SYSTEMIC INCONSISTENCIES IN EXCEL'S GCD CALCULATION: A DETAILED ACADEMIC ANALYSIS OF CRITICAL ERRORS, THEIR PROFOUND REPERCUSSIONS ON GLOBAL EDUCATION, AND STRATEGIC PATHWAYS TO SOLUTIONS

INCONSISTÊNCIAS SISTÊMICAS NO CÁLCULO DO MDC NO EXCEL: UMA ANÁLISE ACADÊMICA DETALHADA DOS ERROS CRÍTICOS, SUAS REPERCUSSÕES PROFUNDAS NA EDUCAÇÃO GLOBAL E CAMINHOS ESTRATÉGICOS PARA SOLUÇÕES

INCONSISTENCIAS SISTÉMICAS EN EL CÁLCULO DEL MCD DE EXCEL: UN ANÁLISIS ACADÉMICO DETALLADO DE ERRORES CRÍTICOS, SUS PROFUNDAS REPERCUSIONES EN LA EDUCACIÓN GLOBAL Y VÍAS ESTRATÉGICAS PARA ENCONTRAR SOLUCIONES

https://doi.org/10.56238/sevened2025.029-018

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ABSTRACT

This article investigates the inconsistencies in the calculation of the Greatest Common Divisor (GCD) in Microsoft Excel and its impact on the teaching of basic mathematics. The study aims to analyze the discrepancies found in the GCD function of Excel, demonstrating how algorithmic errors can compromise learning and the reliability of the tool as a pedagogical resource. The research was conducted through comparative tests between the results provided by Excel and the correct mathematical calculations, in addition to a critical review of reports and discussions about failures in spreadsheet software. The results show that Excel, in certain scenarios, returns incorrect values for the GCD, as illustrated in Figures 5 and 8 (generated by Copilot available in Excel). These inconsistencies represent an obstacle in teaching, as they can induce students to make conceptual errors and hinder the development of logical-mathematical reasoning. Faced with this problem, the article proposes solutions, such as the use of alternative tools, the critical review of the results by the teacher, and the implementation of more robust algorithms. It is concluded that, although Excel is widely used in educational settings, its reliability in essential mathematical operations, such as calculating the GCD, should be questioned. The discussion reinforces the need for greater rigor in the validation of educational software and in teacher training for the critical use of technologies in teaching mathematics.

Keywords: Greatest Common Divisor. Excel. Mathematics Education. Algorithmic Inconsistencies. Elementary Education.

RESUMO

Este artigo investiga as inconsistências no cálculo do Máximo Divisor Comum (MDC) no Microsoft Excel e seu impacto no ensino da matemática básica. O estudo tem como objetivo analisar as discrepâncias encontradas na função MDC do Excel, demonstrando como erros algorítmicos podem comprometer o aprendizado e a confiabilidade da ferramenta como

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recurso pedagógico. A pesquisa foi conduzida por meio de testes comparativos entre os resultados fornecidos pelo Excel e os cálculos matemáticos corretos, além de uma revisão crítica de relatórios e discussões sobre falhas em softwares de planilhas eletrônicas. Os resultados evidenciam que o Excel, em determinados cenários, retorna valores incorretos para o MDC, como ilustrado nas Figuras 5 e 8 (geradas pelo Copilot disponível no Excel). Essas inconsistências representam um obstáculo no ensino, pois podem induzir os alunos a erros conceituais e prejudicar o desenvolvimento do raciocínio lógico-matemático. Diante desse problema, o artigo propõe soluções, como a utilização de ferramentas alternativas, a revisão crítica dos resultados pelo professor e a implementação de algoritmos mais robustos. Conclui-se que, embora o Excel seja amplamente utilizado em ambientes educacionais, sua confiabilidade em operações matemáticas essenciais, como o cálculo do MDC, deve ser questionada. A discussão reforça a necessidade de maior rigor na validação de softwares educacionais e na formação docente para o uso crítico de tecnologias no ensino da matemática.

Palavras-chave: Máximo Divisor Comum. Excel. Educação Matemática. Inconsistências Algorítmicas. Ensino Básico.

RESUMEN

La salud de los niños con enfermedades potencialmente mortales abarca la dimensión física, social, emocional y espiritual y, junto con la red de apoyo, es el núcleo de los cuidados paliativos pediátricos (CPP). La filosofía de la atención centrada en la familia demuestra ser la base del éxito de las prácticas de SPC. Entender las barreras que limitan esta práctica es importante para consolidar estrategias que reafirmen esta atención integral. La comprensión aún errónea de qué son los cuidados paliativos significa que a menudo se los confunde con los cuidados al final de la vida. Esto puede crear dificultades tanto para los profesionales como para las familias, debido a cuestiones culturales y los desafíos emocionales que conllevan estas complejas condiciones clínicas. El panorama actual de desafíos en torno a la CPP involucra principalmente barreras socioculturales, brechas en la formación profesional del equipo multidisciplinario que necesita involucrarse en la atención, cuestiones éticas, organizacionales, estructurales y cuantitativas de recursos humanos. En el intento de superar las principales dificultades asociadas a la atención del CPP, es posible señalar alternativas que involucran tecnología, instrumentalización de los servicios, incorporación de temas como la muerte a nuestra cultura, debates éticos como parte del cotidiano del cuidado y otras potencialidades, a la luz de la legislación brasileña que ampara este tipo de atención.

