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Meanings and perceptions of undergraduate Mathematics students regarding written textual production as educational practice

Abstract: This study sought to understand the meanings and perceptions of undergraduate Mathematics students regarding written text production during their education, relating them to the development of teacher identity and Mathematics teaching. Based on frameworks that discuss writing as a discursive and educational practice, a qualitative approach was adopted, with intentional sampling of students in the 1st and 7th semesters and data collection via an online questionnaire. Enunciations were examined through content analysis, revealing subcategories such as incentives and opportunities, confidence in expressing mathematical concepts, and challenges in appropriating written language. The lack of systematic writing practices in the curriculum and the need to incorporate it as a structuring dimension of initial education were identified.

Keywords: Text Production. Mathematics Teacher Education. Language and Teaching. Mathematics Education.

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ARTICLE

Significados y percepciones de estudiantes de Licenciatura en Matemáticas sobre la producción textual escrita como práctica formativa

Resumen: El estudio buscó comprender los significados y percepciones de estudiantes universitarios de Matemáticas respecto a la producción de textos escritos durante su formación, relacionándolos con el desarrollo de la identidad docente y la enseñanza de las Matemáticas. Con base en marcos que abordan la escritura como práctica discursiva y formativa, se adoptó un enfoque cualitativo, con un muestreo intencional de estudiantes de 1er y 7º semestres y recolección de datos mediante un cuestionario en línea. Las enunciaciones se examinaron mediante análisis de contenido, revelando subcategorías como incentivos y oportunidades, confianza en la expresión de conceptos matemáticos y desafíos en la apropiación del lenguaje escrito. Se identificó la falta de prácticas sistemáticas de escritura en el currículo y la necesidad de incorporarla como una dimensión estructurante de la formación inicial.

Palabras clave: Producción Textual. Formación de Profesores de Matemáticas. Lenguaje y Enseñanza. Educación Matemática.

Sentidos e percepções de licenciandos em Matemática sobre a produção textual escrita como prática formativa

Resumo: O estudo buscou compreender os sentidos e percepções de licenciandos em Matemática sobre a produção textual escrita em sua formação, relacionando-os à constituição da identidade docente e ao ensino de Matemática. Com fundamento em referenciais que discutem a escrita como prática discursiva e formativa, adotou-se abordagem qualitativa, com amostragem intencional de estudantes do 1º e 7º semestres e coleta de dados por questionário online. As enunciações foram examinadas por meio da análise de conteúdo, revelando subcategorias como incentivos e oportunidades, segurança para expressar conceitos matemáticos e desafios na apropriação da linguagem escrita. Identificou-se a ausência de práticas sistemáticas de escrita no currículo e a necessidade de incorporá-la como dimensão estruturante da formação inicial.

Palavras-chave: Produção Textual. Formação de Professores de Matemática. Linguagem e Ensino. Educação Matemática.

1 Introduction

Difficulties related to written text production have been extensively documented in the Brazilian educational context, from Elementary School to Postgraduate studies (Nogaro, Porto, and Porto, 2019). Data from the *Exame Nacional do Ensino Médio* [National High School Exam — ENEM], for example, reveal a significant number of students who fail to achieve satisfactory performance in writing, highlighting weaknesses in the mastery of writing as a communicative and reflective practice. However, this phenomenon extends beyond the school environment and also reaches teacher education programs, where writing, despite being valued in legal guidelines and curriculum frameworks, is still underutilized systematically, especially in undergraduate Mathematics programs.

This situation is exacerbated when one considers that writing, in the field of Mathematics Education, is commonly treated as a secondary activity, to the detriment of approaches that prioritize algorithmic procedures or formal records. However, as Bortoloti and Perovano (2018) point out, textual production in Mathematics teaching should be understood as an essential communicative practice, as it allows students to appropriate mathematical discourse through meaningful interactions with the teacher and peers. Thus, creating spaces for writing mathematical texts is not only a didactic strategy, but a pedagogical commitment that fosters the development of the discipline's own language.

Furthermore, understanding textual production as a educative practice also requires a close look at the forms of expression of undergraduate students. When analyzing texts produced by future mathematics teachers, Freitas and Silva (2024) identify that written productions reveal not only the knowledge mobilized, but also cognitive strategies and ways of signifying concepts. In this sense, recognizing text as a form of investigation and expression can allow pre-service teachers not only to demonstrate technical mastery but also to construct arguments, reflect on their practice, and reorganize their knowledge.

Research such as that of Gonçalves Jr. (2015) and Caporale (2016) has highlighted the potential of writing as a tool for research and the education of teacher identity in initial teacher education. Using reflective journals during Supervised Internships and analyzing the formative records of participants in the *Programa Institucional de Bolsa de Iniciação à Docência* [Institutional Teaching Initiation Grant Program — PIBID], these studies show that written language fosters the organization of thought, the establishment of connections between theory and practice, and the emergence of new understandings about teaching. As Freitas (2006) discusses, writing activates an internal and external dialogue that galvanizes reflection, reframes experiences, and strengthens the investigative stance of future teachers.

In this same vein, Nogaro, Porto, and Porto (2019) argue that textual production contributes significantly to the process of conceptual appropriation and the development of pedagogical knowledge by undergraduate teachers. By writing about their learning and educational experiences, students develop a reflective attitude toward practice, enabling them to critically analyze their actions and construct meanings about their professional performance. Thus, writing transcends its communicative function, becoming an important formative strategy for establishing teaching as an authorial, critical, and situated practice.

In the field of Mathematics Education, this understanding acquires even greater relevance. Pimm (2018) emphasizes that writing allows for a more structured organization of mathematical thought than oral communication, since it involves planning, analysis, and reformulation of ideas. Therefore, promoting textual production practices in Mathematics

teacher education means creating opportunities for undergraduate students, in addition to communicating content, to develop understandings of concepts and develop ways to express them with clarity, didacticism, and pedagogical awareness.

In this context, this article stems from ongoing doctoral research investigating *written text production* (WTP) as a formative dimension in the trajectory of pre-service teachers. For this research, we understand that WTP is not simply a recording or assessment tool, but a formative commitment that contributes to the education of pedagogical thought, the appropriation of school mathematical discourse, and the construction of teacher identity. This perspective is supported by the studies of authors such as Vygotsky (1998), Bronckart (1999), Marcuschi (2008), and Sfard (2008), who understand language as a social and educative practice, capable of mediating learning processes and professional development.

