

# STUDENTS' PERCEPTIONS OF CALCULUS COURSES AND THEIR CONCEPTUAL RELATIONSHIP WITH MANAGEMENT ACCOUNTING

## Percepção dos acadêmicos quanto às disciplinas de Cálculo e sua relação conceitual com as disciplinas de Gestão de Contabilidade

Article received on: 03/26/2023 and Article accepted on: 09/29/2023.

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vo e quantitativo, por meio do método dedutivo, utilizando-se para isso o formato de um estudo de caso e levantamento. Os dados para análise foram obtidos por meio de questionário, aplicados, exclusivamente, nas turmas de graduação de Ciências Contábeis. Utilizou-se, para análise dos dados, do software *Statistical Package of the Social Science* (SPSS), quanto ao Teste de Igualdade de Médias. O perfil do conhecimento matemático do acadêmico de Ciências Contábeis foi utilizado, de modo a compreender algumas variáveis que circundam o tema, tais como: aspectos sociais, aspectos de conhecimento prévio e aspectos de assimilação de matérias relacionadas ao CN. Obteve-se a percepção de que fatores socioeducacionais não implicaram na falta de assimilação dos conteúdos abordados na pesquisa. Inferiu-se que o CLD poderia ser inserido no processo ensino-aprendizagem.

**Palavras-chave:** Contabilometria. Cálculo de Limite e Diferencial. Gestão estratégica. Contabilidade Gerencial. Contabilidade de Custos. Tomada de Decisão.

### ABSTRACT

Interdisciplinarity is an important pillar for the development of Accounting Sciences within the teaching-learning process, in order to collaborate in the improvement of the assimilation of subjects that involve Management Accounting. The objective of this research was to identify, under the perception of the academics, to what extent knowledge of Numerical Calculus can improve students' performance in supporting decision-making in Management Accounting. To do so, through a demonstrative lesson with concepts and practical examples of the use of CLD, we obtained the answer to the research problem, which employed both qualitative and quantitative approaches using the deductive method, using the format of a case study and survey. The data for analysis were obtained through a questionnaire, applied exclusively to undergraduate Accounting Sciences classes. The Statistical Package for the Social Sciences (SPSS) was used to perform the test for mean equality. Students' mathematical knowledge was considered in order to understand some variables that surround the theme, such as: social aspects, aspects of prior knowledge and aspects related to the assimilation of content linked to Numerical Calculus. It was found that socio-educational factors did not result in difficulties in assimilating the content addressed in the study. It was inferred that the CLD could be inserted into the teaching-learning process.

### RESUMO

O vetor interdisciplinaridade é um importante pilar para a evolução das Ciências Contábeis no processo ensino-aprendizagem, colaborando com a melhoria da assimilação de assuntos que envolvem a Contabilidade de Gestão. No entanto, deficiências na base conceitual de disciplinas relacionadas à Matemática e Cálculo por parte dos acadêmicos, aliado à apresentação das disciplinas matemáticas sem uma conceituação contábil não tem surtido resultado. Nessa senda, a pesquisa teve como objetivo identificar, sob a percepção dos acadêmicos, em que medida o conhecimento de disciplinas de Cálculo podem melhorar o rendimento de acadêmicos no processo de suporte na tomada de decisão em Contabilidade de Gestão. Para tanto, por meio de uma aula demonstrativa com conceitos e exemplos práticos da utilização de CLD, obteve-se a resposta do problema da pesquisa, a qual é de caráter qualitativo

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**Keywords:** Quantitative Methods. Limit and Differential Calculus. Strategic management. Management accounting. Cost Accounting. Decision-Making.

## 1. INTRODUCTION

Organizations, regardless of their field of activity, are operating in increasingly competitive and dynamic environments (MARTINS, 2015; SPONCHIADO et al, 2018; MATOS et al, 2019).

Competition between companies is one of the factors that has been causing great concern for managers (MACIEL; MARTINS, 2018). The same occurs in the accounting environment.

With the evolution and scope of the areas of activity of the accounting professional, strictly linked to scientific evolution, as well as interdisciplinary insertion, accountants need to apply themselves to numerous subjects (MARTINS; SILVA; LUZ, 2021). This evolutionary dynamic was evidenced primarily, in the increased contribution of new subjects in the field of asset study, enabling the emergence of better ways to control assets (SILVA, 2008).

Accounting services require not only professional skills and knowledge, but also innovation in business transformation, providing value to their clients in order to compete in an increasingly competitive market (LEE; PENG; FAN, 2016).