Palabras clave: Máximo Común Divisor. Sobresalir. Educación Matemática. Inconsistencias Algorítmicas. Educación Básica.

1 INTRODUCTION

The Greatest Common Factor (CDM) is a fundamental concept in basic mathematics, essential for the simplification of fractions, solving divisibility problems, and applications in number theory. Its teaching is crucial in the development of students' logical and mathematical reasoning, serving as a basis for more advanced content, such as algorithms, cryptography, and optimization. However, the reliability of the tools used for its calculation is essential for correct learning.

Currently, electronic spreadsheets, such as Microsoft Excel, are widely used in educational settings to assist in the teaching of mathematics. However, inconsistencies in the calculation of the MDC in Excel can lead to incorrect results, impairing the students' understanding. As evidenced in Figures 5 and 8 (generated by COPILOT available in Excel), the software has significant flaws in its MDC algorithm, returning erroneous values in certain scenarios. These errors not only compromise the tool's reliability but also reinforce the idea that Excel can be a hindrance in the educational process, especially when it is expected to function as a reliable support resource.

Mathematics education depends on precision and clarity, and errors in widely adopted tools can generate distrust and difficulties in learning. This article seeks to analyze the new discrepancies found in the calculation of the MDC by Excel, discuss their impact on teaching and propose solutions to mitigate these problems, ensuring that technology is an ally, and not an obstacle, in the education of students.

2 THEORETICAL FOUNDATION

The **Greatest Common Factor (CDM)** is a fundamental concept in number theory, defined as the largest integer capable of dividing two or more integers without leaving a remainder (MOD 0). Its application extends from the simplification of fractions to more complex problems, such as encryption algorithms and mathematical optimization.

Properties of MDC

For the MDC calculation to be valid, some conditions must be met:

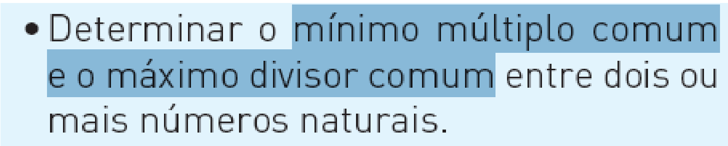
1. **Natural Integers:** The MDC is defined only for non-negative integers, excluding the irrational numbers.
2. **At Least Two Numbers:** The determination of the CDM requires the comparison between two or more values, since it is a common divisor.
3. **Absence of Null or Zero Values:** The MDC is not set to zero, as division by zero is indeterminate. If one of the numbers is zero, the result is the largest non-zero number in the set.

Conceptual Representation of the MDC

Figure 1 illustrates the concept of the CDM, highlighting its nature as the largest shared divisor among the numbers analyzed. This representation is essential for a visual understanding of the CDM determination process, especially in educational contexts, where mathematical abstraction can be challenging for students.

Figure 1

Concept of the CDM



- Determinar o mínimo múltiplo comum e o máximo divisor comum entre dois ou mais números naturais.

Source: (Alfha Mathematics Generation, 2022)

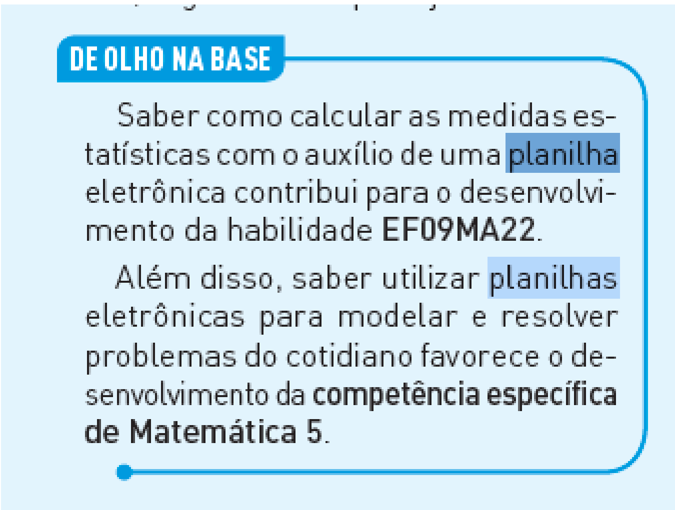
The Ministry of Education (MEC) recognizes the importance of integrating digital technologies in the teaching-learning process and, therefore, encourages teachers to develop skills in electronic spreadsheets, such as Microsoft Excel, Google Sheets and other similar tools. This competence is considered fundamental for:

1. Enrichment of Math and Science Classes:
   a) The spreadsheets allow the visualization of data, the performance of automatic calculations and the application of mathematical functions, facilitating the teaching of concepts such as CDM, MMC, statistics, algebra and geometry.
   b) Automating repetitive operations helps students focus on interpreting the results, rather than getting lost in manual calculations.
2. Promotion of Digital Literacy:
   a) Mastering spreadsheets is an essential skill in the contemporary world, both for academic life and for the job market.
   b) By using these tools in the classroom, students develop computational thinking, data organization, and critical analysis of information.
3. Promotion of Interdisciplinary Teaching:
   a) In addition to mathematics, the spreadsheets can be applied in disciplines such as Geography (analysis of population data), Biology (recording of experiments) and History (quantitative timelines).
   b) Teachers from different areas are encouraged to incorporate worksheets into their methodologies, creating collaborative activities and integrated projects.
4. Preparation for External Evaluations and Science Olympiads:
   a) Many large-scale assessments, such as SAEB and PISA, require interpretation of data and graphs, skills that can be worked through spreadsheets.

b) Students who participate in competitions such as the Brazilian Mathematical Olympiad (OBM) and the Brazilian Informatics Olympiad (OBI) also benefit from this knowledge.