Initial Mathematics teacher education, in this sense, requires the inclusion of practices that foster the development of communicative competence, understood here as the ability to express oneself clearly and precisely, both orally and in writing. National curriculum guidelines, such as CNE/CP Resolutions No. 2/2015 (Brasil, 2015), No. 2/2019[1] (Brasil, 2019), and No. 4/2024 (Brasil, 2024) reiterate the centrality of language in educational processes, emphasizing that proficiency in Portuguese should be promoted as a condition for qualified pedagogical mediation.

However, research indicates that there is still a significant gap in the effective integration of WTP into Mathematics curriculum. Studies such as those by Ripardo (2009), Nogaro, Porto, and Porto (2019), Menezes et al. (2014), and Piano and Bozelli (2024) reveal that many undergraduate students face difficulties in using writing as a tool for reflection and didactic expression, which can directly impact their future pedagogical practices.

In undergraduate programs in the Exact Sciences, the lack of systematic spaces for textual production, especially that focused on pedagogical reflection and argumentation, tends to reinforce a pedagogical culture centered on mathematical formalism, to the detriment of practices that integrate orality and writing as discursive dimensions of teaching. As Marcuschi (2008) points out, writing should not be seen merely as a record, but as a social and discursive practice that enables the elaboration, organization, and communication of knowledge. Bronckart (1999) emphasizes that the way textual genres are mobilized in educational activities directly influences people's ways of thinking, organizing, and acting.

In the context of teacher education, this means that opportunities to work with different genres, whether scientific, pedagogical, or reflective, contribute to the discursive practices that future teachers will bring to their professional practice. Thus, when education is limited to mastery of mathematical formalism, without systematically incorporating reflective and argumentative writing, the opportunity to broaden the undergraduate student's discursive repertoire and prepare them to navigate different languages in mathematics teaching is missed.

Given this scenario, this study sought to understand the meanings and perceptions of undergraduate Mathematics students at the Federal University of Southern and Southeastern Pará (Unifesspa), Campus III in Marabá, Brazil, regarding written text production in their education. The objective was to analyze how these undergraduate students understand writing in their educational journey, what challenges they face, what strategies they recognize as powerful, and to what extent they understand the WTP as a constitutive part of their teacher professionalization process.

The choice to investigate undergraduate students is justified by the understanding that

[1] The aforementioned Resolution was revoked by Resolution No. 4, of May 29, 2024, of the Plenary Council (CP) of the National Education Council (CNE).

their voices offer important clues about the effectiveness, or lack thereof, of educational practices related to writing. By highlighting the experiences and perceptions of undergraduate students, we hope to contribute to the debate on Mathematics teacher education in light of language, proposing possible paths for strengthening written text production (WTP) as a constitutive practice of mathematics teaching.

2 Written text production and teacher education: theoretical foundations

Language, conceived from a socio-interactionist perspective, is understood as a situated, historically, and culturally constructed social practice. More than a formal system of rules, it constitutes a fundamental instrument of symbolic mediation for the organization of thought, the construction of meaning, and people's participation in social practices (Vygotsky, 1998; Bronckart, 1999; Marcuschi, 2008).

In Marcuschi's (2008) view, language should not be reduced to a normative and static structure, but rather understood as a discursive activity embedded in concrete contexts of communication. For the author, the functioning of language can only be fully understood through the discursive practices that constitute it — that is, the interaction between people and the contexts in which they are inserted. In agreement, Bronckart (1999) reinforces that language organizes and regulates human activities, being a condition for people to produce meaning, establish relationships, and act reflectively on the world.

Based on Vygotsky's (1998) approach, it is understood that thought develops through language, with this symbolic mediation being essential for the internalization of knowledge. Language not only expresses ideas but also structures the processes of learning and human development, functioning as a link between the social dimension of experience and the individual construction of knowledge.

From this perspective, teacher education cannot ignore the understanding of language as a constitutive practice of teaching. After all, teaching also involves producing and interpreting discourses, signifying experiences, interacting with multiple texts and genres, and acting linguistically in school and academic contexts. Therefore, valuing language in initial teacher education implies recognizing its structuring role in the ways of teaching, learning, and communicating mathematical knowledge.

Written text production (WPT), understood as a situated discursive practice, plays an important role in the initial education of Mathematics teachers. More than a technical skill, writing constitutes a cognitive, social, and formative process that mobilizes the organization of thought, the construction of meaning, and the development of pedagogical discourses specific to teaching.

Marcuschi (2008) emphasizes that writing must be understood in its context of use, as a communicative and socially situated activity. In this sense, textual production is not limited to the transcription of ideas, but requires planning, drafting, revision, and rewriting — fundamental steps for the creation of a cohesive, coherent, and meaningful text. When writing, one positions oneself, expresses intentions, structures one's thoughts, and actively participates in the social and professional practices to which one belongs.

Bronckart (1999) reinforces this perspective by understanding writing as an instrument of mediation between the individual and social reality, structuring human action on different discursive levels: the global plane — genre and thematic organization; the textual plane — modes of discourse organization; and the enunciative plane — marks of authorship and positioning in the text. For the author, writing is also about constructing identities and modes of acting in the world.

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In the context of teacher education, the WTP allows the student to critically reflect on their experiences, theorize practice, and develop meanings about teaching. Producing texts during the undergraduate program is not limited to meeting academic requirements; it is an activity that fosters the development of teaching identity by allowing future teachers to articulate knowledge, reframe experiences, and organize mathematical and pedagogical thinking in written form.

Silva and Marcuschi (2017) emphasize that the process of text production in the educational environment should involve four stages: planning, writing, revision, and rewriting. Implementing these steps into daily education can promote more conscious writing practices, fostering the development of autonomy and communicative competence among undergraduates. Writing is a way to learn, reflect, and teach.

By recognizing textual production as a educational practice, it is understood that it needs to be effectively integrated into the curriculum of teacher education courses, both as an assessment tool and as a pedagogical strategy. Its absence or sporadic presence in education processes tends to compromise the development of future teachers' discursive competence, hindering their critical and authorial integration into school and academic spaces.