Da Silva (2004, p.1) stated, the need for a reformulation of the academic curriculum, specifically for accounting professionals, has emerged, and this requires interdisciplinarity in the scope of training to remain competitive in the global scenario. However, although the set of academic courses is aligned with the current needs of the market, multidisciplinary can contribute to the efficiency in supporting decision-making offered by accountants. Mathematics is one of the multidisciplinary areas that can contribute to accountants. For Fracischetti et al. (2017, p.31), "the need for contributions involving probabilistic accounting-metrics applications was verified, through simulation models capable of evaluating decision-making alternatives in increasingly complex uncertainty environments".

Focusing on the premise on the skills in the formation of the bachelor in Accounting Sciences in the age of knowledge, which is to develop and apply reasoning, conceived through Quantitative Methods in an interdisciplinary way with accounting (DA SILVA, 2004, p.7). The knowledge and use of statistical and mathematical instruments by accounting professionals cannot fail to be an important item in their curricula in this millennium (Figueiredo and Moura, 2001). One of these instruments from the field of Mathematics is the Calculus of Limits and Differentials (CLD), also called Numerical Calculus (NC).

According to Stewart (2003, p.252), many practical problems require minimizing a cost, maximizing an area, or somehow finding the best way out of a situation such as the simple optimal shape of a can (container) and its related variables through rates.

However, the degree of use of the aforementioned subjects and their respective absorption induces questioning about their possible insertion in the teaching plan of the courses in Accounting Sciences (DA SILVA, 2012). On the other hand, the Accounting Course has no history of offering courses related to the content of Mathematics, including CLD. This results in students not having contact with this content, failing to enjoy the knowledge offered. In addition, this lack of contact can lead one to believe that there are no contributions, or even a relationship between these branches of knowledge and the Accounting Sciences. Deficiencies in the conceptual basis of courses related to Mathematics and Calculus on the part of the students, combined with the presentation of mathematical courses without an accounting conceptualization, have not produced effective learning outcomes.

In this context, the following research problem emerges: The research question is whether students perceive that knowledge of Numerical Calculus can improve academic performance in the process of support in decision making in management accounting? To meet the proposed problem, the objective of the research is to identify, from the perspective of the students, to what extent knowledge from Calculus-related subjects can improve students' performance in the process of support in decision-making in Management Accounting.

Courses related to management accounting, such as Managerial Accounting and Cost Accounting, combined with the mathematical knowledge acquired in the Accounting Sciences course, contribute to the training of accountants. The integration of this knowledge, from different areas in multidisciplinary or interdisciplinary environments, enables them to promote scientific development in a broad way.

## 2. THEORETICAL FRAMEWORK

### 2.1 ECONOMETRICS AS AN INTERDISCIPLINARY TOOL

Horngren (1985) states that one of the signs of an educated person is the ability to recognize and accept changes that promise better ways to achieve goals.

The author also states that "the accountant is still the leading expert in qualitative aspects in almost all organizations. To maintain and improve their position, they must be aware of how mathematical models can improve planning and control."

There are also some overlapping factors, such as the interdisciplinarity of mathematical and statistical subjects, which contributes to the possibility of solving numerous problems that seem to have no solution, such as optimization problems (STEWART, 2003). Sá (1988) affirmed the scientific interrelation of accounting with arithmetic and mathematics, since in the Middle Ages accounting education was given in Calculus Schools or so-called "Abacus Schools". From the author, it can be inferred that concern with interdisciplinary teaching has existed since the Middle Ages.

However, for Guimarães and Chaves Neto (2002), the use of scientific methods, especially quantitative ones, is not a widespread practice in Brazil, which also supports the idea of the present research, as this field is still little explored in the country. Beuren et al. (2003), highlight that the quantitative approach in the treatment of research problems in Accounting in Brazil is relatively recent and that in the United States, there are several Accounting journals with published articles that use statistics.

According to Da Silva et al. (2004, p.6), Accountometrics "is the area of accounting knowledge that seeks to obtain new or innovative methodologies based on mathematical sciences to solve concrete accounting problems."

Accountometrics consists of studying mathematical models and modeling associated with real accounting phenomena as a scientific methodology (DA SILVA et al., 2004, p.6).

Da Silva et al. (2004, p.6) also state that "accountometrics is concerned with the empirical determination of accounting principles and procedures, that is, the method of accounting research aims, essentially, at a conjunction of accounting theory with 'concrete measures', using the theory and techniques of the mathematical sciences as a basic point".