Figure 2

MEC orientation


DE OLHO NA BASE

Saber como calcular as medidas estatísticas com o auxílio de uma planilha eletrônica contribui para o desenvolvimento da habilidade **EF09MA22**.

Além disso, saber utilizar planilhas eletrônicas para modelar e resolver problemas do cotidiano favorece o desenvolvimento da **competência específica de Matemática 5**.

Source: (Alpha Mathematical Generation, 2022)

2.1 INCONSISTENCIES IN THE CALCULATION OF THE MDC BY EXCEL AND THEIR IMPACTS ON MATHEMATICS EDUCATION

Microsoft Excel, although widely used as an educational tool, has serious inconsistencies in the calculation of the Greatest Common Factor (CDM) that contradict fundamental mathematical principles. As evidenced in Figure 3, the software makes two critical errors that directly impact the teaching-learning process. First, Excel violates the MDC's own mathematical definition by allowing it to be calculated with only one number. According to Rosen (2011), the CDM is by nature a common divisor, which necessarily presupposes the comparison between at least two integers. When the software returns its own number as a result for a single value (e.g., MDC(15)=15), it is ignoring the basic principle of commonality that gives the operation its name, creating a serious conceptual contradiction.

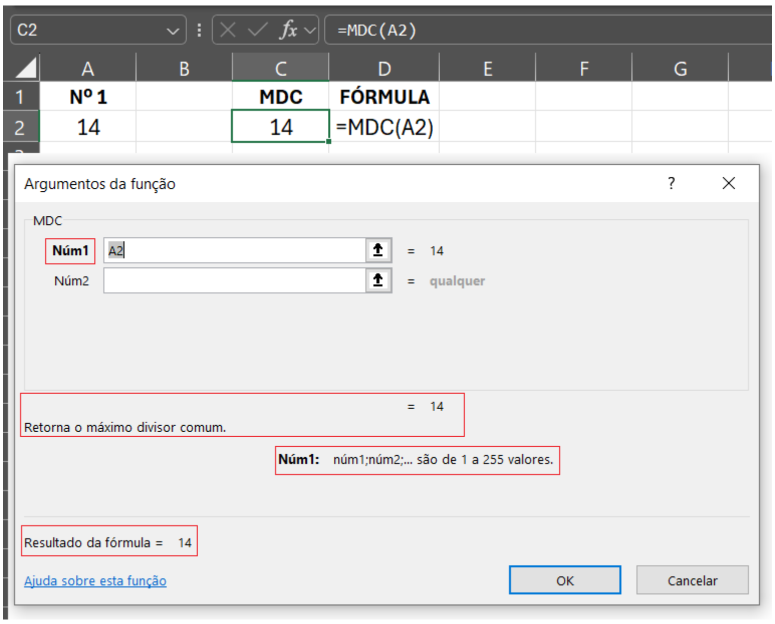
In addition, the documentation for the MDC function in Excel presents an incorrect description by stating that it can receive "from 1 to 255 values" (Microsoft, 2023). This formulation induces students to conceptual errors, creating confusion about the nature of the CDM and making it difficult to correctly understand its mathematical properties. Figure 3 clearly demonstrates this semantic inconsistency, where Excel presents the expression "returns the greatest COMMON divisor" for cases with a single value, which constitutes a mathematical nonsense.

These errors have a significant impact on mathematics education. As Borwein and Bailey (2004) point out, educational computational tools must preserve mathematical rigor to avoid misunderstandings. The case of Excel illustrates how the inadequate implementation of mathematical concepts in widely used software can compromise learning. Apostol (1976) reinforces that the greatest common divisor requires at least two non-null integers to be defined correctly, a principle that Excel ignores in its implementation.

Given this scenario, it is recommended that educators adopt three main measures: first, always contrast Excel results with manual calculations for verification; secondly, to transform these inconsistencies into objects of discussion in the classroom, using them as examples of the importance of conceptual understanding; and finally, consider the use of computational alternatives with more rigorous implementation, such as GeoGebra or WolframAlpha. This case serves as a warning about the risks of uncritical dependence on technological tools in mathematics teaching, reinforcing the need for theoretical mastery on the part of both educators and students.

Figure 3

MDC Inconsistency in Excel (A Number)



Source: (the author 2025)

2.2 INCONSISTENCIES IN THE CALCULATION OF THE MDC BY THE VBA AND THEIR IMPACTS ON MATHEMATICS EDUCATION

The analysis of Visual Basic for Applications (VBA), a programming language integrated with Microsoft Excel, reveals that the conceptual error in the calculation of the Greatest Common Divisor (CDM) also persists in this platform. As proven in Figure 4, the implementation of the MDC in VBA reproduces the same flaw found in the native function of Excel, accepting as valid the calculation with only one number - a direct contradiction to the fundamental mathematical principle that defines the MDC necessarily as a common divisor between two or more integers (Apostol, 1976).