The discursive perspective on teacher education finds significant depth in the work of Sfard (2008), who proposes that learning is entering new forms of discourse. For the author, people learn not only by acquiring content, but by becoming active participants in specific discursive communities. In this sense, education as a Mathematics teacher implies appropriating a set of discursive practices that organize the way one speaks, writes, and thinks about the teaching and learning of Mathematics.

Sfard (2008) proposes a metaphor of learning as discursive participation, in which people develop as they fluently use the elements of a given community's discourse — in this case, pedagogical and mathematical discourse. Thus, writing becomes an important mediator of professional learning, as it allows for the appropriation of specific vocabularies, the articulation of pedagogical ideas, and the construction of authorial positions on educational practice.

Furthermore, the author identifies components that structure discourses: keywords, visual mediators, mathematical narratives, and routines. These elements, when mobilized by undergraduates in written texts, signal their insertion into the discursive practices of the educational and mathematical fields. Textual production, in this case, not only reveals what a person knows, but also how they organize this knowledge, how they position themselves in relation to knowledge, and how they construct meanings for their future teaching practice in educational practices and when projecting themselves as education professionals.

Thus, by integrating the contributions of Bronckart (1999), Marcuschi (2008), Sfard (2008), and Silva and Marcuschi (2017), it is understood that written textual production in the context of initial Mathematics teacher education is a educative discursive practice. It can allow the undergraduate not only to develop linguistic and communicative skills, but also to actively participate in the discursive communities to which they wish to belong, building their teaching identity and appropriating the discourses that support the teaching and learning of Mathematics.

3 Methodology

This qualitative, exploratory-descriptive study aimed to understand the meanings and perceptions of undergraduate Mathematics students at the Federal University of Southern and Southeastern Pará (Unifesspa), Campus III, in Marabá, Brazil, regarding written text production during their education. For this study, we understand *meanings* as socially constructed and shared meanings about written text production, in its relationship to Mathematics and the

constitution of teaching; and *perceptions* as individual impressions and evaluations, shaped by the undergraduate's personal trajectory and experience. The study seeks to contribute to the debate on the inclusion of writing as a educative practice in undergraduate Mathematics programs, based on the perspectives of those in education.

The choice of a qualitative approach is based on the assumptions of Lüdke and André (2013), who emphasize the focus on the meanings attributed by participants to the phenomena they experience, as well as the appreciation of the complexity of social and formative contexts. This is research that prioritizes understanding people's processes and interpretations, rather than measuring variables or statistical generalization.

The study was conducted with undergraduate students regularly enrolled in the first and seventh semesters of the Mathematics degree program at Unifesspa. Participants were selected through purposive sampling (Gil, 2008) to encompass different stages of the educational journey: the beginning of the degree, represented by first-semester students, and the final stage, represented by seventh-semester students. This selection allowed us to contrast initial expectations with more mature perceptions about writing in the context of teacher education.

Data were collected through an online questionnaire, structured in Google Forms, consisting of open- and closed-ended questions, between June and July 2024. The instrument was sent to 34 students, 22 in the first semester and 12 in the seventh, and yielded 11 valid responses (enunciations): 3 in the first semester and 8 in the seventh. A limitation of this study is the small number of participants who completed the questionnaire, which limits the breadth of possible inferences. However, this limitation does not compromise the interpretative depth of the qualitative approach adopted, which focuses on understanding the meanings and perceptions of the participants. The use of the digital tool enabled greater accessibility and guaranteed the anonymity of respondents, respecting the ethical principles of human research.

The questionnaire questions were organized into two thematic axes and administered to 11 students from both classes, as shown in Table 1. Participants' enunciations were systematized using Content Analysis (Bardin, 2016), focusing on identifying emerging thematic categories. The process involved skimming, coding by thematic axes, categorizing enunciations, and inferring meanings attributed to written text production (WPT) during the education course. This method was chosen because of its suitability for investigating representations, beliefs, and meanings, which are central aspects of the study.

Table 1: Thematic axes, questions, and subcategories identified

Category	Investigative Questions	Emerging Subcategories
Experiences with textual production in Basic and Higher Education	How would you describe your experience with writing during your academic life — school and university? What types of texts have you produced most during your school and academic life? What, in your opinion, are the main challenges you face in writing?	Incentives and opportunities; Skill development; Difficulties and insecurities.
Perceptions about textual production in/for Mathematics teaching	Do you believe that writing practice can help with understanding mathematical concepts? Do you feel comfortable expressing mathematical concepts through writing? Do you agree that writing practice should be integrated into Mathematics teacher education? Explain your answer.	Contributions to mathematical understanding; Discursive confidence and mastery; The educative role of teacher writing.

Source: Own elaboration

Regarding ethical aspects, all participants were informed of the study's objectives, agreed to the terms of voluntary participation, and their identities were kept confidential. The study is part of ongoing doctoral research and was approved by the Research Ethics Committee of the Faculty of Sciences of the Paulista State University, Bauru campus.

4 Results and Discussion

In this section, we present and discuss the data generated from the enunciations of undergraduate students in the Mathematics program at the Federal University of Southern and Southeastern Pará (Unifesspa), aiming to understand their meanings and perceptions regarding written text production during their education. The analysis was organized based on interpretative categories constructed based on the participants' enunciations, which emerged from the interweaving of empirical data and the theoretical frameworks underlying the study.

As described in the previous section, participants were intentionally selected, considering two distinct phases of their educational journey: students in the first and seventh semesters of the program. During the data collection phase, they ranged in age from 17 to 43, and had different educational and professional trajectories.

Through analysis of the participants' enunciations, we identified *meanings* — socially constructed and shared meanings — attributed to writing in its relationship to Mathematics and the constitution of teaching, as well as *perceptions*, understood as individual impressions arising from each undergraduate's educational experience. The enunciations were grouped into categories that express relevant aspects of their education, such as: experiences with writing during their educational journey; confidence in expressing mathematical concepts in writing; the perception of writing as a pedagogical and educational resource; and the influence of writing practices on the teaching and learning processes of Mathematics. Each category is presented below, articulating the undergraduates' enunciations with the theoretical contributions of the study, in order to critically reflect on the education practices that (in)visibilize writing as a constitutive dimension of teaching in Mathematics.

