS, 2020), "an immediate solution would be explicit use parentheses to ensure the correct order of operations, writing $2^{(3^2)}$ instead of 2^3^2 ". However, this does not solve the underlying problem, as the way Excel interprets the precedence of operators reveals inconsistencies in the applied computation logic.

It is recommended that Excel users be aware of this limitation and, when necessary, validate their calculations on other platforms, especially when working with complex formulas involving multiple powers. In the short term, it would be desirable for Microsoft to correct this behavior in Excel, bringing it in line with standard mathematical conventions and with the operation of other similar tools. Meanwhile, awareness of this particularity of Excel is essential to avoid errors in critical applications.

Figure 4

The Illusion of Precision: The Challenge of Excel's Floating-Point Arithmetic in Subtraction

A2		
=8400*(0,9-0,3-0,6)		
A	B	C
Excel Formula	Excel Formula Text	Excel Result
0,00	=8400*(0,9-0,3-0,6)	0,000000000000093258734

Source: (the author 2025).

When you perform the $8400 \times$ calculation $(0.9 - 0.3 - 0.6)$, you get an unexpected result: 0.000000000000093258734, instead of zero, as established by the fundamental mathematical properties.

This behavior raises a relevant question about the software's adherence to the universal properties of mathematics, such as the null element of multiplication — which determines that any number multiplied by zero must result in zero — and the principle of algebraic equivalence, according to which logically identical expressions should generate compatible results. Since the expressions $0.9 - 0.6 - 0.3$ and $0.9 - 0.3 - 0.6$ are mathematically equivalent, both should lead to a null value, preserving the consistency of the calculations.

The relevance of the question intensifies when considering that the operation was performed with only one decimal place, which should ensure greater precision in the result. In educational and administrative settings, the reliability of calculations is essential not only for decision-making but also for rigorous teaching of mathematical fundamentals.

This scenario gains even more importance when considering the impacts of this type of occurrence — especially in the teaching of mathematics and in the security of financial and administrative calculations. Transparency in the interpretation of results and understanding of the limitations of technological tools are crucial elements to avoid conceptual distortions and ensure accuracy in operations.

This scenario gains even more importance when considering:

1. The ubiquity of Excel in educational institutions;
2. The relevance of arithmetic as a basic operation in mathematics;

3. The trust that educators place in technological solutions;
4. The contrast with free alternatives that, in this particular case, more strictly follow mathematical conventions.

The persistence of this error on a periodically used and widely used paid tool like Excel is especially concerning when compared to the flawless performance of free alternatives like WPS Office and LibreOffice Calc. This type of discrepancy raises questions about the suitability of Excel for certain pedagogical uses, especially in the teaching of basic mathematical concepts, as pointed out by GONÇALVES and MEDEIROS (2020).

Figure 5
WPS Office: Mathematical Precision and Free Calculation

	A	B
1	Arithmetic Operation WPS	WPS Text Formula
2	0,000000000000000000000000	=8400*(0,9-0,6-0,3)
3	0,000000000000000000000000	=8400*(0,9-0,3-0,6)

Source: (the author 2025).

The WPS Office spreadsheet is compliant with fundamental mathematical properties, ensuring accuracy in essential arithmetic calculations. When performing operations such as $8400 * (0.9 - 0.3 - 0.6)$, the software correctly returns zero, respecting both the null element property of the multiplication and the precision of its floating-point arithmetic.

WPS Office has emerged as a newer alternative to Excel and offers free access to users seeking accuracy and reliability in mathematical operations. The possibility of using free software that maintains mathematical consistency reinforces the importance of accuracy in educational and administrative environments.

Considering that simple numerical inconsistencies can impact mathematical interpretations and professional applications, it is relevant to reflect on how different software has handled fundamental calculations over the years. The evolution of digital tools and the correction of mathematical discrepancies is essential to ensure reliable results in academic and operational environments.

Figure 6

Calc Worksheet: When Gratuity Meets Accuracy

A2		$\sum$	$=8400*(0,9-0,6-0,3)$
	A		B
1	Arithmetic Operation Calc		Calc Text Formula
2	0,000000000000000000000000		=8400*(0,9-0,6-0,3)
3	0,000000000000000000000000		=8400*(0,9-0,3-0,6)

Source: (the author 2025).

The LibreOffice Calc spreadsheet also stands out for respecting fundamental mathematical principles, offering reliable results in arithmetic operations. When calculating expressions such as $8400 \times (0.9 - 0.3 - 0.6)$, it returns the correct value — zero — evidencing its logical conformity. As a free alternative to Excel, Calc offers consistency, affordability, and reliability, essential values in educational and administrative contexts. Mathematical precision is more than detail: it is a requirement for well-founded decisions.

