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TERMINOLOGY OF FUNCTION ARGUMENTS IN MICROSOFT EXCEL: AN ANALYSIS OF THE LOOKUP_VALUE ARGUMENT OF THE VLOOKUP FUNCTION IN MATHEMATICS EDUCATION

TERMINOLOGIA DE ARGUMENTOS NO MICROSOFT EXCEL: UMA ANÁLISE DO VALOR_PROCURADO DA FUNÇÃO PROCV NA EDUCAÇÃO MATEMÁTICA

TERMINOLOGÍA DE LOS ARGUMENTOS DE FUNCIÓN EN MICROSOFT EXCEL: UN ANÁLISIS DEL VALOR_BUSCADO DE LA FUNCIÓN BUSCARV EN LA EDUCACIÓN MATEMÁTICA

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ABSTRACT

This study analyzes the correspondence between Lookup_value, the name assigned to the first argument of the VLOOKUP function in Microsoft Excel, and the role played by this element in the lookup operation. The qualitative study combines document analysis with controlled functional testing in Excel, using text, numerical, and date inputs. For comparison, official sources and interfaces from Google Sheets and LibreOffice Calc were examined. The tests showed that the nature of the input can vary without altering its role in the procedure in the cases analyzed. The comparative examination identified Lookup_value, search_key, and Search criterion for functionally corresponding positions, revealing lexical choices that emphasize different aspects of the operation. The results neither establish the superiority of any of these formulations nor indicate a failure in VLOOKUP processing. They do, however, reveal an issue of conceptual correspondence between the name used and the role performed in the lookup operation. In Mathematics Education, this distinction contributes to including interface terminology in the analysis of computational representations.

KEYWORDS: *Mathematics Education. Spreadsheets. Microsoft Excel. VLOOKUP. Terminology*.

RESUMO

Este estudo analisa a correspondência entre valor_procurado, nome atribuído ao primeiro argumento da função PROCV no Microsoft Excel, e o papel exercido por esse elemento na operação de busca. A pesquisa qualitativa combina análise documental e testes funcionais controlados no Excel, com entradas textuais, numéricas e de data. Como contraste, foram examinadas fontes oficiais e interfaces do Google Planilhas e do LibreOffice Calc. Os testes mostraram que a natureza da entrada pode variar sem alterar sua participação no procedimento, nos casos analisados. O exame comparativo identificou Lookup_value, search_key e Search criterion para posições funcionalmente correspondentes, evidenciando escolhas lexicais que destacam aspectos distintos da operação. Os resultados não estabelecem superioridade entre essas formulações nem indicam falha no processamento do PROCV. Evidenciam, contudo, uma questão de correspondência conceitual entre o nome empregado e o papel desempenhado na busca. Na Educação Matemática, essa distinção contribui para incluir a terminologia das interfaces na análise das representações computacionais.

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PALAVRAS-CHAVE: Educação Matemática. Planilhas eletrônicas. Microsoft Excel. PROCV. Terminologia.

RESUMEN
Este estudio analiza la correspondencia entre valor_buscado, nombre atribuido al primer argumento de la función BUSCARV en Microsoft Excel, y el papel desempeñado por este elemento en la operación de búsqueda. La investigación cualitativa combina el análisis documental con pruebas funcionales controladas en Excel, utilizando entradas textuales, numéricas y de fecha. Como contraste, se examinaron fuentes oficiales e interfaces de Google Sheets y LibreOffice Calc. Las pruebas mostraron que la naturaleza de la entrada puede variar sin alterar su participación en el procedimiento, en los casos analizados. El examen comparativo identificó Lookup_value, search_key y Search criterion para posiciones funcionalmente correspondientes, evidenciando elecciones léxicas que destacan distintos aspectos de la operación. Los resultados no establecen superioridad entre estas formulaciones ni indican una falla en el procesamiento de BUSCARV. Evidencian, sin embargo, una cuestión de correspondencia conceptual entre el nombre empleado y el papel desempeñado en la búsqueda. En Educación Matemática, esta distinción contribuye a incluir la terminología de las interfaces en el análisis de las representaciones computacionales.

PALABRAS CLAVE: *Educación Matemática. Hojas de cálculo. Microsoft Excel. BUSCARV. Terminología.*

1. INTRODUCTION

Digital technologies have assumed an increasingly relevant role in mathematics teaching and learning, not only because they enable calculations to be performed, but also because of the ways in which they support the exploration and organization of knowledge. Within this context, spreadsheets provide accessible environments for connecting mathematical procedures with computational resources, allowing formulas, data, and quantitative relationships to be brought together within a single interface (Ho *et al.*, 2022). Their use in educational activities therefore increases the need to examine not only the results produced by the software, but also the resources through which users interpret and construct the procedures they perform.