4.1 Experiences with textual production in Basic and Higher Education

This first category brings together the undergraduates' perceptions, understood as individual impressions and assessments arising from their experiences, regarding textual production throughout Basic Education and Higher Education, with an emphasis on the formative journey experienced in the Mathematics undergraduate program. The enunciations reveal trajectories marked by contrasts, in which moments of encouragement and learning intertwine with experiences of insecurity, technical difficulties, and a lack of appreciation for writing as a pedagogical practice.

By drawing on their school and academic memories, the participants reveal how writing was, or was no longer, used as a tool for learning and expression, both in contexts prior to university and in more recent formative experiences. The enunciations indicate that, despite some advances in Higher Education, writing still does not occupy a central position in the teacher education process, often being treated as an accessory, instrumental practice, and dissociated from Mathematics. This perception allows us to problematize the absence of a writing culture in teacher education programs, as discussed by authors such as Freitas and Fiorentini (2008), Silva and Marcuschi (2017), Nogaro, Porto, and Porto (2019), among others. Based on this category, we seek to understand how these experiences, sometimes promoting, sometimes limiting, influence the development of authorship, autonomy, and teaching identity among Mathematics undergraduate students.

The undergraduates' enunciations about their experiences with writing throughout their

school and university careers reveal a formative journey marked by contrasts: on the one hand, positive experiences mediated by teachers, projects, and institutional programs; on the other, persistent challenges related to organizing ideas, mastering grammar, and little familiarity with academic writing practices. The enunciations reveal three main subcategories: incentives and opportunities, skill development, and challenges faced.

These three subcategories correspond to developments in the first category presented in Table 1 — *Experiences with text production in Basic and Higher Education*. In Table 1, the emerging subcategories were identified from the enunciations, and in Table 2, they are presented in detail, associated with the units of meaning extracted from the undergraduate students' enunciations. Thus, the direct relationship between the general categories established in the initial stage of the analysis and the more specific segments used in this section is maintained. The data are organized in Table 2.

Table 2: Experiences with textual production in Basic and Higher Education

Subcategory	Units of meaning
Incentives and opportunities	"College gave me new opportunities to develop my writing skills..." (7th semester undergraduate student) "There were many incentives, especially in projects..." (7th semester undergraduate student)
Skills development	"At the beginning of my degree, I had a lot of difficulty [...] I learned a lot and I continue to learn" (7th semester undergraduate student) "I have some ease with textual development" (1st semester undergraduate student)
Challenges and difficulties	"Organizing the ideas needed for this is the biggest challenge" (7th semester undergraduate student) "Lack of familiarity with academic writing" (1st semester undergraduate student) "Grammar" (1st and 7th semester undergraduate students)

Source: Research Data

The undergraduates' enunciations reveal that their experiences with writing are influenced by multiple factors: some are marked by institutional encouragement and teacher support; others by insecurity, discontinuity, and a lack of systematic practices. This ambivalence echoes what Nogaro, Porto, and Porto (2019) argue when they identify the fragile presence of writing in teacher education programs, despite its formative and communicative potential.

The *Incentives and opportunities* subcategory appears prominently in the enunciations of seventh-semester undergraduates, who point out that opportunities to develop written text production were mostly associated with extracurricular experiences, such as research and extension projects. When one participant states, *"College gave me new opportunities to develop my writing skills"*, it is evident that, although writing is not systematically integrated into the curriculum, its valorization can occur in alternative, more flexible educational contexts. This experience, although localized, is similar to what Bronckart (1999) conceptualizes as socially situated language practices: concrete discursive actions, anchored in specific communicative purposes and in real spheres of language use, in which people constitute themselves as authors of their own words.

Along the same lines, stating that *"There were many incentives, especially in projects"*, another undergraduate student highlights the importance of experiencing spaces that combine

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teaching, research, and outreach as enhancers of reflective, collaborative, and discursive practices. Such experiences are fundamental to breaking with the instrumental logic of school-based writing, centered on assessment or academic formality. As Marcuschi (2008) argues, textual production needs to be understood as an interactive, dialogical, and contextualized process, not as an isolated exercise devoid of social meaning. By participating in institutional projects, undergraduate students come into contact with diverse textual genres, communicative purposes, and processes of rewriting and revision, thus developing skills that go beyond the mechanical repetition of models.

These writing practices experienced in projects contribute to the formation of teaching identity, especially when understood as spaces of authorship, mediation, and experimentation. From Vygotsky's (1998) perspective, the development of higher cognitive functions, such as logical organization of thought, planning, and critical expression, occurs through symbolic mediation, with language, especially writing, being one of the main instruments in this process. Thus, when education offers opportunities for undergraduates to write about their practice, produce scientific texts, reports, articles, or pedagogical reflections, it contributes not only to improving communication but also to strengthening their professional awareness and intellectual autonomy.

In the *Skill development* subcategory, the grouped enunciations reveal that the development of writing skills does not occur linearly, nor spontaneously, but is directly related to personal trajectories, pedagogical mediation, and the length of exposure to writing practices. The account of a seventh-semester undergraduate student — *"At the beginning of my undergraduate degree, I had a lot of difficulty because I had spent 21 years away from studying. But with dedication and the help of my doctor professor [...] I learned a lot and continue to learn"* — is exemplary in this regard. It highlights that resuming writing, even after a long absence, becomes possible and productive when the formative process is anchored in meaningful pedagogical relationships. From Vygotsky's (1998) perspective, this expresses the essential function of mediation in learning: the teacher acts as an instrument connecting the student to the objects of knowledge, enabling the internalization of cognitive tools, such as written language.

Furthermore, it is clear that progress in writing proficiency is often related to overcoming emotional and cognitive barriers. The enunciation *"I have some ease with textual development"* (1st-semester undergraduate student) converges with an intermediate self-perception, in which the individual recognizes their productive capacity, although still in the process of maturing. This highlights that, even in the early stages of education, forms of partial appropriation of written language as a tool for organizing thought and expressing knowledge already emerge. As Marcuschi (2008) points out, writing is always situated and gradual, and its appropriation requires contexts that favor planning, textualization, and rewriting—elements absent when textual production is treated solely as an evaluative task.

On the other hand, the enunciation that *"Text production was never my strong point"* (1st-semester undergraduate student) expresses a common dimension in teacher education programs: the presence of individuals who recognize themselves as weak in writing, often due to a lack of systematic writing practices throughout their schooling. This type of perception highlights what Freitas and Fiorentini (2008) discuss when they point out that many students enter Higher Education with a history of school practices that did not encourage authorship or critical reflection on writing. For these individuals, the undergraduate program could function as a space for redefining their relationship with language, as long as it recognizes writing as a formative component, rather than a technical barrier to be overcome individually.