Figure 7

Logical Precision in Spreadsheet Software: A Boolean Analysis

A2		$\times$	$\checkmark$	f_x	$=8400*(0,9-0,6-0,3)=8400*(0,9-0,3-0,6)$
	A		B		C
1	Excel Formula		Excel Formula Text		Excel Result
2	FALSE		=8400*(0,9-0,6-0,3)=8400*(0,9-0,3-0,6)		FALSE

Source: (the author 2025).

The Boolean system is a fundamental logical structure used in several areas of computer science, mathematics, and engineering, especially in the construction of algorithms, search systems, and digital circuits.

It is based on Boolean algebra, developed by George Boole in the nineteenth century, which operates with two logical values: true (1) and false (0). "Boolean algebra is the

foundation of modern computational logic, allowing the construction of digital systems that operate with binary precision." (Silva, 2019, p. 35).

According to Oliveira (2016), the use of Boolean operators in search systems "allows the refinement of results, making the retrieval of information more efficient and accurate". This logic is "essential in the construction of logic gates, which in turn make up the integrated circuits of "computers" (Martins, 2008, p. 10).

Excel's behavior when performing mathematical comparisons can raise questions about its accuracy in fundamental calculations. When running the equation $8400 * (0.9 - 0.6 - 0.3) = 8400 * (0.9 - 0.3 - 0.6)$, it is observed that the software returns **FALSE**, suggesting a discrepancy in the evaluation of mathematical equality.

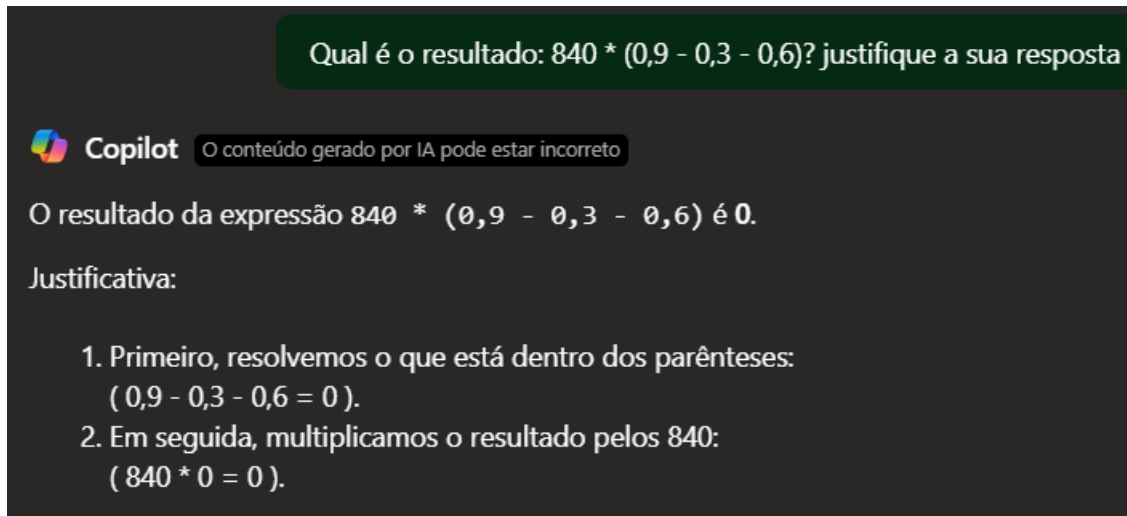
Although subtraction is not commutative, the groupings $0.9 - 0.6 - 0.3$ and $0.9 - 0.3 - 0.6$, when solved from left to right, result in the same final value. Therefore, it is expected that multiplying these results by 8400 yields identical values, returning **TRUE** in the logical comparison.

A relevant aspect in this scenario is that the WPS Office and LibreOffice Calc spreadsheets, both free alternatives, correctly perform this calculation and return TRUE, respecting the fundamental mathematical properties.

This reinforces the importance of accuracy in the interpretation of results, especially in pedagogical and academic environments, where mathematical rigor is essential for the training of users. In this way, understanding how different software processes calculations and mathematical interpretations helps in choosing appropriate tools for teaching and correctly applying mathematical concepts.

Figure 8

Copilot in Excel: Redefining the Accuracy of Mathematical Operations



Source: (the author 2025).

Copilot in Excel is an innovation that transforms the way users interact with spreadsheets by integrating **artificial intelligence** directly into the Excel interface. This functionality allows you to perform complex tasks with natural language commands, such as "create sales chart for the last 6 months" or "highlight the top 10 values in column A".

According to Edivaldo (2025), "Copilot in Excel is a revolutionary tool that improves the way users interact with their data. With the help of artificial intelligence, Copilot allows the interpretation of commands in natural language, which simplifies complex tasks and optimizes users' time."