This discussion becomes particularly important when considering that interaction with mathematical technology takes place through its own systems of representation and commands. Duval (2006) highlights the importance of representations for mathematical activity and understanding, while recent studies indicate that the integration of digital resources changes the ways mathematical objects can be approached and establishes new relationships between knowledge and technology (Drijvers; Sinclair, 2024). In spreadsheets, this mediation is also reflected in the language used to present functions, arguments, and syntactic structures, all of which contribute to the reading required to construct and interpret a formula.

In Microsoft Excel, this issue can be observed in the VLOOKUP function, which is used to perform lookups within a data table. Its syntax identifies the first argument as Lookup_value,

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which specifies the element used to establish a match in the first column of the table. This designation raises a conceptual question relevant to Mathematics Education: to what extent does the name assigned to this argument make explicit the function it performs in the lookup mechanism? The issue extends beyond obtaining the correct result and directs attention to the relationship between terminology, syntactic organization, and the meaning of the procedure expressed within the computational environment.

The names assigned to the components of a formula are not entirely separate from how those components are interpreted. In an experimental study involving experienced spreadsheet users, Jansen and Hermans (2021) found that named parameters, among other features of the representation investigated, supported the understanding of functions. In another computational domain, Avidan and Feitelson (2017) found that parameter names can provide relevant information for reading code. Although these findings cannot be directly transferred to students or to the use of VLOOKUP, they provide a basis for considering the terminology of syntactic elements as a dimension worthy of investigation rather than reducing it to an ancillary feature of the interface.

The relevance of this examination becomes more apparent when different spreadsheet environments use different terms for functionally corresponding components. Microsoft Excel identifies the first argument of VLOOKUP as Lookup_value, whereas other systems adopt terms more explicitly associated with the lookup operation, such as search_key in Google Sheets. This difference does not, in itself, establish the superiority of one lexical choice over another, but reveals distinct ways of designating the element used in the lookup. Comparing these terms makes it possible to distinguish the nature of the content provided from the function it assumes during processing.

This discussion is directly relevant to Mathematics Education because learning to use a formula is not limited to reproducing its syntax or obtaining the expected result. Engaging with computational resources in mathematical activities involves recognizing relationships among the data entered, the commands used, and the procedure being constructed. Research on spreadsheets has highlighted opportunities for connecting mathematical ideas with computational thinking (Van Borkulo *et al.*, 2023), while studies of digital technologies have emphasized changes in how mathematical objects and practices are approached in mathematics education (Engelbrecht; Borba, 2024). From this perspective, examining the terms presented by the interface provides a basis for discussing the correspondence between computational language and the conceptual organization of the procedure being performed.

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Against this background, the study is guided by the following research question: to what extent does the designation Lookup_value, assigned to the first argument of the VLOOKUP function in Microsoft Excel, conceptually represent the role performed by this argument in the lookup operation? The objective is to analyze the correspondence between this designation and the conceptual function performed by the first argument, considering the diversity of accepted inputs and, as a documentary contrast, the terms used in other spreadsheet environments. To this end, documentation and interfaces from Microsoft Excel, Google Sheets, and LibreOffice Calc are examined alongside controlled functional testing conducted in Excel to determine whether the functional role of the first argument remains unchanged across different forms of input.

2. THEORETICAL FRAMEWORK

Analyzing the terminology used in spreadsheet functions requires a framework that brings together Mathematics Education, digital technologies, and computational language. This perspective makes it possible to examine the terms presented by the interface not as isolated elements, but in relation to the meanings and functions they assume in the construction of procedures. To support this approach, the theoretical framework draws on studies addressing the educational use of digital resources and spreadsheets, as well as research on representation, formula comprehension, and the naming of components in computational environments.

2.1. Digital technologies and spreadsheets in mathematics education

The growing presence of digital technologies in Mathematics Education has expanded opportunities for exploring concepts, working with information, and developing activities that connect mathematical knowledge with computational resources. In this context, their educational relevance extends beyond the technical capabilities of the tools to include the ways in which objects of knowledge are accessed, manipulated, and related during use. Weigand, Trgalová, and Tabach (2024) situate these transformations within a context in which teaching, learning, and assessment incorporate possibilities arising from technological development.

Among these resources, spreadsheets bring together data, expressions, and results within a single workspace. Ho *et al.* (2022) highlight their capacity to establish connections between mathematical ideas and computational thinking, while Van Borkulo *et al.* (2023), in a study conducted in statistics education, examine their use with authentic data and computational practices. The pedagogical relevance of these environments therefore lies not only in the automation of calculations, but also in the relationships established among the information entered, the formulas constructed, and the procedures employed.