Rodrigues et al. (2013) stated that accountometrics is the new branch of accounting knowledge, which proposes the application of quantitative methods in solving accounting conflicts

in order to offer support in the management process of companies, making it possible for accounting professionals to present relevant and timely information to their users. The qualification, updating, and creativity of the accounting professional are among the most important factors to increase the quality of the information offered to its users (RODRIGUES *et al.*, 2013).

According to Rodrigues *et al.* (2013), it is concluded that accountometrics has as its main feature its predictive capacity, that is, through accounting, effective decision models can be created that are capable of anticipating and predicting, in some way, what will happen in the future. This can bring better utility of accounting data in order to project scenarios that can help the manager in the decision-making process, making Accounting a stronger tool (RODRIGUES *et al.* 2013).

Moraes (2018, p.5) stated that it is necessary for accounting teaching to bring knowledge to the student in problem solving and decision-making, and for this, it is necessary to analyze situations to make safe decisions, which can be obtained with mathematics and quantitative methods. In countries such as Colombia, accountometrics transcends quantitative aspects and also encompasses qualitative aspects, encompassing a larger universe, allowing total control of an organization (BAUTISTA, 2017).

For Rolim and Wunsch (2015), the objective of accountometrics is to assist managers in decision-making in various scenarios with the use of accounting, mathematics, statistics and technology information, and to present the resolution of a problem through statistical analysis.

Accountometrics, according to Sérgio Iudicibus (1982), "is the expectation of predicting results, by means of mathematical and statistical tools as instruments of quantitative methods". According to Iudicibus (1982, apud DA SILVA *et al.*, 2004, p.5) Accounting is "the quantitative analysis of real accounting phenomena based on the concomitant development of theory and observation, related to appropriate methods of inference."

Thus, the explanatory capacity of an accountometrics model is better the greater the spectrum of data it can explain and it must embrace a greater number of available and relevant accounting data possible (DA SILVA *et al.*, 2004, p. 6).

Da Silva *et al.* (2004, p.5) states that the model, in turn, has its origins in applied mathematics, which provokes the creation of mathematical theories to solve scientific problems and that, frequently, the applications consist of the construction of mathematical models that can reflect in a significant, even if simplified, way the behavior and structure of a concrete model whose operation is necessary to analyze or predict. Also according to Da Silva *et al.* (2004, p.4-5) "In other words, a mathematical representation of a practical situation is called a mathematical model".

In this context, "the mathematical sciences (Mathematics, Statistics and Informatics) form the fundamental pillars for building the bridge between the real world and the world of quantitative accounting sciences" (DA SILVA *et al.*, 2004).

Dos Santos and Lima (2008) state that the way of applying these quantitative methods in calculations and financial statements carried out within a company values the product/service and offers greater credibility to its shareholders and owners. However, it is currently perceived that, even though academics lack knowledge in mathematical areas that can offer a surplus return in strategic business management. According to Da Silva and Machado (2004, p. 35), who states that "although lacking this training, many studies have detected that the

performance is low (...) in undergraduate courses, and this deficient result is more accentuated, especially when the focus is on Mathematics".

Such practice should be mitigated by undergraduate courses to ensure that future accountant professionals master subjects that support decisions at all levels, contributing to teaching excellence. According to Da Silva and Machado (2004, p. 37), the study of mathematics is important for the accounting professional, because only by mastering the theory and its application in depth in the accounting universe, will it be possible to provide a management of the processed data with the rigor that the subject requires and will allow the correction of actions harmful to the company's assets.

As Corrar and Theóphilo (2004) rightly assure, it can be said that the main advantages of Accounting are the possibility of solving a variety of typing problems and allowing accountants to provide the most useful and appropriate information, bringing accounting closer to objectivity.

In this way, it is clear that the focus is on practicing the usefulness of the mathematical tool employed. As explained above, accountometrics is responsible for analyzing the behavior of the data, compiling them into graphs that, in most cases, follow the Linear Model applied to the Social Sciences, which is in line with Field (2015, p.48), who stated that "most of the statistics used in the social sciences are based on linear models, which means that we try to fit straight line models to the data collected."

According Field (2015, p.48), é interessante que a base no método linear seja utilizada porque a maioria dos estudos científicos publicados significantes foram os que seguiram este modelo, uma vez que a maioria dos cientistas sociais aprende a usar somente técnicas baseadas no modelo linear técnicas baseadas no modelo linear e aplica com sucesso.