Based on the enunciations in the *Challenges and difficulties* subcategory, undergraduate students reveal that, despite recognizing the importance of textual production, many face

structural difficulties related to organizing ideas, familiarity with academic genres, and mastering the standard language. The report of a seventh-semester student — *"The greatest difficulties arise in how these texts should be presented, but mainly in organizing the ideas necessary for this"* — highlights the lack of practices that favor textual planning and structuring as part of the education process. This gap compromises not only the clarity of written expression but also the development of pedagogical reasoning, since, as Marcuschi (2008) highlights, textual production requires a process that involves logical organization, internal cohesion, and discursive articulation, skills that need to be taught and practiced systematically in the context of teacher education.

The difficulty with academic writing, mentioned by a first-semester undergraduate student, expresses another critical dimension of the educational process: *"Lack of familiarity with academic writing"*. This enunciation reinforces the diagnosis of Silva and Marcuschi (2017), who point to the persistence of a school education centered on the reproduction of content and mechanical writing, to the detriment of an approach that prioritizes authorship, reflection, and the production of meaning. In the case of undergraduate students, this lack of prior contact with scientific and pedagogical language hinders not only the writing of academic papers but also the development of plans, reflective records, and didactic texts, essential for teaching practice. Academic writing, in this context, cannot be treated as an expected skill, but as a competency that needs to be developed throughout the education process, based on contextualized experiences and coordinated by teachers sensitive to the different trajectories of students.

Problems with grammar, frequently referred to as *"grammar"* and *"grammatical errors"* (1st and 7th semester undergraduate students) reinforce a restricted conception of writing still rooted in many school and university contexts, in which the focus is on normative correctness rather than the development of expression and argumentation. This view, as criticized by Marcuschi (2008), reduces textual production to an exercise in obeying grammatical rules, emptying its discursive, cognitive, and formative potential. For undergraduate students to overcome these difficulties, their education must promote a shift: from a concern with grammar as an end, to an understanding of language as a tool for thought, communication, and pedagogical practice. Such a shift requires that writing be treated as a procedural and situated practice, in which errors are part of learning and are opportunities for reflection, not grounds for censorship.

The analysis of the undergraduate students' enunciations in this category reveals a heterogeneous educational landscape, while also revealing structural trends in how written text production has been experienced by undergraduate Mathematics students. On the one hand, there is evidence that research projects, outreach, and sensitive teaching mediation have emerged as important opportunities for encouraging writing, fostering the development of a more positive relationship with written language. On the other hand, significant difficulties persist related to textual organization, mastery of academic writing, and the restrictive conception of grammar as an end in itself.

This ambivalence converges with the lack of systematic and cross-disciplinary work with textual production throughout the course, which contributes to the strengthening of perceptions such as writing as a technical task or isolated activity. In this sense, authors such as Marcuschi (2008) and Silva and Marcuschi (2017) argue that teacher education needs to understand writing as a situated discursive practice, permeated by cognitive, social, and historical processes, in which authorship, argumentation, and communicative clarity are constructed within meaningful social practices and not simply evaluated based on their normative correctness.

At the same time, the presence of reports highlighting progress in writing skills

demonstrates that writing can be learned and improved throughout education, provided appropriate institutional, curriculum, and pedagogical conditions are provided. These findings echo Vygotsky's (1998) assertion that the development of higher functions, such as written language, is directly related to cultural mediation and social interaction. Thus, promoting textual production as a formative dimension in the initial education of Mathematics teachers is not just a question of method, but a commitment to the formation of people capable of reflecting, communicating, teaching and positioning themselves critically in the educational field.

4.2 Perceptions and meanings about textual production in/for Mathematics teaching

This second category focuses on the perceptions — understood as individual impressions and assessments — of undergraduate students regarding the possibilities, meanings, and challenges of textual production in the specific context of Mathematics teaching and learning. The perceptions gathered here, when analyzed in light of the theoretical framework, allow us to identify broader meanings attributed to writing, related to its role in the formation of mathematical knowledge, the organization of thought, and pedagogical practice.

The enunciations reveal diverse understandings of the role of writing in the formation of mathematical knowledge, the organization of thought, and pedagogical practice. While some participants expressed confidence in using written language to express mathematical content, others expressed insecurity and difficulties, particularly with regard to clarity, precision, and the connection between language and content.

At the same time, the data converge toward a recognition of writing as a formative and pedagogical resource, capable of fostering conceptual understanding, didactic communication, and the development of discursive skills essential to teaching. The enunciations indicate that, for most undergraduate participants, writing allows mathematical reasoning to become visible and constitutes a legitimate form of expression and systematization of knowledge. This perception is similar to the discussions of Marcuschi (2008) and Sfard (2008), who understand writing as a situated discursive practice, linked to specific ways of saying, representing, and signifying, and not simply as a technique for encoding previously organized ideas.

Thus, this category proposes a reflection on how undergraduate students understand writing as an integral part of their education, analyzing their experiences and perspectives on the relationship between writing and Mathematics. The aim, therefore, is to discuss the extent to which these perceptions reveal similarities or divergences from writing as a didactic, formative, and discursive practice within the process of becoming a Mathematics teacher.

The undergraduate students' perceptions of writing in the context of Mathematics teaching were organized into subcategories that express both the meanings attributed to the practice and the feelings related to its implementation. Among these, the issue of confidence in expressing mathematical concepts in writing stands out, highlighting the diversity of trajectories and levels of appropriation of written language as a pedagogical tool. While some participants expressed comfort and familiarity with writing as a means of expressing mathematical reasoning, others revealed insecurity, hesitation, or limitations regarding clarity, systematization, and word choice. These variations point to the influence of factors such as academic history, pedagogical practices experienced during the course, and opportunities, or lack thereof, to practice writing in formative contexts.