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Using a digital tool involves knowledge that belongs neither exclusively to the mathematical domain nor to the technical domain. In developing the concept of digital mathematical competence, Geraniou and Jankvist (2019) discuss the integration of mathematical and digital competencies required to solve technology-mediated tasks. In spreadsheets, this integration can be observed when users need to identify data, select functions, organize references, and interpret results, drawing on knowledge of both the problem and the environment in which it is addressed.

The educational use of Excel and Calc has also been examined in studies devoted to exploring mathematical content through spreadsheets (Gonçalves, 2014). More recently, research on these environments has addressed aspects that extend beyond the availability of resources, including conditions of access, visibility, and the functional appropriation of tools incorporated into the software (Gonçalves, 2026). This broader perspective makes it possible to consider features of the interface itself among the elements that can be examined in contexts involving mathematical knowledge and technology.

2.2. Representation, language, and understanding in computational environments

Understanding a mathematical expression depends not only on the object to which it refers, but also on the forms used to represent it. Duval (2006) emphasizes that mathematical activity involves systems of representation with their own characteristics and that coordinating these systems plays a role in accessing mathematical objects. In digital environments, this relationship takes on another dimension, as symbols, commands, and expressions become part of a language that is also shaped by the computational organization of the tool.

The way these elements are presented affects the conditions under which they can be read and interpreted. Green and Petre (1996), in proposing the cognitive dimensions of notations framework, show that notational systems can be examined in terms of properties related to the activities they support. In the field of human-computer interaction, Norman (2013) discusses the importance of making the possibilities offered by a system perceptible, while Rogers, Sharp, and Preece (2023) address principles related to interaction and interface intelligibility. These contributions provide a basis for considering the language presented by software as part of the relationship among the user, the task, and the digital resource.

The lexical choices used to identify computational components add a specific dimension to this discussion. Lawrie *et al.* (2007), in their investigation of identifier names, found differences in comprehension and memory associated with the forms used to name them. Avidan and Feitelson (2017), in an experimental study with developers, likewise found that variable and

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parameter names provide information used in interpreting code, with the names assigned to parameters being particularly relevant. Although these studies belong to the field of programming and do not support direct inferences about students using spreadsheets, they provide a basis for investigating terminological choices when examining the intelligibility of computational constructs.

In spreadsheets, this discussion is closely related to research on formulas. Jansen and Hermans (2021) investigated different forms of presentation and identified the presence of named parameters among the features associated with function comprehension. Ragavan, Sarkar, and Gordon (2021), in turn, show that interpreting a spreadsheet may require reconstructing relationships embedded in formulas, going beyond simply observing the resulting values. These studies support the relevance of examining how an expression communicates its organization to the user, without assuming that any single feature determines the resulting understanding.

2.3. Formulas and arguments in spreadsheets

A formula brings together components that perform distinct functions within a given procedure. Cell references, operators, constants, and functions are organized according to specific syntactic rules, and interpreting a formula requires recognizing both the content provided and the role performed by each part of the expression. Within functions, arguments occupy specific positions and provide the elements required for the intended processing. The names assigned to these arguments may indicate what must be provided, their role in the operation, or a characteristic of the content they accept.

When different types of content can occupy the same position without changing the function performed by a component, it becomes relevant to examine how that component is identified by the interface. The purpose is not to assume that a lexical choice determines user understanding, but to examine the relationship between the term employed and what the argument does within the formula.

The relationship between language and processing in Excel has previously been addressed in a study examining the semantic dimension of terms used in the spreadsheet environment in relation to the mathematical results produced (Gonçalves; Campigotto; Holschuh, 2024). The present study adopts a different focus: rather than investigating the numerical correctness of the result, it examines the correspondence between the name of an argument and its function within the procedure. This focus defines the scope of the object under investigation and extends the discussion of how computational components are identified in tools that are also used for mathematical activities.

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In this study, conceptual correspondence between an argument's name and its function is examined through three criteria: the nature of the input, the role performed during processing, and the information conveyed by the designation. These criteria distinguish terms referring to the supplied content, the lookup operation, or both. Accordingly, value, data, key, and criterion are analyzed in their documented contexts without assuming equivalence or terminological superiority. This distinction guides the comparison of interfaces, official documentation, and functional test results.

3. METHODOLOGY

This study adopts a qualitative, documentary, and comparative-analytical approach, combined with controlled functional testing conducted in Microsoft Excel. It examines the designation assigned to the first argument of the VLOOKUP function, considering its official description, the different types of input that can occupy this position, and the function that remains associated with it during the lookup operation. Excel constitutes the primary object of investigation, while Google Sheets and LibreOffice Calc are used as sources of terminological contrast.