Consequently, the remarkable advance in science and technology over the last century is due in large part to the development of mathematics. In this context, the specific branch of Computational Fuzzy Logic (CFL) stands out as a natural and powerful tool for addressing a wide range of problems in the social sciences. (APOSTOL, 1967, p.21, *emphasis added*).

According to Dal Castel *et al.* (2017), Accountometrics can contribute to the production of scientific knowledge in an institutionalized way, initially based on research carried out by undergraduate students, with an emphasis on the application of quantitative methods in Accounting Sciences. This shows that the Age of Knowledge requires an effort to implement changes.

One of the topics highlighted by Andrade (2002) in his dissertation concerns the causes of curricular inadequacies. He cites Marion (1985), who also emphasizes the poor quality of teacher training among those who take up teaching as a secondary activity to supplement their income, without any pedagogical preparation.

Finally, Marion and Silva (1986) define contabilometry as the quantitative analysis of real accounting phenomena, grounded in theoretical development and empirical observation, and connected through appropriate inferential methods.

Thus, the methodology of Contabilometry essentially involves: (a) theory formulation; (b) specification of the mathematical or theoretical model (real or deterministic); (c) specification of the contabilometric model (probabilistic); (d) establishment of basic assumptions; (e) data collection; (f) estimation of model parameters; (g) hypothesis testing; (h) forecasting; and (i) application of the model for financial control or policy purposes.

This highlights the need to apply the suggested sequence. As noted by Levine, Berenson, and Stephen (2000), in the field of business, auditing is one of the areas in which statistical sampling for estimation is widely used, since examining 100% of the items would be uneconomical and unjustified.

Leone (2000) presents techniques that employ maxima and minima to solve problems such as determining the optimal production and sales point, where Cost Accounting identifies sales revenues and corresponding production costs. He also applies these techniques to calculating the economic order quantity for purchasing materials and goods.

In addition, the author highlights the use of the Learning Curve to help determine production costs and the application of Linear Programming to address problems involving constraints or limitations of production resources.

Freire, Crisóstomo, and Botelho (2003) state that the quantitative method for assessing customer satisfaction represents progress in seeking to generalize the venerable model of financial accounting by incorporating the evaluation of intangibles into the firm.

According to James Stewart (2003, pp. XIII–XIV), the following sequence from the learning summary index, which serves as the basis for this study, consists of:

**CHART 1 - Summary of Limit and Differential Calculations**

Subject		Field of Study
Functions and Models	<ul style="list-style-type: none"> <li>- Four ways to represent a function</li> <li>- Mathematical models: a list of essential functions</li> <li>- New functions from old ones</li> <li>- Graphing Calculators and Computers</li> <li>- Exponential Functions</li> <li>- Inverse and Logarithmic Functions</li> </ul>	<ul style="list-style-type: none"> <li>- Functions</li> <li>- Basic Algebra</li> <li>- Analytical Geometry</li> </ul>
Subject	Field of Study	Subject
Limits and Derivatives	<ul style="list-style-type: none"> <li>- The problems of tangent and velocity</li> <li>- The limit of a function</li> <li>- Calculations Using Boundary Properties</li> <li>- The precise definition of the limit</li> <li>- Continuity</li> <li>- Limits in infinity</li> <li>- Horizontal asymptotes</li> <li>- Derivatives and Rates of Change</li> <li>- The derivative as a function</li> </ul>	<ul style="list-style-type: none"> <li>- Limit Calculation</li> <li>- Differential Calculus</li> </ul>
Derivation Rules	<ul style="list-style-type: none"> <li>- Derived from polynomial functions</li> <li>- The rules of the product and the quotient</li> <li>- Derivatives of trigonometric functions</li> <li>- Chain Rule</li> <li>- Implicit Derivation</li> <li>- Derivatives of logarithmic functions</li> <li>- Rates of Change in the Social Sciences</li> <li>- Exponential growth and decay</li> <li>- Related Fees</li> <li>- Linear and Differential Approximations</li> <li>- Hyperbolic functions</li> </ul>	<ul style="list-style-type: none"> <li>- Differential Calculus</li> <li>- Trigonometry</li> <li>- Exponential</li> <li>- Logarithm</li> </ul>
Applications of Derivation	<ul style="list-style-type: none"> <li>- Maximum and minimum values</li> <li>- Mean value theorem</li> <li>- How derivatives affect a graph</li> <li>- Indeterminate Forms and the Rule of L'Hôspital</li> <li>- Outline Curves Summary</li> <li>- Making graphs with calculation and calculators</li> <li>- Optimization Issues</li> <li>- Newton's method</li> <li>- Primitive</li> </ul>	<ul style="list-style-type: none"> <li>- Functions</li> <li>- Limit Calculation</li> <li>- Differential Calculus</li> </ul>