This duplication of the error in different layers of the software (user interface and programming environment) configures a structural problem with profound educational implications. Research in the field of mathematics education (Guzman & Boero, 2016) shows that inconsistencies of this type generate cascading negative effects: students, when faced with results that contradict what they learned in the classroom, develop not only distrust of technological tools, but also doubts about their own understanding of mathematical concepts. This situation creates an additional barrier to the learning process, requiring teachers to dedicate precious time to explaining and contextualizing software errors, rather than focusing on developing students' mathematical skills.

The faculty thus faces a double challenge: in addition to teaching the mathematical concepts themselves, they need to develop strategies to deal with technological limitations. As Ponte et al. (2018) point out, this includes creating specific activities to identify and analyze software errors, developing complementary teaching materials that present the correct calculations, and implementing protocols for manual verification of the results obtained computationally. This pedagogical overload is particularly problematic in educational contexts with limited resources, where teacher time is a scarce resource.

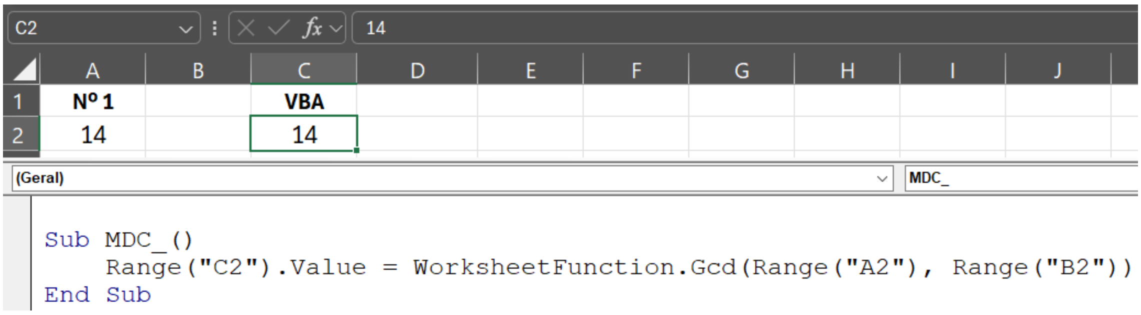
From a technical point of view, the persistence of this error in both Excel and VBA (Figure 4) reveals deep questions about the development of educational software. As Knuth (1997) pointed out, the implementation of mathematical algorithms in computer systems requires special rigor, particularly when these systems are intended for educational environments. The failure to meet this basic requirement in the case of the MDC suggests a worrying disconnect between software developers and the actual needs of mathematics education.

Given this scenario, three approaches are essential: first, the triangulation of results, systematically comparing the outputs of Excel/VBA with other reliable software or with manual calculations; second, the transformation of these errors into learning opportunities, using them as case studies to discuss the importance of critical thinking in computational mathematics; and third, the adoption of pedagogically validated alternatives, such as GeoGebra, which correctly implement mathematical algorithms.

This case serves as a strong warning about the risks of uncritical dependence on technological tools in mathematics teaching. Even in widely adopted and licensed software such as Excel, the solid understanding of fundamental mathematical concepts by teachers and students remains the last and most important filter against the spread of conceptual errors. The experience with the incorrect calculation of the CDM in the VBA reinforces the need for greater dialogue between software developers, educators and mathematicians, aiming at the creation of tools that really support, and not hinder, the teaching-learning process.

Figure 4

MDC inconsistency in VBA (a number)



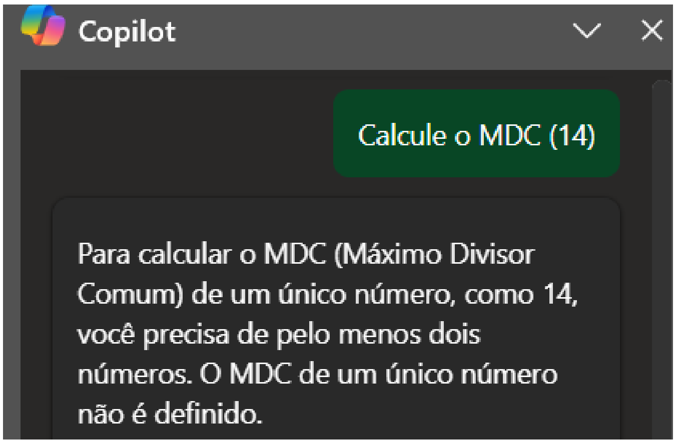
Source: (the author 2025)

Copilot integrated into Excel confirmed a significant error in the software's calculation (Figure 5). It is alarming that Microsoft continues to market Excel as a tool of precision and high added value, even in the face of recurring failures that compromise its reliability. These mistakes aren't just technical – they have real impacts, especially in education, where millions of students and institutions rely on Excel for data analysis, research, and learning mathematical and statistical concepts.

The persistence of these problems in such an essential and widely adopted tool represents a serious failure on the part of Microsoft. If the company intends to keep Excel as a global standard, it is unacceptable that it does not prioritize agile fixes and transparency about known limitations. Unresolved errors in educational and professional software perpetuate misinformation, undermine academic training, and undermine user confidence. Microsoft needs to take responsibility and fix these deficiencies urgently.