The analysis draws on official documentation, interface records, and results obtained from controlled functional testing. The comparison among the three environments is not intended to evaluate their performance or establish the superiority of any of the terms identified, but rather to identify different ways of designating components that perform corresponding functions in the operation under examination.

3.1. Corpus construction and delimitation

The corpus comprises official webpages and interface records from Microsoft Excel, Google Sheets, and LibreOffice Calc. The selection was restricted to content related to the VLOOKUP function, with particular attention to its syntax, the designation of the first argument, and the description assigned to this component. Sources maintained by the organizations responsible for the three programs were used to ensure that the terms examined corresponded to those presented in their own support materials (Microsoft, n.d.; Google, n.d.; The Document Foundation, n.d.).

Microsoft Excel constitutes the primary object of this study. Google Sheets and LibreOffice Calc are included exclusively as sources of contrast, allowing other designations for the argument occupying a corresponding position in the lookup operation to be observed. The

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inclusion of these environments does not involve evaluating performance, available features, or comparing the products themselves. In the interfaces configured in English, the lookup function examined in this study is presented as VLOOKUP, as shown in Figures 1, 2, and 3.

The interface records were collected on September 3, 2026. Microsoft Excel was accessed through Microsoft 365, Version 2609, Build 20430.20048 (Click-to-Run), Current Channel (Preview), with the interface configured in English. LibreOffice Calc Version 24.8.4.2 was also used with the interface configured in English. Google Sheets was accessed through its web-based environment, configured in English. These details define the conditions under which the designations were observed, without assuming that they will remain unchanged in subsequent versions or configurations.

3.2. Controlled functional testing

The controlled functional testing was conducted in Microsoft Excel to examine the behavior of the first argument of VLOOKUP when different types of input were provided. A two-column table was constructed, linking three inputs to their respective return values: Test to Production, 125 to Logistics, and 09/17/2026 to Quality. In all executions, the range $A$2:$B$4 was kept fixed, as were the specification of the second column as the return column and the use of exact matching in the lookup.

Text, numerical, and date inputs were entered directly into the formulas, represented, respectively, by =VLOOKUP("Test",$A$2:$B$4,2,0), =VLOOKUP(125,$A$2:$B$4,2,0), and =VLOOKUP(DATE(2026,9,17),$A$2:$B$4,2,0). Direct entry preserved the representational differences among the three cases without standardizing them through cell references. All other components of the formulas remained unchanged.

The observation focused on the returned result and the role performed by the first argument in each execution. The study did not evaluate speed, performance, or features of the different environments, nor did it assess participant learning. These tests provided the empirical basis for examining whether variation in the nature of the input changes the function performed by the first argument and, subsequently, for relating this result to the terminology adopted by Excel and the designations observed in the other environments.

3.3. Analytical procedures

The analysis was organized around three criteria: the nature of the input, the functional role of the first argument of VLOOKUP, and the information conveyed by its designation. First, the functional test results were compared to determine whether the use of text, numbers, and

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dates altered the function of the first argument in the lookup operation. The terms identified in Excel, Google Sheets, and LibreOffice Calc were then examined in relation to the descriptions provided in their respective official sources.

The terms value, data, key, and criterion were not assumed to be equivalent, nor was any of them presumed to be necessarily superior to the others. The analysis considered the nature of the input, the function performed during processing, and the information conveyed by the argument's designation. These criteria made it possible to examine whether each designation emphasizes the supplied content, the lookup operation, or both.

From an educational perspective, the interpretation focused on the correspondence between the language presented by the spreadsheet and the elements required to read the formula. Student performance, difficulty, and learning were not evaluated. The educational implications are therefore discussed at the conceptual and representational levels, without attributing to lexical choice alone effects that were not measured.

4. RESULTS AND DISCUSSION

The results are examined in terms of the relationship among the inputs processed by VLOOKUP, the function performed by its first argument, and the designations identified in the selected environments. The discussion considers both the conceptual correspondence among these elements and their implications for reading formulas in Mathematics Education contexts.

4.1. Diversity of inputs and consistency of the functional role

The controlled functional tests showed that different types of input can occupy the first argument of VLOOKUP without altering the role performed by this component in the lookup operation. The text input "Test" returned Production, the number 125 returned Logistics, and the date represented by DATE(2026,9,17) returned Quality. In all executions, the input provided as the first argument was used to locate a match in the first column of the table and, based on that match, retrieve the result specified in the return column.