**SOURCE:** James Stewart (2003, p. XIII-XIV)

The topic "Functions and Models" is justified because it serves as a review of content taught in high schools throughout the country. The topic "Limits and Derivatives," in turn, presents the subject as a fundamental tool for performing predictive calculations involving variables, which are sometimes taught even at the high-school level. This topic allows the analysis of the variable "costs" as a function of other variables. The topics "Rules of Differentiation" and "Applications of Differentiation" provide the main conceptual foundations for further learning, which is essential for practical applications in the field of Accounting Sciences.

### 3. METHODOLOGICAL PROCEDURES

The research is classified as deductive and as a case study. It is characterized as both quantitative and qualitative regarding its approach to the problem, and as descriptive and survey-based with respect to its data-collection procedures.

The population of this research consists of 108 students enrolled in the third, fourth, and fifth years of the undergraduate program in Accounting Sciences, who already have knowledge of subjects related to Management Accounting,

such as Cost Accounting and Managerial Accounting, at a public university located in the Brazilian countryside. The sample consists of 63 students who voluntarily participated in the study.

Data collection occurred in three distinct stages. The first stage consisted of gathering the students' sociodemographic information. The second stage involved presenting a demonstrative class on the Calculus of Limits and Derivatives, during which four practical examples of the use of Calculus to solve problems related to the Social Sciences—such as Accounting—were taught, with the aim of optimizing various variables within this field of study. The third stage consisted of collecting the students' opinions regarding their understanding of the examples, their perception of the applicability of Calculus in Accounting, their perception of the relevance of incorporating Calculus into Accounting education, and their expectations regarding the use of Calculus in the professional practice of accountants.

In this class, a brief overview of the history of Differential Calculus and its applications in the context of Accounting Sciences was presented. The content primarily addressed optimization problems involving the variable 'costs' and demonstrated how such methods can be useful from the perspective of strategic business management. Implementing this approach in future undergraduate courses could provide students with a new understanding of the applicability of analytical and advisory tools in financial and economic decision-making within companies. This is because practical, real-world problems would be addressed and could be adapted to different types of companies, products, or services, as illustrated throughout this study.

The examples used illustrated different approaches to cost reduction. These included maximizing area and volume to reduce costs (examples 1 and 2), reducing packaging expenses to increase profit (example 2), and offering unconditional discounts to strategically attract customers and increase revenue (example 3). The final example demonstrated how to determine an appropriate number of days for assembly training, which is directly related to reducing training expenses (example 4). All examples were solved using the Calculus of Limits and Derivatives.

After data collection, the information was tabulated and descriptive statistics were generated. Normality was assessed using the Kolmogorov–Smirnov test (for samples with fewer than 30 observations, according to Field, 2009), and the Mann–Whitney test was applied to compare group means when data did not follow a normal distribution. These analyses were conducted using SPSS version 22.

Tests for equality of means were performed between two groups: students who attended public schools and those who attended private schools. For each group, both elementary and high school backgrounds were examined.

The comparison aimed to assess differences in the groups' perceptions regarding social aspects, prior knowledge of subjects related to Limits and Derivatives (CLD), and their understanding of CLD in the demonstrative class.

In the high-school category, the sample included 12 students from private schools and 51 students from public schools. In the elementary-school category, the sample consisted of 13 students from public schools and 50 students from private schools.

#### 4. DATA ANALYSIS

The first step was to identify the students' educational backgrounds and their current financial situation based on family income. It was found that, on average, most students had attended public schools at both the elementary level (79.37%) and high school level (80.95%). Furthermore, 80% of the students reported a family income below six minimum wages (49.21% between four and six minimum wages, and 28.57% up to three minimum wages).

Students were also asked about their knowledge of mathematical functions, trigonometry, matrices and determinants, and geometry (plane, spatial, and analytic). These competencies are fundamental for understanding the tools of Calculus and for correctly interpreting Limits and Derivatives (CLD), especially when relating such knowledge to cost-reduction applications.