Table 3 details the subcategories related to the second category listed in Table 1, entitled *Perceptions on text production in/for Mathematics Teaching*. These subcategories — *understanding mathematical concepts through text production; confidence in expressing mathematical concepts through texts; importance of text production practices in Mathematics*

teacher education; and *influence of text production practices on the teaching and learning process* — were constructed based on the participants' enunciations and associated with the units of meaning extracted from them. Thus, Table 3 constitutes an analytical framework that deepens and exemplifies, with empirical data, the categories already presented in Table 1. Next, Table 3 brings together representative excerpts of these perceptions, grouped according to the subcategory in question.

Table 3: Text production practices in/for Mathematics teaching

Subcategories	Units of meaning
Understanding mathematical concepts through textual production	"To understand what Math questions are asking of us, we need to have a good command of text production for better comprehension" (1st-semester undergraduate student). "Mathematics and textual knowledge are linked. To understand the wording of a question, textual knowledge is necessary" (1st-semester undergraduate student). "Through these practices, we learn to deal with everyday situations. When writing about something, we must first research it, which helps with better understanding" (1st-semester undergraduate student). "Writing itself provides us with greater learning in our lives, so if we connect this mathematical knowledge to textual practice, we can better utilize the content" (7th-semester undergraduate student). "I believe that anything you practice always brings positive benefits. Whether in your daily life or in your academic life. The more you write, the more you improve" (7th-semester undergraduate student).
Confidence in expressing mathematical concepts through texts	"I can do this as long as I have knowledge of the area being presented" (1st semester undergraduate student). "Most of the time, I feel quite insecure" (1st semester undergraduate student). "I enjoy writing and explaining these concepts in the best possible way, so I see that in written production, it would be possible to achieve good results, so that whoever is reading it can understand" (7th semester undergraduate student). "Some concepts are sometimes difficult to explain in words, but once you practice, it becomes a comfortable way" (7th semester undergraduate student).
Importance of textual production practices in the education of Mathematics teachers	"We need teachers to be increasingly didactic in their classes" (7th-semester undergraduate student). "Text production is very important for undergraduates to become qualified professionals" (7th-semester undergraduate student). "Text production is essential; during the course, we learn about the practice of text production, which is very important" (1st-semester undergraduate student). "Teachers must have mastery of all areas of knowledge!" (1st-semester undergraduate student).
Influence of textual production practices on the teaching and learning process	"Practicing with writing helps students better understand the subject matter, which can benefit the teaching and learning process" (7th-semester undergraduate student). "Students who know how to write well and have good public speaking skills help them formulate mathematical problems" (7th-semester undergraduate student).

	"Acquiring knowledge that helps with future activities during and after their undergraduate studies in Mathematics" (1st-semester undergraduate student). "Having knowledge and understanding of text can help me create, express, relate, and understand any situation" (1st-semester undergraduate student). "Contextualizing mathematical examples is a good way to teach and encourage mathematical understanding" (1st-semester undergraduate student).

Source: Research Data

Based on the subcategory *Understanding mathematical concepts through textual production*, the undergraduate students' enunciations reveal a significant perception of textual production as a tool for learning Mathematics. Writing, in this context, is understood not only as a form of communication, but also as a cognitive practice that fosters the construction of meaning, the organization of thought, and conceptual understanding. As one participant states: *"To understand what the Math questions are asking of us, we need to have a command of text production to better understand"* (1st-semester undergraduate student). This enunciation highlights a direct relationship between reading and writing skills and mathematical performance, especially with regard to reading and interpreting problems, a skill often neglected in educational processes.

This connection between language and thought is extensively discussed by Vygotsky (1998), who emphasizes that the development of higher functions, such as logical reasoning, is intrinsically linked to language, especially written language. Textual production allows not only the recording of information but also the reformulation, reworking, and consolidation of knowledge. In this sense, the enunciation *"Mathematics and textual knowledge are linked. To understand the statement of a question, textual knowledge is necessary"* (1st-semester undergraduate student) reinforces the idea that there is no full understanding of mathematical content without the mediation of language, whether oral, written, or symbolic.

Furthermore, undergraduate students point to writing as a practice that fosters autonomous learning and investigative skills. One student stated: *"Through these practices, we learn to deal with everyday situations. When writing about something, we must first research it, which helps in better understanding"* (1st-semester undergraduate student). This excerpt shows that writing stimulates a movement of seeking and reconstructing knowledge, functioning as a mediating instrument between the individual and the world. This perspective resonates with Bronckart's (1999) theory, for which language is a social practice and organizer of human action; and with Marcuschi's (2008) view, which sees writing as a process that articulates reading, interpretation, planning, and rewriting — essential dimensions of learning.

Students also recognize that writing can enhance the learning process when integrated with mathematical content. A seventh-semester participant responded: *"Through writing alone, we can achieve greater learning in our lives, so if we connect this mathematical knowledge to textual practice, it's possible to better utilize the content"*. This enunciation highlights the epistemic function of writing, which, according to Marcuschi (2008), allows a person to think about what they are learning, organize arguments, and make explicit the cognitive operations involved in problem-solving. Writing about Mathematics, therefore, is a way of learning Mathematics, as it requires the explanation of reasoning, the justification of procedures, and the translation of concepts into accessible language.

The idea that *"the more you write, the more you improve"* (7th-semester undergraduate student) points to writing as a practice that develops through experience and consistency. This understanding is anchored in the notion that language proficiency is not a starting point, but a

process socially constructed over time, as Sfard (2008) emphasizes when proposing that learning involves engaging in new discursive practices. For undergraduates, becoming able to write about Mathematics is also a step in the process of becoming a teacher, someone who not only masters content but also knows how to communicate it clearly, critically, and contextually.

In the subcategory *Confidence in expressing mathematical concepts through texts,* the undergraduate students' enunciations indicate that confidence in expressing mathematical concepts through writing is strongly related to educative experiences and mastery of the content to be communicated. The enunciation *"I can do this as long as I have knowledge of the area to be presented"* (1st semester undergraduate student) highlights that discursive confidence depends, to a certain extent, on conceptual confidence. This perception is consistent with Sfard's (2008) proposition, according to which learning is entering into new discursive practices. That is, for a person to appropriate mathematical discourse, they must first understand its internal structures, its vocabularies, and its forms of argumentation. Textual production requires more than mastery of linguistic norms; it requires familiarity with the meanings, ways of thinking, and objectives specific to school Mathematics.