Table 1. Behavior of the First Argument of VLOOKUP in Excel

Input	Type	Result
"Test"	Text	Production
125	Number	Logistics

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DATE(2026,9,17)	Date	Quality

Source: The author, 2026.

The results make it possible to distinguish the nature of the input from the role it performs within the formula. Text, numbers, and dates have their own characteristics and require forms of representation appropriate to each type of content, but this variation does not change their role in the procedure performed by VLOOKUP. In all three cases, the first argument provides the element used for the lookup in the first column of the table. Thus, the tests show not only that the function accepts different types of input, but also that the function performed by the first argument remains constant across the cases examined.

This distinction is relevant to the interpretation of formulas in educational contexts. Understanding a spreadsheet function involves recognizing not only the content entered, but also the role performed by its components within the computational procedure. Jansen and Hermans (2021) identified relationships between forms of presentation and the comprehension of spreadsheet formulas, while Ragavan, Sarkar, and Gordon (2021) showed that interpreting them may require reconstructing relationships that are not immediately apparent from the results displayed. In the case examined here, distinguishing the nature of the input from its function in the lookup operation helps explain why different types of content can occupy the same position without changing the organization of the procedure.

The terminology used for computational components becomes relevant in this process because it contributes to how the structure of the formula is presented to the user. In a study of identifiers in programming, Lawrie *et al.* (2007) found differences in comprehension and memory associated with the names used. These findings do not support inferring equivalent effects on students using spreadsheets, but they do support examining the relationship between the designation of a component and the role it performs. In Mathematics Education, this analysis is also related to the integration of mathematical and digital knowledge discussed by Geraniou and Jankvist (2019).

The results of this stage do not, on their own, support characterizing Lookup_value as an inappropriate designation. The controlled functional tests establish a more specific finding: in the cases examined, the nature of the input varies, while the role performed by the first argument remains unchanged. This consistency provides the empirical basis for comparing, in the following section, the designations assigned to the corresponding component in the selected spreadsheet environments.

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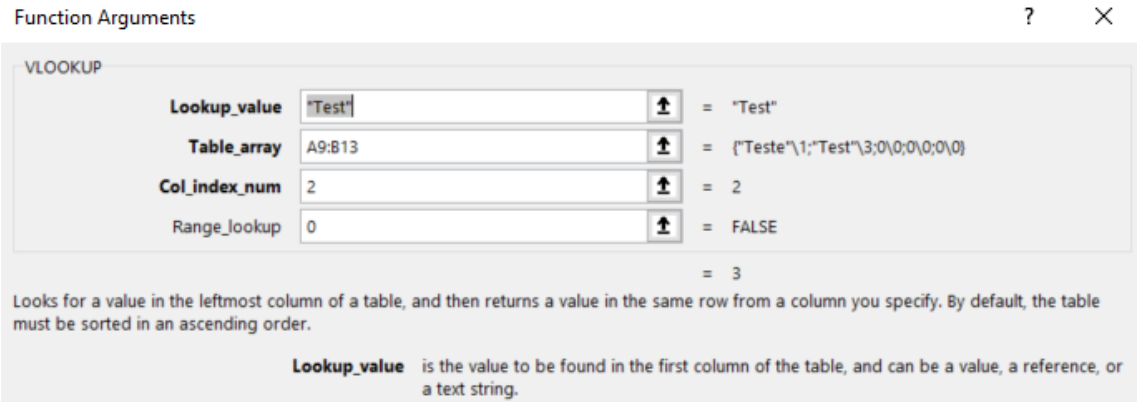
4.2. Designations assigned to the first argument

The interface records show that the three environments examined use different terms for the first argument of the lookup function. Microsoft Excel, Google Sheets, and LibreOffice Calc use Lookup_value, search_key, and Search criterion, respectively, for components that occupy corresponding positions in VLOOKUP. All three terms identify the element used to locate a match in the first column.

In Microsoft Excel, the first argument is identified as Lookup_value, as shown in Figure 1. The interface states that this element is to be found in the first column of the table and that it can be a value, a reference, or a text string. This description is consistent with the results presented in the previous section, in which different types of input occupied the same position without changing their function in the lookup operation.

Figure 1. Description of the First Argument of the VLOOKUP Function in Microsoft Excel



Source: The author, 2026.

The interface record makes it possible to distinguish the name of the argument from the explanation provided for its use. Lookup_value identifies the component, while the text presented by Excel describes its role in the procedure and specifies the different forms accepted in that position. The name and the description thus provide distinct information about the same element.

In Google Sheets, the first argument is presented as search_key, as shown in Figure 2. Unlike Lookup_value, this designation incorporates the terms search and key into the identification of the component used in the operation.