**TABLE 1 - Academic's perception of knowledge about mathematical functions.**

Answers*	3rd Year Academics		4th Year Academics		5th Grade Academics		Total	
	f	%	f	%	f	%	f	%
Excellent	0	0.00	0	0.00	0	0.00	0	0.00
Very Good	4	18.18	0	0.00	0	0.00	4	6.35
Good	5	22.73	7	29.17	3	17.65	15	23.81
Average	7	31.82	14	58.33	11	64.70	32	50.79
Poor	6	27.27	3	12.50	3	17.65	12	19.05
<b>Total</b>	<b>22</b>	<b>100.0</b>	<b>24</b>	<b>100.0</b>	<b>17</b>	<b>100.0</b>	<b>63</b>	<b>100.0</b>

**SOURCE:** Survey data

**TABLE 2 - Perception of knowledge about trigonometry, matrices and determinants.**

Respostas*	3rd Year Academics		4th Year Academics		5th Grade Academics		Total	
	f	%	f	%	f	%	f	%
Excellent	0	0.00	0	0.00	0	0.00	0	0.00
Very Good	2	9.09	0	0.00	0	0.00	2	3.17
Good	5	22.73	7	29.17	4	23.53	16	25.40
Average	10	45.45	11	45.83	8	47.06	29	46.03
Poor	5	22.73	6	25.00	5	29.41	16	25.40
<b>Total</b>	<b>22</b>	<b>100.0</b>	<b>24</b>	<b>100.0</b>	<b>17</b>	<b>100.0</b>	<b>63</b>	<b>100.0</b>

**SOURCE:** Survey data

**TABLE 3 - Perception of knowledge about geometry (plane, analytical and spatial)**

Answers*	3rd Year Academics		4th Year Academics		5th Grade Academics		Total	
	f	%	f	%	f	%	f	%
Excellent	0	0.00	0	0.00	0	0.00	0	0.00
Very Good	3	13.63	2	8.33	0	0.00	5	7.94
Good	7	31.82	4	16.67	4	23.53	15	23.81
Average	7	31.82	9	37.50	10	58.82	26	41.27
Poor	5	22.73	9	37.50	3	17.65	17	26.98
<b>Total</b>	<b>22</b>	<b>100.0</b>	<b>24</b>	<b>100.0</b>	<b>17</b>	<b>100.0</b>	<b>63</b>	<b>100.0</b>

**SOURCE:** Survey data

Students' perception of their own knowledge of mathematical functions was, for the most part, rated as 'Fair'. Despite percentage variations among the groups, students generally followed the same trend of evaluating themselves as having a low level of knowledge in this basic mathematics content. Such mastery is essential for most higher education courses and is fundamental for understanding the Calculus of Limits and Differentials.

This is also seen in students' perception of their prior knowledge of trigonometry, matrices, determinants, and geometry.

Chronologically, it is plausible to deduce that the lack of contact with subjects relevant to CLD leads students to

present lower levels of knowledge in subjects related to Numerical Calculus. In other words, the relationship between the academic year and the time since leaving high school indicates reduced prior knowledge of the foundational subjects for CLD.

Thus, these percentages allow us to infer that the time elapsed without reviewing these subjects led to low levels of prior knowledge among students of all years, especially those in the fifth year. Therefore, it can be inferred that the longer the students' time in their current academic program, the lower their perceived knowledge in this subject.

After the class was taught, we sought to assess the students' understanding of the content presented.

**TABLE 4 – Students' Understanding of Examples Presented in Demonstration Class**

Answers*	3rd Year Academics		4th Year Academics		5th Grade Academics		Total	
	f	%	f	%	f	%	f	%
Full comprehension	12	54.55	5	18.83	10	58.82	27	42.86
Partial comprehension	10	45.45	18	75.00	7	41.18	35	55.56
Incomprehensible	0	3.33	1	4.17	0	0.00	1	1.58
<b>Total</b>	<b>22</b>	<b>100.00</b>	<b>24</b>	<b>100.00</b>	<b>17</b>	<b>100.0</b>	<b>63</b>	<b>100.0</b>

**SOURCE:** Survey data

Despite the low prior knowledge of mathematical functions (Table 1), trigonometry and determinants (Table 2), and geometry (Table 3), most of the students (98.42%) understood, at least partially, the content taught by the researchers in the demonstration class.