Figure 5

Excel VBA Inconsistency (A Number)



Source: (the author 2025)

The calculation performed in Excel, when dealing with the divisors of a natural number, involves analyzing the numbers that can divide exactly that number without leaving any remainder, using the MOD operation equal to zero. The divisors of a natural number naturally include the number itself, because every number is divisible by itself. In this context, when studying divisors, there is no need to use the expression "common divisors", since we are dealing specifically with the divisors of a single number, and this eliminates any ambiguity. Clearly understanding this property is critical, as it helps to avoid confusion during the calculation process and ensures more accurate results. In addition, this notion allows you to better understand the concept of factorization, contributing to the development of more efficient calculations, especially in tools such as Excel, where it is possible to automate these calculations quickly and without errors. Figure 6.

Figure 6

Property of the divisors of a number

Source:(Alfha Mathematical Generation, 2022)

When dealing with the divisors of a natural number in Excel, the main objective is to identify all positive integers that divide that number exactly, i.e., without leaving any remainder (MOD 0). This process is essential for a variety of mathematical and data analysis applications, such as factoring, simplifying fractions, and determining numerical properties.

Every natural number has at least two divisors: the number 1 and itself. For example, the divisors of 7 are just 1 and 7 since it is a prime number. A number like 12 has a longer list of divisors: 1, 2, 3, 4, 6, and 12. This characteristic is essential to avoid confusion, especially since we are not dealing with "common divisors" (which involve comparing two or more numbers), but rather divisors of a single value.

In Excel, we can automate the identification of these dividers using functions such as MOD and IF. The MOD function checks whether the division between two numbers is exact by returning the rest of the operation. If the remainder is zero, it means that the tested number is a valid divisor. By combining this function with SE, we can filter out only the values that meet this condition.

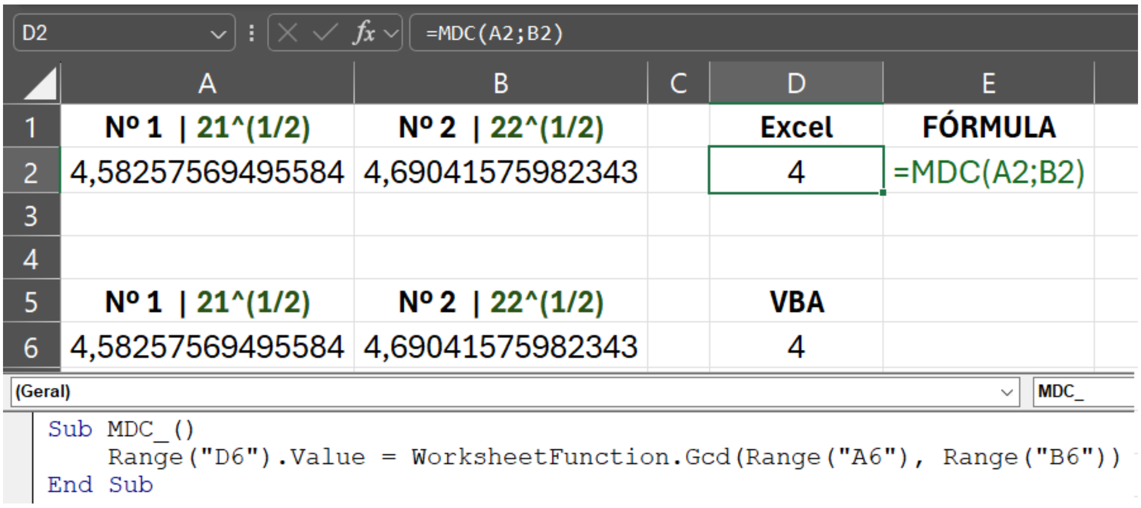
For example, to find the divisors of 12, we can create a list of numbers 1 through 12 and apply the formula =IF(MOD(12, A1)=0; A1; ") in an adjacent column. The result will be the display of only the numbers that divide 12 without leaving any remainder: 1, 2, 3, 4, 6 and 12. This method is efficient and can be adapted to any natural number by simply adjusting the reference and test interval.

Understanding how to calculate divisors in Excel not only streamlines mathematical processes, but also serves as a foundation for more advanced concepts, such as calculating the greatest common divisor (CDM) or the least common multiple (LCM). In addition, this knowledge is useful for creating dynamic spreadsheets that require automatic divisibility checks, contributing to more accurate and efficient analysis.

In summary, mastering the calculation of divisors in Excel facilitates the manipulation of numerical data, avoiding errors and allowing the application of mathematical techniques in a practical and automated way. Whether for educational or professional purposes, this resource is a valuable tool for those who work with spreadsheets and need to perform mathematical operations with agility and reliability.

Figure 7

Excel & VBA: Critical inconsistencies in the MDC algorithm



Source: (the author 2025)

An important point that deserves to be highlighted is the analysis of **Figure 7**, which demonstrates an unusual application of Excel: the calculation of the **Greatest Common Difference (CDM)** involving irrational numbers, such as √21 and √22. This approach is impactful because, mathematically, the concept of CDM is defined only for integers, since divisors are, by nature, exact values and not approximate. However, Excel, as a numerical calculation tool, can return results even in theoretically unfeasible cases, such as operations with irrationals. This is because the software works with decimal approximations and, depending on the function used (such as =MDC), it can round values or apply internal calculation methods that generate unexpected outputs (INT or Truncar). This particularity reinforces the need for caution when interpreting results in Excel, especially when dealing with mathematical functions designed for integers applied to unconventional cases.