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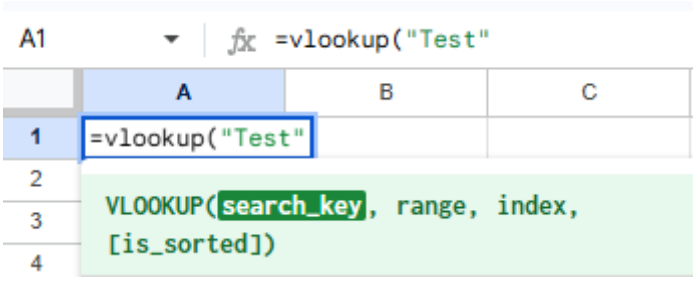
Figure 2. First Argument of the VLOOKUP Function in Google Sheets

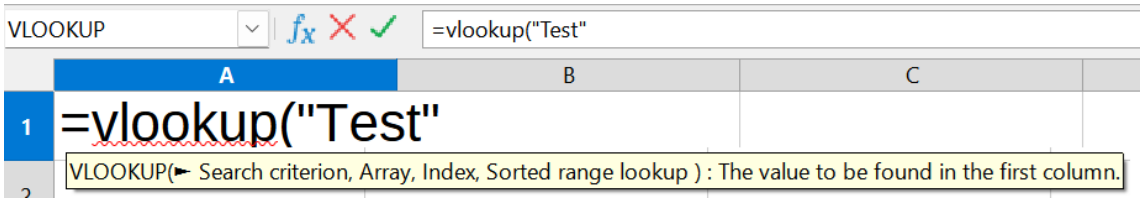


Source: The author, 2026.

The variation observed does not provide a basis for establishing greater precision or adequacy of one expression over another. It shows that different environments may use different designations for components that perform corresponding functions, making it relevant to relate the terms employed to the operation performed.

In LibreOffice Calc, the help displayed while entering the formula identifies the first argument as Search criterion, as shown in Figure 3. This designation combines criterion with Search, while the interface itself indicates that this is the element to be found in the first column.

Figure 3. First Argument of the VLOOKUP Function in LibreOffice Calc



Source: The author, 2026.

The LibreOffice Calc record adds another aspect to the comparison. Although the argument is designated as Search criterion, its description uses value to indicate what is to be found in the first column. Criterion and value therefore appear within the same guidance resource, but serve distinct terminological functions: the former is part of the argument name, whereas the latter describes the content involved in its use.

Taken together, the three interfaces use Lookup_value, search_key, and Search criterion for the first argument of VLOOKUP. This variation occurs in relation to a function that remained constant across the cases examined: providing the element used to locate a match in the first

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column and retrieve the associated result. This finding provides the basis for the discussion of the relationships among value, data, key, and criterion developed in the following subsection.

4.3. Value, data, key, and criterion: conceptual distinctions

The results make it possible to distinguish the nature of the input from the function it performs in VLOOKUP. This distinction is necessary when examining Lookup_value, since the Excel interface itself allows different forms of content to occupy the first argument. The tests involving text, numbers, and dates do not demonstrate that the term adopted by Excel is incorrect. Rather, they show that different types of content can occupy the first argument without changing its function in the lookup operation.

Replacing value with data would not, by itself, resolve the issue under examination, since this alternative would not necessarily make the role of the first argument in the operation explicit. The central issue lies in the relationship among the name used, the content received by VLOOKUP, and the function performed by this element.

search_key and Search criterion exhibit another characteristic by associating the first argument with the lookup operation performed by VLOOKUP. The LibreOffice Calc record is particularly informative: the interface uses Search criterion to name the argument and employs value when explaining what is to be found in the first column. Value and criterion thus appear within the same guidance resource, but serve different terminological functions.

The four terms examined do not necessarily express the same aspect. The designation of the first argument may emphasize the content it receives, its role in the lookup operation, or both aspects. The controlled functional tests showed that the nature of the input varies, while its function remains constant across the cases analyzed. The issue under investigation, therefore, is not whether Lookup_value is computationally valid, but what this designation makes explicit about the operation performed.

From the perspective of Mathematics Education, terminology forms part of how the structure of a formula is presented to the user, without warranting inferences about comprehension or learning. The results provide a basis for discussing the correspondence between name and function, as well as the elements provided by the interface for interpreting the expression. The educational implications of these findings are examined in the following subsection.

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4.4. Implications for mathematics education

The terminology used in a function forms part of how its structure is presented to the user. In VLOOKUP, recognizing that the first argument provides the element used in the lookup makes it possible to relate the syntax displayed by the spreadsheet to the procedure being performed. In educational activities, using a formula involves not only entering data and obtaining results, but also identifying the purpose of its components.