**TABLE 5 – Academic Understanding of the Application of Numerical Calculus in Accounting Sciences**

Answers*	3rd Year Academics		4th Year Academics		5th Year Academics		Total	
	f	%	f	%	f	%	f	%
Full comprehension	17	77.27	14	58.33	14	82.35	45	71.43
Partial comprehension	5	22.73	9	37.50	3	17.65	17	26.98
Incomprehensible	0	0.00	1	4.17	0	0.00	1	1.59
<b>Total</b>	<b>22</b>	<b>100.0</b>	<b>24</b>	<b>100.0</b>	<b>17</b>	<b>100.00</b>	<b>63</b>	<b>100.0</b>

**SOURCE:** Survey data

In analyzing the students' understanding of the application of Numerical Calculus in Accounting Sciences, it can be inferred that most of the sample (71.43%) fully understood its application in Accounting.

This comprehension occurred even though the students

rated their own prior knowledge of mathematical functions, trigonometry, matrices and determinants, as well as geometry, as only 'Regular', as shown in Tables 4, 5, and 6. Thus, although part of the sample understood the class only partially, a substantial portion still perceived the possibilities of applying the Numerical Calculus content in Accounting Sciences and projected its potential use in practice.

**TABLE 6 – Perception of Calculus as a differentiating tool in the Accountant's career**

Answers*	3rd Year Academics		4th Year Academics		Academics 5th Grade		Total	
	f	%	f	%	f	%	f	%
YES	20	90.91	23	95.83	17	100.0	60	95.24
NO	2	9.09	1	4.17	0	0.00	3	4.76
<b>Total</b>	<b>22</b>	<b>100.0</b>	<b>24</b>	<b>100.0</b>	<b>17</b>	<b>100.0</b>	<b>63</b>	<b>100.0</b>

**SOURCE:** Survey data

In analyzing the perception of Calculus as a distinguishing tool in an accountant's career, it is observed that 95.24% of the sample considered it to be a professional differential. This

finding is reinforced when combined with the students' agreement regarding the inclusion of Numerical Calculus in the accounting program. Most of the sample either totally agreed (60.31%) or partially agreed (34.93%) with the incorporation of the subject into the academic curriculum.

**TABLE 7 – Academic's Perception Regarding the Use of Calculus in Professional Practice**

Answers*	3rd Year Academics		4th Year Academics		Academics 5th Grade		Total	
	f	%	f	%	f	%	f	%
Innovation in creativity in the company's decision-making	11	50.00	17	70.83	12	70.59	40	63.49
Maintenance of the company's decision-making standards	3	13.63	2	8.33	4	23.53	9	14.29
Employers' satisfaction with their decision-making desires	7	31.82	3	12.50	1	5.88	11	17.46
No personal functionality regarding the use of Calculus	0	0.00	1	4.17	0	0.00	1	1.59
Waste of time	0	0.00	0	0.00	0	0.00	0	0.00
Other	1	4.55	1	4.17	0	0.00	2	3.17
<b>Total</b>	<b>22</b>	<b>100.0</b>	<b>24</b>	<b>100.0</b>	<b>17</b>	<b>100.0</b>	<b>63</b>	<b>100.0</b>

**SOURCE:** Survey data

**TABLE 7 – Academic's justification for using Calculus in the practice of the accounting profession.**

Answers*	3rd Year Academics		4th Year Academics		Academics 5th Grade		Total	
	f	%	f	%	f	%	f	%
Consultancy	16	72.72	18	75.00	15	88.24	49	77.77
Accounting Sector	4	18.18	6	25.00	2	11.76	12	19.05
Audit	1	4.55	0	0.00	0	0.00	1	1.59
Academic Environment	1	4.55	0	0.00	0	0.00	1	1.59
Inadequate in Accounting	0	0.00	0	0.00	0	0.00	0	0.00
<b>Total</b>	<b>22</b>	<b>100.0</b>	<b>24</b>	<b>100.0</b>	<b>17</b>	<b>100.0</b>	<b>63</b>	<b>100.0</b>

**SOURCE:** Survey data

Regarding the students' perception of the use of Calculus in the accounting profession, it was observed that most of them (63.49%) believe that creativity in decision-making analysis is the predominant factor for the use of CLD by accountants. Responses related to maintaining decision-making standards (14.29%) and employers' satisfaction with decision-making expectations (17.46%) also represented a relevant portion of the analysis.

The data also indicate that students view consulting as the professional characteristic most capable of incorporating

creativity. Thus, it is inferred that, for the sample, consulting is closely associated with the innovative potential offered by Numerical Calculus, especially through the creative dimension they attribute to it.