Among the most relevant resources, the following stand out:

- Automatic creation of graphs and pivot tables;
- Suggestion and explanation of formulas;
- Generation of insights based on data;
- Automation of repetitive tasks, such as formatting and filling;
- On-demand VBA code creation.

The intelligent assistive system is also capable of importing external data, applying custom filters, and highlighting relevant information, making it a true **productivity assistant** for finance professionals, data analysts, and students. (Microsoft, 2025).

Microsoft 365 [Copilot](#) is an innovative tool that unites artificial intelligence with your organization's specific data. Integrated with Microsoft 365 apps such as Word, Excel,

PowerPoint, Outlook, and Teams, Copilot not only makes it easier to find crucial information but also simplifies content creation and maximizes operational efficiency. (Mindtek, 2025).

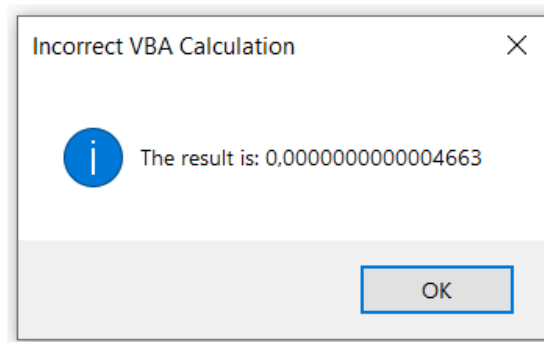
It is curious to note that the assistant, an AI tool integrated into Excel, performs the calculations correctly, aligning with academic guidelines. On the other hand, the same calculation performed directly in the spreadsheet presents a discrepancy, raising doubts about the neutrality of the order of operations in decimal multiplication. It is important to highlight that the analysis considered only one decimal place, which shows a relevant inconsistency in the educational and academic context.

These observations demonstrate how this tool, by combining artificial intelligence and mathematical rigor, represents a technological and educational advance of great impact, contributing significantly to the teaching of computational logic and applied mathematics.

Figure 9

*Inconsistency in VBA: $8400 * (0.9 - 0.6 - 0.3) \neq 0$*

```
Sub Arithmetic_VBA()  
    Dim num As Double  
    Dim a As Double  
    Dim b As Double  
    Dim c As Double  
    Dim Result As String  
  
    num = 8400  
    a = 0.9  
    b = 0.6  
    c = 0.3  
  
    Result = Format(num * (a - b - c), "0.0000000000000000")  
  
    MsgBox "The result is: " & Result, vbInformation, _  
        "Incorrect VBA Calculation"  
End Sub
```



Source: (the author 2025).

The analysis of calculations in VBA reveals arithmetic challenges that compromise the accuracy of computational results. This inconsistency highlights yet another obstacle to universal education, highlighting the need for more rigorous didactic strategies and continuous improvements in the teaching of computing and mathematics.

Figure 10

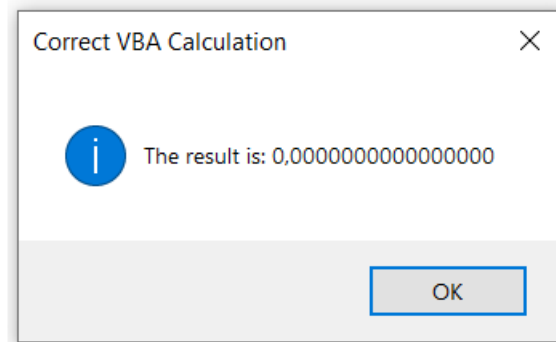
Teaching Dedication: VBA Algorithm That Improves Mathematical Precision

```
Sub Arithmetic_VBA_()
    Dim num As Variant
    Dim a As Variant
    Dim b As Variant
    Dim c As Variant
    Dim Result As Variant

    num = CDec(8400)
    a = CDec(0.9)
    b = CDec(0.6)
    c = CDec(0.3)

    Result = num * (a - b - c)

    MsgBox "The result is: " & Format(Result, _
    "0.0000000000000000"), vbInformation, _
    "Correct VBA Calculation"
End Sub
```



Source: (the author 2025).

Visual Basic for Applications (VBA) is a programming language built into Microsoft Excel that allows you to automate tasks and create custom solutions. Among the most sophisticated uses of VBA is the creation of **high-precision algorithms**, especially in contexts where native Excel calculations are not robust enough for scientific, financial, or statistical applications.

According to the *VBA Programming Workbook of the Federal University of Paraná*, "VBA allows the creation of custom mathematical functions with full control over variables,

conditional structures, and decimal precision, which makes it ideal for complex calculations that require reliability" (KLEINA, 2025).