Duval (2006) highlights the importance of representations in mathematical activity. In spreadsheets, a formula constitutes a computational representation of a procedure, in which the names assigned to arguments are among the elements available for interpreting it. This terminology does not determine user understanding, but it can be examined in terms of the correspondence between the term presented and the role performed within the expression. The integration of mathematical and digital knowledge discussed by Geraniou and Jankvist (2019) reinforces the relevance of considering these aspects in the educational use of technological resources.

The results do not support the claim that Lookup_value hinders learning or that another designation would lead to better understanding. Such effects would require research involving participants. What the findings do show is the relevance of including the names assigned to functions and their arguments among the aspects that can be examined in digital environments also used for mathematical activities. The comparison among Lookup_value, search_key, and Search criterion shows that a corresponding functional role can be presented through different lexical choices.

The discussion also extends to possible improvements in how these functions are presented. Terminology, documentation, and interface guidance resources can be examined without presupposing changes to the processing performed by the software. In the case of systems that are widely used and maintained over time, potential modifications also need to take backward compatibility with existing formulas and files into account. This study does not assess the technical feasibility of any specific modification, but indicates that terminological precision can be discussed separately from computational functioning.

For Mathematics Education, the case of VLOOKUP highlights the importance of distinguishing the content provided from the role it performs within the formula. This distinction makes it possible to include interface language in the analysis of digital tools without reducing the discussion to the correctness of the results produced. The analysis also provides a basis for investigating other functions in which argument designations may raise similar questions.

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5. FINAL CONSIDERATIONS

This study examined the correspondence between Lookup_value, the designation assigned to the first argument of VLOOKUP in Microsoft Excel, and the function performed by this element in the lookup operation. The controlled functional tests showed that text, numerical, and date inputs can occupy this position without changing its function in the cases analyzed. Despite differences in the content provided and in its forms of representation, the first argument remained responsible for specifying the element used to locate a match in the first column of the table and retrieve the associated result.

The comparison with Google Sheets and LibreOffice Calc revealed different terminological choices for functionally corresponding components: Lookup_value, search_key, and Search criterion. This variation does not establish a hierarchy among the three formulations. In Excel, value is used to identify an argument that accepts different forms of content, as documented in the interface itself. The issue under investigation therefore concerns what the designation makes explicit about the function performed by this component during the lookup operation.

Replacing value with data would not, by itself, resolve the issue examined, since this alternative would not necessarily make the function of the first argument explicit. Key and criterion, in turn, incorporate a reference to the lookup operation, but this characteristic does not provide a basis for classifying them as superior choices. The results therefore support a distinction between the content accepted in a given position within the formula and the way its function is expressed terminologically. The case examined concerns conceptual correspondence between name and function rather than a failure in VLOOKUP processing.

In Mathematics Education, this finding broadens the examination of spreadsheets beyond performing calculations and obtaining results. Reading a formula involves recognizing the content entered, its syntactic organization, and the function of its arguments. The terminology presented by the interface forms part of this representation, although the data from this study do not support attributing effects on comprehension or learning to any specific lexical choice. Studies involving participants could investigate whether different ways of naming these components produce measurable effects on the interpretation and construction of formulas.

The findings also make it possible to consider terminology, documentation, and interface guidance resources as aspects that may be improved without conflating them with the processing performed by the function. In established software, potential modifications need to take technical requirements and backward compatibility with existing formulas and files into account, the

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feasibility of which was not evaluated in this study. VLOOKUP thus illustrates how the relationship between the name assigned to an argument and the function it performs constitutes a relevant object of investigation in Mathematics Education, with potential for further research involving other functions and spreadsheet environments.

REFERENCES

AVIDAN, E.; FEITELSON, D. G. Effects of variable names on comprehension: an empirical study. In: IEEE/ACM INTERNATIONAL CONFERENCE ON PROGRAM COMPREHENSION (ICPC), 25., 2017, Buenos Aires. **Proceedings [...]**. [S. l.]: IEEE, 2017. p. 55–65. DOI: 10.1109/ICPC.2017.27.

DRIJVERS, P.; SINCLAIR, N. The role of digital technologies in mathematics education: purposes and perspectives. **ZDM – Mathematics Education**, v. 56, n. 2, p. 239–248, 2024. DOI: 10.1007/s11858-023-01535-x.

DUVAL, R. A cognitive analysis of problems of comprehension in a learning of mathematics. **Educational Studies in Mathematics**, v. 61, n. 1-2, p. 103–131, 2006. DOI: 10.1007/s10649-006-0400-z.