However, some undergraduate students express insecurity when writing about mathematical concepts, as evidenced by the enunciation: *"Most of the time, I feel quite insecure"* (1st-semester undergraduate student). This enunciation reveals not only a technical difficulty but also an emotional obstacle, which may stem from education based on oral communication and the mechanical use of strategies, with no room for the written expression of reasoning, justifications, or reflections. As Freitas and Fiorentini (2008) point out, this gap is recurrent in teacher education programs, where written language is still treated as an isolated activity rather than as a constitutive practice of teaching. Insecurity, in this case, should not be seen as an individual weakness, but rather as an indication of the lack of formative experiences that value writing as a pedagogical and cognitive practice.

On the other hand, there are enunciations that express greater familiarity and comfort with writing as a tool for didactic explanation, as in the excerpt: *"I like writing and explaining these concepts in the best way possible, so I see that in textual production it would be possible to achieve good results, so that whoever is reading can understand"* (7th semester undergraduate student). This enunciation converges with an initial appropriation of the teaching discourse, in which the person begins to perceive writing as a means of pedagogical mediation. This perception aligns with what Marcuschi (2008) argues, when he states that writing is, at the same time, a communicative practice and a tool for organizing thought. In this context, writing becomes an exercise in explaining mathematical reasoning, didactic planning, and producing meaning for others — in other words, core skills for teaching.

Still, the participants recognize the complexity of expressing mathematical ideas in writing, as revealed by the following enunciation: *"Some concepts are sometimes difficult to explain in words, but once you practice, it becomes a comfortable medium"* (7th-semester undergraduate student). This enunciation expresses a procedural understanding of learning to write, based on practice and situated repetition. This understanding reinforces the thesis of Marcuschi (2008), Bronckart (1999), and Sfard (2008), for whom writing competence is socially constructed, through participation in real-life situations of textual production and mediation with other people, objects, and situations. Thus, offering undergraduate students opportunities to write about Mathematics, whether explaining concepts, developing assignments, or writing plans, is a powerful strategy for developing their discursive confidence and teaching competence.

In the subcategory *Importance of text production practices in Mathematics teacher education* the undergraduate students' enunciations reveal a growing understanding of text production as a fundamental element in Mathematics teacher education. The enunciation *"Text*

production is very important for undergraduates to become qualified professionals" (7th semester undergraduate student) highlights the perception that, in addition to contributing not only to language proficiency, but also to the development of more qualified, articulate, and reflective teaching. This idea aligns with what Freitas and Fiorentini (2008) argue when they state that communicative competence, both oral and written, is an essential condition for teaching practice, especially in a field like Mathematics, which has historically been associated with technical language and impersonal discourse.

In this sense, the importance of textual production as a structuring part of the course is clearly expressed in enunciations such as: *"Text production is essential. During the course, we learn about the practice of text production, which is very important"* (1st-semester undergraduate student). This perception highlights the need to promote teaching that encourages the exercise of authorship, didactic explanation, and argumentation, understanding writing as a continuous educational practice. Marcuschi (2008) corroborates this perspective by conceiving textual production as a situated, procedural, and interactive discursive practice, dimensions that contribute to the development of teacher identity and intellectual autonomy.

The relationship between writing and pedagogical practice is also expressed in the enunciation *"We need teachers to be increasingly didactic in their classes"* (7th-semester undergraduate student), which suggests that clarity in communication, including in written form, is seen as one of the pillars of good teaching. This demand for didactics reflects the idea that teaching requires more than mastery of content; it also requires the ability to translate, organize, and make understandable what one intends to teach. Writing, in this context, constitutes one of the ways in which teachers structure their practice, communicate their objectives, plan their actions, and systematize their knowledge.

On the other hand, the enunciation *"The teacher must have mastery of all areas of knowledge!"* (First-semester undergraduate student), although somewhat rhetorical, expresses a broader view of the demands placed on the contemporary teacher, especially regarding the integration of different areas of knowledge and the ability to navigate multiple discourses. This perspective reinforces the importance of initial education addressing writing not only as a technique but also as a cultural, pedagogical, and political practice. As Bronckart (1999) and Silva and Marcuschi (2017) point out, education as a teacher also involves training as a discursive person who critically interacts with various fields of knowledge, and textual production is one of the central pathways to this development.

Based on the subcategory *Influence of textual production practices on the teaching and learning process*, the undergraduate students' enunciations reveal the perception that textual production can act as a pedagogical resource that significantly enhances the teaching and learning processes of Mathematics. The enunciation *"The practice of writing helps students better understand the subject matter, which can benefit the teaching and learning process"* (7th-semester undergraduate student) refers to writing as a tool for organizing and systematizing knowledge, expanding conceptual understanding and promoting more meaningful learning. This view is consistent with Marcuschi (2008), who understands writing as a discursive practice capable of activating cognitive, reflective, and communicative mechanisms, essential for the development of intellectual autonomy.

The relationship between textual production and the ability to formulate mathematical problems is evidenced in the enunciation *"The fact that the student knows how to write well and has good oratory skills helps in formulating mathematical problems"* (7th semester undergraduate student). This perception suggests that written language allows a person not only to understand enunciations but also to create problem situations and structure logical arguments. This creative dimension of writing is echoed by Bronckart (1999), who argues that language organizes human activity and mediates between thought and action. In the context of teacher

education, this means that writing about Mathematics is also learning to teach Mathematics, through the production of tasks, examples, and didactic explanations.

Another relevant aspect is the association between writing and the professional development of undergraduate students, as indicated by the enunciation *"Acquisition of knowledge that helps in future activities during and after the undergraduate degree in Mathematics"* (1st semester undergraduate student). This understanding reinforces the idea that writing should not be treated as a practice restricted to the academic environment, but as a competency that permeates the entire teaching career, from the development of plans and reports to the production of teaching materials, intervention projects, and scientific texts. Freitas and Fiorentini (2008) draw attention to this point by stating that systematic writing during initial education contributes to consolidating teachers' professional identity, enabling them to reflect, communicate, and justify their pedagogical choices.

The enunciation *"Having textual knowledge and understanding can help me create, express, report, and understand any situation"* (1st-semester undergraduate student) broadens this perspective by highlighting that writing acts as a cross-cutting tool for a person's critical development. This understanding is in line with Vygotsky (1998), who recognizes language as a mediator of higher mental functions. When undergraduate students develop their textual competence, they not only enhance their ability to communicate but also develop metacognitive skills, such as reflecting on their own learning, constructing arguments, and restructuring their thoughts. This is a process that transcends discipline and contributes to conscious, ethical, and transformative professional practice.