Common Applications of VBA Algorithms for Mathematical Accuracy

- **Calculations with high decimal precision** (avoiding automatic Excel rounding);
- **Numerical simulations** such as Newton-Raphson or Monte Carlo methods;
- **Statistical modeling** with error control and iteration;
- **Conversion of scientific units** with custom formulas;
- **Validation of financial formulas** such as IRR, NPV and amortization.

In addition, the use of **external libraries** and the manipulation of references in VBA allow you to further expand the calculation capacity. As Tomás Vásquez points out, in many VBA projects there is a need to add references to enable advanced features. These capabilities may include document manipulation or database access, operations that require precision and full control over the algorithms" (VASQUEZ, 2025).

By identifying an arithmetic inconsistency in the VBA, the author developed an algorithm that performs calculations in accordance with fundamental mathematical properties. This algorithm was developed with the aim of improving the accuracy of the results in the worksheets, offering students a more consistent learning experience that is aligned with mathematical principles. Thus, this initiative strengthens technical education and global mathematical learning and highlights the strategic role of Excel in the training of critical and analytical professionals, technically prepared for the challenges of the digital age.

Figure 11

Arithmetic in Excel: Continuity of Inconsistencies in Fundamental Operations and their Effects on Mathematics Education

B8 : ✕ ✓ f_x =FÓRMULATEXTO(A8)		
	A	B
1	- 144.115.188.075.856.000	=4/(0,9-0,8-0,1)
2	72.057.594.037.927.900	=4/(0,9-0,7-0,2)
3	72.057.594.037.927.900	=4/(0,9-0,6-0,3)
4	#DIV/0!	=4/(0,9-0,5-0,4)
5	#DIV/0!	=4/(0,9-0,4-0,5)
6	36.028.797.018.964.000	=4/(0,9-0,3-0,6)
7	#DIV/0!	=4/(0,9-0,2-0,7)
8	- 144.115.188.075.856.000	=4/(0,9-0,8-0,1)

Source: (GONÇALVES & RODRIGUES, 2022)

Excel has proven to be a powerful tool, but it also has limitations in its arithmetic operations, especially when they involve division by zero. This problem had already been registered by the author in a previous publication in the work *Interdisciplinary Dialogues in Education*, drawing attention to unexpected results that challenge basic mathematical principles.

In the present work, this discussion is resumed based on tests carried out in the licensed version of Excel 365. It is observed that the expression $4 / (0.9 - 0.7 - 0.2)$, under rounding limited to one decimal place, returns a high and negative value, even if the denominator approaches zero.

On the other hand, when rearranging the terms to $4 / (0.9 - 0.2 - 0.7)$, the spreadsheet returns the message #DIV/0!, suggesting an incoherent treatment in the face of mathematically equivalent situations (GONÇALVES and RODRIGUES, 2020).

It is interesting to note that, despite the time that has elapsed since the first publication, this limitation still persists, having been observed for decades in Excel. This reinforces the importance of critically reflecting on the algebraic behavior of the digital tools used in mathematics teaching — especially in view of their broad educational reach and the need for conceptual precision in the formation of globally prepared citizens.

3 FINAL CONSIDERATIONS

Research shows that Excel, although widely adopted in educational and professional contexts around the world, has arithmetic inconsistencies that directly impact the teaching-learning process.

Over the past few years, the author has published several analyses that show multiple arithmetic inconsistencies, questioning why such situations persist in a tool marketed for decades. It should be noted that this article does not aim to depreciate the image of the platform, but rather to contribute to pedagogical improvements, proposing reflections on adjustments that respect the algorithmic logic of the functions, especially in cases of semantic failures.

Such improvements could strengthen conceptual precision and avoid prejudice to the didactic use of a tool recognized as essential for global education. The results of this study represent a significant contribution to both academia and society at large. By generating applied knowledge and promoting critical reflections, the research strengthens the role of the university as an agent of social and intellectual transformation.

The union between theory and practice enriches learning, developing essential skills for the contemporary market. In addition to proposing effective solutions for the community, this education model stimulates innovation and social inclusion.

In view of this evidence, it is possible to affirm that this research significantly deepened the understanding of the proposed theme. However, like all scientific work, it has limitations that must be recognized and considered.

These limitations do not compromise the relevance of the findings, but indicate opportunities for improvement for future investigations. In this sense, it is recommended that future studies expand the sample, diversify the contexts analyzed, and adopt complementary methodologies, such as data triangulation.

It is also suggested the development of longitudinal studies, which allow monitoring the phenomena over time, as well as the deepening of the theoretical review based on more recent productions. Such recommendations aim to strengthen the continuity of research in the area, promoting scientific advances and contributing to the construction of more solid, applicable and socially relevant knowledge.

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