ENGELBRECHT, J.; BORBA, M. C. Recent developments in using digital technology in mathematics education. **ZDM – Mathematics Education**, v. 56, p. 281–292, 2024. DOI: 10.1007/s11858-023-01530-2.

GERANIOU, E.; JANKVIST, U. T. Towards a definition of “mathematical digital competency”. **Educational Studies in Mathematics**, v. 102, n. 1, p. 29–45, 2019. DOI: 10.1007/s10649-019-09893-8.

GONÇALVES, R. A. **Introdução à matemática financeira por meio de planilhas eletrônicas**: Calc & Excel no ensino médio. Saarbrücken: Novas Edições Acadêmicas, 2014.

GONÇALVES, R. A. Funcionalidade estatística latente no Microsoft Excel: presença arquitetural e acessibilidade funcional. **RECIMA21 – Revista Científica Multidisciplinar**, v. 7, n. 7, 2026. DOI: 10.47820/recima21.v7i7.8583.

GONÇALVES, R. A.; CAMPIGOTTO, K. J. J.; HOLSCHUH, S. A. G. Planilha eletrônica Excel: quando o valor semântico da palavra denuncia o erro do resultado na matemática. In: BIANCHESSI, C. (org.). **Tecnologias digitais na educação**: dos limites às possibilidades. v. 6. Curitiba: Bagai, 2024. p. 89–98.

GOOGLE. PROCV. **Ajuda dos Editores de arquivos Google**. [S. l.]: Google, [s. d.]. Available at: https://support.google.com/docs/answer/3093318?hl=pt-BR. Accessed on: Sep. 3, 2026.

GREEN, T. R. G.; PETRE, M. Usability analysis of visual programming environments: a ‘Cognitive Dimensions’ framework. **Journal of Visual Languages & Computing**, v. 7, n. 2, p. 131–174, 1996. DOI: 10.1006/jvlc.1996.0009.

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HO, W. K.; GHOSH, J.; KAUR, B.; LOOI, C. K. Spreadsheets: a technological nexus between big ideas in mathematics and computational thinking in mathematics classrooms. **Proceedings of the Asian Technology Conference in Mathematics**, v. 2022, p. 1–17, 2022.

JANSEN, B.; HERMANS, F. The effect of a block-based language on formula comprehension in spreadsheets. In: IEEE/ACM INTERNATIONAL CONFERENCE ON PROGRAM COMPREHENSION (ICPC), 29., 2021, Madrid. **Proceedings [...]**. [S. l.]: IEEE, 2021. p. 288–299. DOI: 10.1109/ICPC52881.2021.00035.

LAWRIE, D.; MORRELL, C.; FEILD, H.; BINKLEY, D. Effective identifier names for comprehension and memory. **Innovations in Systems and Software Engineering**, v. 3, n. 4, p. 303–318, 2007. DOI: 10.1007/s11334-007-0031-2.

MICROSOFT. Função PROCV. **Suporte da Microsoft**. [S. l.]: Microsoft, [s. d.]. Available at: https://support.microsoft.com/pt-br/excel/functions/vlookup-function. Accessed on: Sep. 3, 2026.

NORMAN, D. A. **The design of everyday things**. Rev. and expanded ed. New York: Basic Books, 2013.

RAGAVAN, S. S.; SARKAR, A.; GORDON, A. D. Spreadsheet comprehension: guesswork, giving up and going back to the author. In: CHI CONFERENCE ON HUMAN FACTORS IN COMPUTING SYSTEMS, 2021, Yokohama. **Proceedings [...]**. New York: Association for Computing Machinery, 2021. p. 1–21. DOI: 10.1145/3411764.3445634.

ROGERS, Y.; SHARP, H.; PREECE, J. **Interaction design**: beyond human-computer interaction. 6. ed. Indianapolis: Wiley, 2023.

THE DOCUMENT FOUNDATION. Funções de planilha: PROCV. **Ajuda do LibreOffice**. [S. l.]: The Document Foundation, [s. d.]. Available at: https://help.libreoffice.org/latest/pt-BR/text/scalc/01/04060109.html. Accessed on: Sep. 3, 2026.

VAN BORKULO, S. P.; CHYTAS, C.; DRIJVERS, P.; BARENDSEN, E.; TOLBOOM, J. Spreadsheets in secondary school statistics education: using authentic data for computational thinking. **Digital Experiences in Mathematics Education**, v. 9, p. 420–443, 2023. DOI: 10.1007/s40751-023-00126-5.

WEIGAND, H.-G.; TRGALOVÁ, J.; TABACH, M. Mathematics teaching, learning, and assessment in the digital age. **ZDM – Mathematics Education**, v. 56, p. 525–541, 2024. DOI: 10.1007/s11858-024-01612-9.

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