Similarly, the recognition that *"contextualizing mathematical examples is a good way to teach and stimulate mathematical understanding"* (1st-semester undergraduate student) highlights the importance of connecting language and reality in Mathematics teaching. In this sense, textual production can function as a methodological strategy capable of fostering connections between mathematical concepts and concrete situations, fostering learning. This practice is consistent with Sfard's (2008) discursive approach, which argues that learning is about participating in a specific discourse. Producing texts that contextualize mathematical concepts, whether explanatory, reflective, or narrative, is a way to insert future teachers into the discourse of Mathematics teaching, fostering a critical appropriation of language and the knowledge that constitutes it.

In this context, the analyses presented in this category demonstrate that undergraduate students recognize, despite varying levels of formative maturity, the relevance of textual production in the teaching and learning processes of Mathematics and in the development of their teaching identity. The enunciations demonstrate that writing is perceived as a tool that organizes thought, makes reasoning visible, and enables the systematization of mathematical knowledge, both for the student and the future teacher.

The connection between language and Mathematics, considered by Vygotsky (1998) and Sfard (2008) as a mediator of cognitive development, appears in the enunciations as a decisive element for understanding content and clarifying explanations. The undergraduate students understand that writing helps them not only better understand concepts but also develop the ability to communicate them didactically. This epistemic and communicative dimension of language, as argued by Marcuschi (2008) and Bronckart (1999), reveals the formative potential of writing, especially when embedded in reflective, collaborative, and situated practices.

It was also evident that confidence in writing about mathematical content is a gradually developed aspect, influenced by educational opportunities, conceptual mastery, and experiences with written language throughout education. Undergraduate students who had

access to systematic writing practices, especially in the context of projects or with teacher support, demonstrated greater confidence in using writing as a pedagogical tool. Conversely, reports of insecurity and difficulty point to the lack of consistent practices throughout the course, as Freitas and Fiorentini (2008) warn when criticizing curriculum fragmentation and the lack of emphasis on language in undergraduate Mathematics programs.

Furthermore, the enunciations reveal that undergraduate students attribute an expanded role to writing, one that goes beyond disciplinary communication and encompasses the organization of teaching work, the development of plans, the systematization of experiences, and engagement in investigative practices. This indicates that textual production, when treated as a cross-cutting dimension of education, can contribute to strengthening autonomy, authorship, and critical thinking — fundamental values for teaching practice committed to an emancipatory education.

Thus, the data discussed in this category highlight the need for Mathematics teacher education programs to embrace written textual production not as an appendix to education practices, but as a constitutive dimension of teaching and professional development. By integrating language into the processes of teaching, learning, and reflection, the educational horizons of future teachers are broadened, enabling them to critically appropriate the pedagogical discourse of Mathematics and become active and authoritative individuals in the educational field.

By linking the undergraduate students' individual perceptions with the adopted theoretical frameworks, it was possible to identify broader meanings attributed to written text production in the context of initial Mathematics education. These socially constructed and shared meanings relate to the understanding of writing as a constitutive practice of teaching, capable of mediating the construction of mathematical knowledge, the organization of thought, pedagogical communication, and the exercise of authorship. This perspective reinforces that, beyond a technical or evaluative skill, written text production constitutes a structuring element of the teacher's professional identity and a resource for critical, reflective, and socially situated action in Mathematics teaching.

5 Final considerations

The study presented in this article sought to understand the meanings and perceptions of undergraduate Mathematics students at the Federal University of Southern and Southeastern Pará (Unifesspa) regarding written text production in their education, highlighting the impacts of this practice on the development of teacher identity and education for Mathematics teaching. The study revealed that, despite the curriculum and structural limitations of undergraduate programs, the research participants recognize writing as a powerful tool for organizing thoughts, explaining mathematical reasoning, and developing teaching skills.

The analyses demonstrate that written production is not perceived solely as a technical resource, but as a process of meaning-making that connects language, cognition, and pedagogical practice. At this point, it was possible to identify socially constructed meanings, along the lines of Marcuschi (2008) and Bronckart (1999), who conceive of writing as a situated discursive practice, and also according to Sfard (2008), who understands it as a form of insertion into the discourse of Mathematics teaching. The undergraduate students' enunciations indicate that writing, when encouraged by sensitive pedagogical mediations, has the potential to promote greater autonomy, critical thinking, and confidence in the expression of mathematical knowledge. On the other hand, the data also highlight significant weaknesses in the undergraduate students' educational path, especially regarding the lack of systematic textual production practices integrated into the curriculum. Writing is still treated, in many cases, as a secondary or evaluative task, rather than as an essential educational component.

Therefore, the need for written textual production to be incorporated as a structuring dimension of initial teacher education is reaffirmed. This implies not only expanding the spaces for writing in the curriculum, but also rethinking methodologies, pedagogical timelines, and assessment practices to foster a comprehensive language culture. Preparing teachers capable of writing about, with, and for Mathematics means preparing individuals who understand knowledge as a social and discursive practice, prepared to critically engage with the challenges of teaching and learning in Basic Education.

In this context, it is pertinent to suggest that future research delve deeper into the relationship between textual production and Mathematics teacher education in different institutional contexts, considering, for example, regional specificities, different curriculum arrangements, and continuing education pathways. Longitudinal studies could also monitor the impact of systematic writing practices on the formation of teacher identity over time. Furthermore, research that explores the potential of specific textual genres, such as practice reports, authorial articles, or pedagogical narratives, can contribute to a broader understanding of how language articulates the construction of teaching know-how. Such developments are fundamental to consolidating a education that recognizes writing as an act of thinking, teaching, and transforming.

Thus, it is hoped that this article will contribute to strengthening the debate on the inclusion of written language in teacher education, providing support for curriculum policies that are more sensitive to the discursive dimensions of teaching. More than education teachers to implement technical procedures, it is urgent to train professionals who know how to talk about them, write about them, and teach them with meaning, clarity, and humanity.

Conflicts of Interest

The authors declare no conflicts of interest that could influence the results of the research presented in the article.

Data Availability Statement

The data produced and analyzed in the article will be made available upon request to the authors.

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