The analysis of the behavior of the MDC function in Microsoft Excel, as shown in Figure 8, reveals a serious inconsistency that calls into question the reliability of the software as a tool for mathematical teaching. The core of the problem lies in the fact that Excel performs Greatest Common Divisor calculations even when fed with irrational numbers—an operation that, from the point of view of classical number theory (as presented in Hardy and Wright's seminal work), simply has no mathematical significance.

This discrepancy is not a mere technical detail, but a conceptual distortion with profound consequences. When students or professionals use Excel to calculate the MDC of numbers such as √21 and √22, the software returns seemingly plausible numerical values, creating the illusion that it is a valid operation. In fact, the very notion of divisor loses its meaning when applied to irrational numbers, since divisibility is a concept defined exclusively for whole numbers.

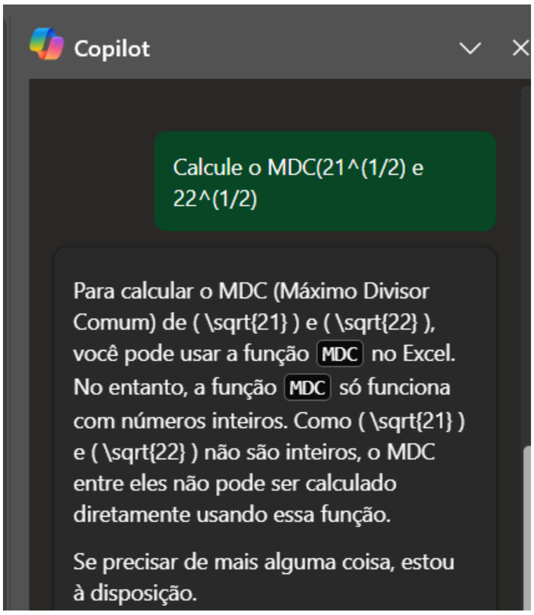
The pedagogical impact of this behavior is particularly worrying. Teachers who rely on Excel as a teaching tool may inadvertently convey misconceptions to their students. Software, by failing to distinguish between valid and invalid entries, ends up trivializing one of the most fundamental concepts of number theory. This situation is aggravated by the fact that Excel does not issue any error message or warning when confronted with these semantically incorrect operations.

From a practical point of view, this limitation of Excel suggests the need for greater caution when using electronic spreadsheets for the teaching of advanced mathematics. Although software is extremely useful for various numerical applications, cases like this demonstrate that its use must always be accompanied by a solid theoretical foundation. Alternatives such as computer algebra systems (CAS) or programming languages with specialized mathematical libraries may offer more rigorous approaches to these concepts.

This analysis does not intend to disqualify Excel as a computational tool, but rather to alert to the importance of understanding its conceptual limitations. The episode serves as a valuable reminder that, in the age of ubiquitous computing, the relationship between digital tools and mathematical rigor needs to be constantly re-evaluated and critically examined, especially in educational contexts where the formation of correct concepts is essential for the development of mathematical thinking.

Figure 8

Severe Limitations in Excel: Irrational Numbers and the Failure of the MDC



Source: (the author 2025)

2.3 DEVELOPMENT OF AN ADVANCED ALGORITHM FOR CALCULATING THE MDC WITH AUTOMATIC CORRECTION AND EDUCATIONAL FEEDBACK

After extensive research and analysis of the limitations of existing implementations, the author proposes an innovative algorithm that overcomes the shortcomings of conventional CDM functions in spreadsheets. The developed system incorporates sophisticated mechanisms for handling invalid inputs, based on the instructional design principles of Mayer (2009) and the best practices of educational programming by Guzdial (2015).

The algorithm has three main layers of auto-correction. First, when it detects negative values - a situation that traditionally generates errors in standard implementations - it automatically performs the conversion to its absolute values, thus maintaining the mathematical validity of the calculation as established by Knuth (1997). In the case of null values, which normally interrupt processing, the system applies the mathematical identity properties, returning the non-null value when applicable, following the principles described by Graham et al. (1994).