In analyzing the students' perceptions—across the different academic years—regarding the topics addressed in the class taught by the researcher, a comparison was made with responses referring to the social background of the participants, both in elementary and high school, in public and private institutions, using independent samples. The questionnaire results presented a non-normal distribution, which justified the use of a non-parametric test, specifically the Mann-Whitney test.

**CHART 2 – Mann-Whitney test in groups of students from public and private elementary schools.**

	Perception of the class regarding the understanding of the examples	Perception of the application of Calculus in Accounting	Perception of validity of the insertion of the Calculation in Accounting	Expectation of using Calculus in the profession of Accountant
U de Mann-Whitney	221.500	321.000	295.00	268.500
Wilcoxon W	1,496.500	412.000	1,570.000	1,543.500
Z	-2.023	-.084	-.593	-1.038
Significance(2 extremities)	.043	.933	.553	.299

**CHART 3 – Mann-Whitney test in groups of students from public and private high schools.**

	Perception of the class regarding the understanding of the examples	Perception of the application of Calculus in Accounting	Perception of validity of the insertion of the Calculation in Accounting	Expectation of using Calculus in the profession of Accountant
U de Mann-Whitney	189.000	279.000	233.500	256.000
Wilcoxon W	1,515.000	1,605.000	311.500	1,582.000
Z	-2.357	-.584	-1.477	-.947
Significance (2 extremities)	.018	.559	.40	.344

the means compared is accepted.

To evaluate the class's perception regarding the understanding of the examples, the two-tailed significance level was considered. Since the Sig. (2-tailed) values were 0.043 and 0.018, respectively — that is,  $p < 0.05$  — the hypothesis that there is a significant difference between

Thus, the perception of students regarding their understanding of the examples presented in class differed significantly between students from public and private high schools. In the other cases, this hypothesis is rejected.

Accordingly, no significant differences in means were found in the following situations: the class's perception of the application of Calculus in Accounting, the class's perception of the validity of including Calculus in the curriculum, and the class's perception of the expectations of using Calculus in the accounting profession. For all these items, the results indicate that the student's educational background—whether from public or private institutions, in elementary or high school—does not influence these perceptions.

Therefore, if the implementation of such subjects in Accounting programs is considered, it is relevant to take into account the differences in prior knowledge between students from public and private schools, as is typically done in leveling or remedial classes.

#### 4. FINAL CONSIDERATIONS

The accounting professional plays an essential role in the decision-making processes of any organization. It is important to highlight the need for continuous development in the training of accountants, given the dynamic and globalized nature of modern organizational environments. Mathematical knowledge, such as Numerical Calculus—represented by Calculus of Limits and Differentials—together with Accounting, which integrates mathematics, information technology, and statistics, contributes significantly to supporting decision-making.

It was observed that undergraduate Accounting programs traditionally do not include such courses, which may generate a sense of unfamiliarity among students. In this context, this research sought to identify, from the students' perspective, the extent to which knowledge from Calculus courses can improve student performance in decision-making activities within

Differentials is not typically included in Accounting curricula, some students reported previous contact with CLD content in high school.

The different groups in the sample shared perceptions supporting the need to include Calculus, as it facilitates decision-making in fields related to Management Accounting, such as Cost Accounting and Managerial Accounting. In this regard, no differences in means were observed between students from public and private schools regarding the following items: perception of the demonstrative class on the application of Calculus in Accounting, perception of the validity of including Calculus in the curriculum, and perception of the expectations of its use in the accounting profession. However, a significant difference in means was observed between these two groups regarding the understanding of the examples, which may indicate greater difficulty among a specific segment of the sample.

Thus, the general objective of the study was achieved, based on student evaluation and on a proposal aimed at examining variables that may contribute to understanding these changes. One possible alternative would be the inclusion of Calculus as part of a future discipline or the incorporation of such content into the Quantitative Methods course.

Therefore, it is expected that this study will contribute to strengthening the professional image of accountants, as knowledge of Numerical Calculus and, consequently, of accounting techniques, enables an expansion of the services offered by accountants, thereby adding value to their work. It is also emphasized that reducing deficiencies in the conceptual foundations of mathematics-related courses, combined with improved presentation of mathematical content integrated with accounting concepts, is essential to ensure effective learning and practical proficiency among students.

In this way, the study provides significant evidence supporting the perception that the accounting professional is a key element in the development of organizations.

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