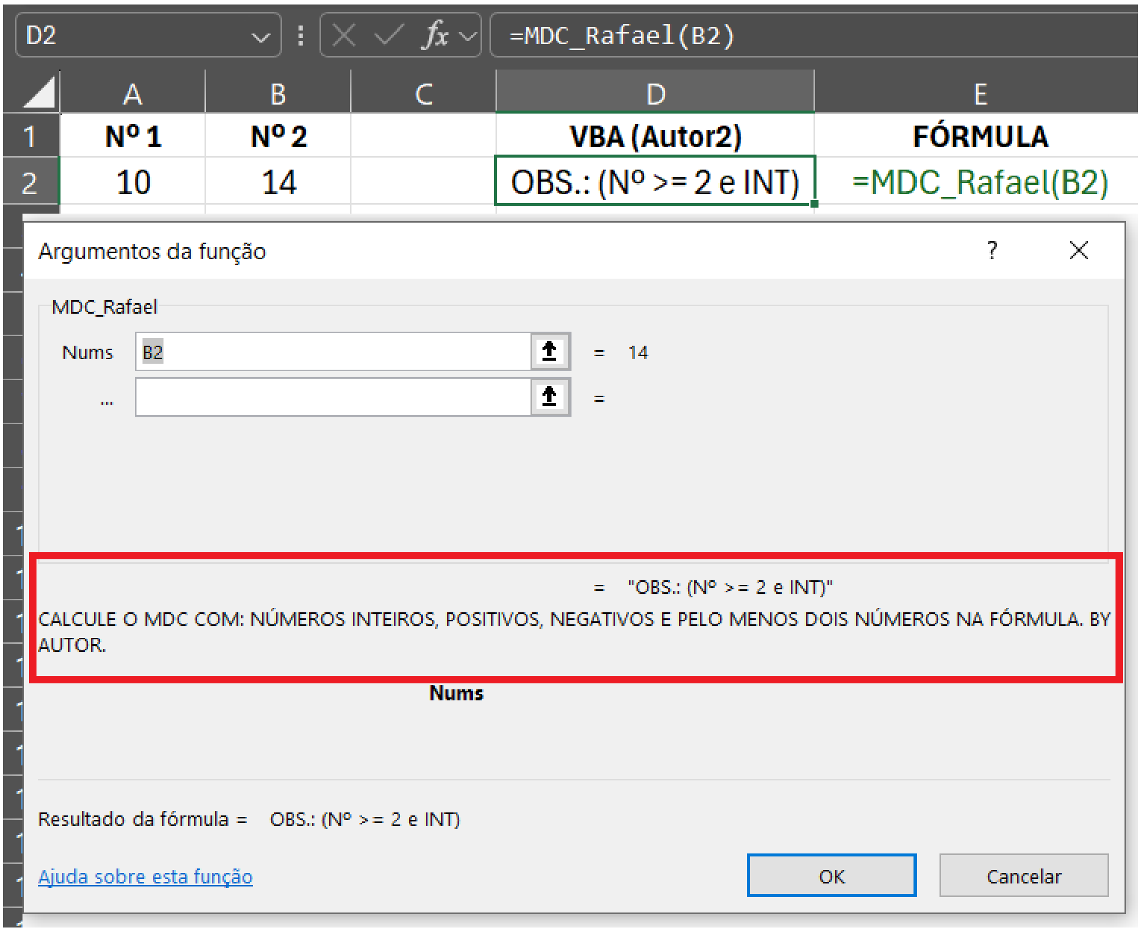
The second significant innovation deals with the situation in which only one value is reported. Unlike conventional implementations that mistakenly return their own number, the algorithm identifies this condition and responds with contextual educational feedback, explaining the need for at least two values for the calculation of the CDM, in line with VanLehn's (2006) pedagogical concepts about learning from mistakes. This approach transforms a potential misconception into a learning opportunity.

For decimal numbers, the system implements a controlled rounding routine followed by precision checking, based on Goldberg's (1991) work on computational arithmetic. When the conversion to integer results in a significant loss of precision, the algorithm alerts the user to the mathematical limitation, thus promoting conceptual understanding of the appropriate numerical domains for calculating the CDM.

The most striking differential of this algorithm is in its constructive feedback system, developed based on the principles of educational scaffolding by Wood et al. (1976). Instead of the traditional cryptic error messages such as "#NÚM" or "#DIV/0!", the system provides specific and didactic guidance. For example, when a student enters non-integer values, he receives not only an indication of the error, but also an explanation of the domain of natural numbers and suggestions for correction. This approach was validated by Shute's (2008) studies on formative feedback in digital learning environments.

Figure 9

New proposal (attending) for formulas with a single value



Source: (the author 2025)

In the figure above, it shows two numbers, one in cell A2 and the other in cell B2. However, the formula was set up to calculate the MDC only from cell B2. According to the properties of the MDC, Excel returns with an important guideline: to calculate the MDC, you need to enter at least two numbers. This orientation appears in cell D2, reminding the student that the formula needs two values to perform the calculation correctly.

In the next figure, Excel is guiding the student in a clear and effective way, highlighting that it is not possible to perform precise calculations with irrational values. This guidance ensures that the results obtained are reliable, promoting accuracy in calculations and reinforcing the importance of using rational values to ensure the accuracy of the results. The concept of precision and gratitude in education is reflected in this care to avoid mistakes that could compromise the understanding of students.

In addition, Figure 11 presents the algorithm developed in Excel's VBA, which implements the properties of the Greatest Common Factor (MDC). This algorithm not only performs the calculations correctly, but also serves as a didactic tool to demonstrate the practical application of important mathematical concepts. The use of VBA (Visual Basic for

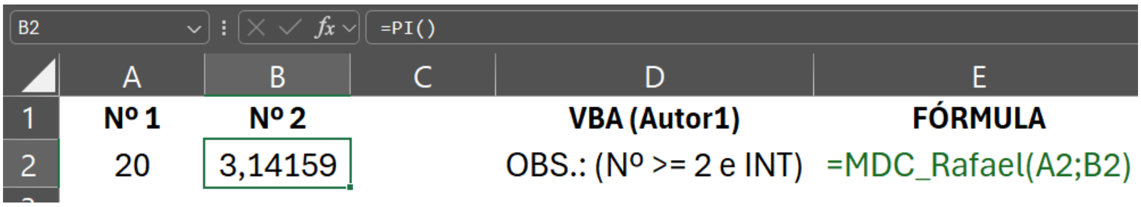
Applications) enables a more dynamic and interactive approach, allowing students to see the theory being applied in practice, which reinforces the understanding and retention of the content.

This methodology not only reiterates the fundamental concepts of mathematics, but also facilitates a deeper understanding of the methods used to solve problems such as the calculation of the CDM. The clarity of the instructions in Excel, combined with the precision of the calculations performed, provides a solid foundation for students to develop practical mathematical skills applicable to various everyday situations.

By adopting this innovative approach as shown in figure 10, the educational environment becomes more stimulating and efficient, inspiring confidence in students and encouraging enthusiasm for learning. Clarity of orientation avoids common mistakes, such as the inappropriate use of irrational numbers, and helps students to better understand the limits and conditions of mathematical operations. In this way, students not only learn the theory, but also acquire skills to apply this knowledge accurately and safely in their future activities, whether academic or professional.

Figure 10

New proposal (attending) for formulas with irrational value(s)



Source: (the author 2025)

In particular, Figure 11 shows the algorithm developed in Excel's Visual Basic for Applications (VBA), which is designed to accurately meet the properties of the Greatest Common Divider (MDC). This algorithm not only solves mathematical problems related to the MDC, but also illustrates the possibility of presenting and building a high-quality education, using technological tools to enrich learning.

This approach goes beyond the simple application of mathematical formulas, as it reinforces the fundamental concepts of number theory and arithmetic. By applying an algorithm in VBA, the student has the opportunity to see how abstract ideas in mathematics can be transformed into practical and effective solutions, increasing their understanding of mathematical methods. Programming, in this context, serves as a bridge between theory and practice, providing more concrete and interactive learning.

The clarity of the instructions provided by the algorithm and the accuracy of the calculations performed are essential aspects to ensure that students develop applicable and useful mathematical skills in various situations. With the use of Excel and VBA, students not only learn about the concepts of division and factors, but can also visualize how mathematical operations are done automatically and systematically, which helps to solidify learning.

In addition, this innovative methodology has the power to inspire confidence and enthusiasm in the learning process. The use of tools such as Excel, combined with VBA, creates a more dynamic and engaging educational environment, which motivates students to explore and experiment with mathematical concepts in a practical and fun way. This interaction with technology also stimulates a growing interest in mathematics, transforming learning into a more motivating and effective experience.

Finally, by applying this type of teaching, education becomes more accessible and rich, allowing students to acquire a deeper and safer understanding of mathematical methods, which prepares them to use this knowledge effectively in their future academic or professional activities.

Figure 11

Algorithm to meet MDC properties (VBA)

```
Function MDC_Rafael(ParamArray nums() As Variant) As Variant
    Dim i As Integer, n As Integer
    Dim a As Long, b As Long
    Dim result As Long
    n = UBound(nums) - LBound(nums) + 1
    For i = 0 To UBound(nums)
        If nums(i) <> Int(nums(i)) Then
            MDC_Rafael = "OBS.: (N° >= 2 e INT)"
            Exit Function
        End If
    Next i
    If n < 2 Then
        MDC_Rafael = "OBS.: (N° >= 2 e INT)"
        Exit Function
    End If
    Dim nullOrZeroCount As Integer
    nullOrZeroCount = 0
    For i = 0 To UBound(nums)
        If IsNull(nums(i)) Or nums(i) = 0 Then
            nullOrZeroCount = nullOrZeroCount + 1
        End If
    Next i
    If nullOrZeroCount = n Then
        MDC_Rafael = "Indefinido"
        Exit Function
    End If
    a = Abs(nums(0))
    For i = 1 To UBound(nums)
        b = Abs(nums(i))
        result = MDC(a, b)
        a = result
    Next i
    MDC_Rafael = result
End Function
Function MDC(a As Long, b As Long) As Long
    Do While b <> 0
        Dim temp As Long
        temp = b
        b = a Mod b
        a = temp
    Loop
    MDC = a
End Function
```

Source: (the author 2025)

3 FINAL CONSIDERATIONS

The analysis carried out in this study exposes an alarming reality: Microsoft Excel, a tool widely disseminated in the global educational environment, has structural flaws that seriously compromise its use as a pedagogical resource. The persistence of basic errors in fundamental mathematical calculations – as demonstrated in the case of the Greatest Common Divisor (CDM) – reveals a worrying disconnect between the software's functionalities and the actual needs of mathematics education.

The paradox is evident: while the Ministry of Education (MEC) continues to recommend Excel as an essential tool for technical courses and professional training, students are faced with software that distorts basic mathematical concepts. This contradiction is aggravated when we consider that it is a proprietary and costly solution, whose errors have persisted for more than a decade without correction by the developer. The flaws go beyond mere technical inaccuracies – they represent a violation of fundamental mathematical principles that should be sacred in any tool with educational pretensions.

The results of this research offer valuable contributions to various social actors. For the academic community, they highlight the urgency of rethinking the uncritical use of technological tools in teaching. For educational managers, they serve as a warning about the need to carefully evaluate the software recommended in the curriculum guidelines. And for developers, they represent a call to technical and educational responsibility that should accompany products with such diffusion in schools.

Still, it is essential to recognize the limitations of this study. Although it had contributions from students and some professors, it was based predominantly on technical analysis and literature review, leaving room to include a larger number of participants in future research. In addition, the focus was restricted to the flaws in the calculation of the CDM, even knowing that other mathematical inconsistencies in Excel also deserve to be investigated in future works.

The current situation of Excel in education configures a technological-pedagogical paradox that can no longer be ignored. Until Microsoft takes responsibility for fixing these basic flaws, it is up to the education community to develop strategies to mitigate their harmful effects. The present study hopes to contribute to this awareness and to the construction of alternatives that really serve the purposes of mathematics teaching in the twenty-first century.

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