

Reflective writing through *vaivém*: a study of future mathematics teachers' productions

Escritura reflexiva sobre *vaivém*: un estudio de las producciones de futuros profesores de matemáticas

L'écriture réflexive sur *vaivém* : une étude des productions de futurs professeurs de mathématiques

Escrita reflexiva no *vaivém*: um estudo das produções de futuras professoras de matemática

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Abstract

This article aims to investigate signs of reflective writing in *Vaivém*-based texts produced by future teachers from a Mathematics Teaching degree program at Instituto Federal do Paraná, Capanema Campus, in Brazil. To do so, the School Learning Assessment tool called *Vaivém* was used, which, in short, facilitates written communication between the teacher and students. Excerpts from the *Vaivém*s produced by five students from a Mathematics Teaching degree program at Instituto Federal do Paraná were analyzed, within the context of a pre-service teacher training subject offered in the first academic term of 2022. Through the aforementioned work, it was possible to identify that *Vaivém* provides opportunities for the occurrence of reflective writing. In this sense, some characteristics contained in the students' reflections were highlighted such as: venting/expression of feelings, professional expectations, views on teaching practice, rethinking and world views. It is important to highlight the role played by the professor's interventions, which promoted individualized dialogues and allowed future teachers to reflect on aspects of their personal and professional lives.

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Keywords: Mathematics education, School learning assessment, Reflective writing, Vaivém.

Resumen

Este artículo tiene como objetivo investigar signos de escritura reflexiva en las producciones escritas de futuros profesores de una clase de Licenciatura en Matemáticas del Instituto Federal de Paraná, campus de Capanema en Vaivéns. Para ello, se utilizó un instrumento para la Evaluación de los Aprendizajes Escolares denominado Vaivém, que, en definitiva, facilita la comunicación escrita entre docente y alumnos. Se analizaron extractos de los Vaivéns producidos por cinco estudiantes de la Licenciatura en Matemáticas en un campus del Instituto Federal de Paraná, en el contexto de una disciplina de pasantía supervisada realizada en el primer semestre de 2022. A través de este trabajo, fue posible identificar que el Vaivém proporciona oportunidades para la manifestación de escritos reflexivos — y, de esa forma, fueron destacadas algunas características presentes en las reflexiones manifestadas, tales como: arrebatado/expresión de sentimientos, expectativas profesionales, pensamiento sobre la práctica docente, repensamiento y cosmovisión. Se destaca el papel de las intervenciones realizadas, que promovieron diálogos individualizados, permitiendo a los futuros docentes reflexionar sobre aspectos de su vida personal y profesional.

Palabras clave: Educación matemática, Evaluación del aprendizaje escolar, Escritura reflexiva, Vaivém.

Résumé

Cet article vise à enquêter sur les signes d'écriture réflexive dans les productions écrites des futurs enseignants d'une classe de licence en mathématiques à l'Institut fédéral du Paraná, campus Capanema à Vaivéns. À cette fin, un instrument d'évaluation des apprentissages scolaires appelé Vaivém a été utilisé — qui, en bref, facilite la communication écrite entre l'enseignant et les élèves. Des extraits des Vaivéns produits par cinq étudiants de la Licence en Mathématiques sur un campus de l'Institut Fédéral du Paraná ont été analysés, dans le cadre d'une discipline de stage supervisé tenue au premier semestre 2022. Grâce à ce travail, il a été possible d'identifier que le Vaivém offre des opportunités pour la manifestation d'écritures réflexives — et, de cette manière, certaines caractéristiques présentes dans les réflexions manifestées ont été mises en évidence, telles que : explosion/expression de sentiments, attentes

professionnelles, réflexion sur la pratique de l'enseignement, repenser et vision du monde. Le rôle des interventions réalisées est mis en évidence, ce qui a favorisé des dialogues individualisés, permettant aux futurs enseignants de réfléchir sur des aspects de leur vie personnelle et professionnelle.

Mots-clés : Enseignement des mathématiques, Évaluation des apprentissages scolaires, Écriture réflexive, Vaivém.

Resumo

Neste artigo, tem-se por objetivo investigar indícios de escrita reflexiva nas produções escritas de futuras professoras de uma turma de Licenciatura em Matemática do Instituto Federal do Paraná campus Capanema em Vaivéns. Para tanto, utilizou-se um instrumento para Avaliação da Aprendizagem Escolar denominado Vaivém — que, em síntese, oportuniza a comunicação escrita entre professor e estudantes. Foram analisados excertos dos Vaivéns produzidos por cinco discentes do curso de Licenciatura em Matemática de um campus do Instituto Federal do Paraná, em um contexto de uma disciplina de estágio supervisionado realizada no primeiro semestre letivo de 2022. Por meio deste trabalho, foi possível identificar que o Vaivém oportuniza a manifestação de escritas reflexivas — e, desse modo, destacaram-se ainda algumas características presentes nas reflexões manifestadas, tais quais: desabafo/expressão de sentimentos, expectativas profissionais, pensamento sobre a prática docente, repensar e visão de mundo. Ressalta-se o papel das intervenções realizadas, que promoveram diálogos individualizados, proporcionando que as futuras professoras refletissem sobre aspectos de suas vidas pessoais e profissionais.

Palavras-chave: Educação Matemática, Avaliação da Aprendizagem Escolar, Escrita Reflexiva, Vaivém.

Reflective Writing through Vaivém: a Study of Future Mathematics Teachers' Productions

The use of different assessment tools in mathematics teachers' education has been studied by some members of *Grupo de Estudo e Pesquisa em Educação Matemática e Avaliação* - GEPEMA³ (Mathematics Education and Assessment Research and Study Group, in free translation). Assessment tools allow future teachers to record their learning, their knowledge, their difficulties and the ways they deal with issues related to mathematics and their (future) professional practice.

As a major part of assessment tools is based on written production, records written by future teachers are an important information source. One of these assessment tools is called *Vaivém*, through which professor and student communicate in writing weekly based on an initial question (Silva, 2018). Studies conducted through the use of *Vaivém* have shown that the questions asked by the professor generated different types of reflection among future teachers (Rodrigues, 2019; Rodrigues & Cyrino, 2020; Silva, 2018; 2023; Silva et al., 2019; Silva et al., 2022; Silva et al., no prelo).

Different tools are used to study future teachers' reflective writing like pre-service diaries (Galiazzi & Lindemann, 2003), reflective diaries (Passos, 2008; Pontes, 2011; Silva & Passos, 2016) and classroom notebooks containing reflections (Gardin & Santos, 2021, 2022). In all these tools, future teachers are encouraged to write reflectively on what they have experienced in pre-service training or in teacher education subjects. Pontes (2011, p. 2, our translation) states that "recording our experiences in a reflective way means *thinking reflectively*, that is, focusing on a situation or an object in order to perform an analysis".

Thus, the aim of this article is to investigate signs of reflective writing in *Vaivém*-based written productions created by a group of future teachers from a *Licenciatura em Matemática* degree program (Mathematics Teaching degree program, in free translation) at *Instituto Federal do Paraná*, Capanema campus, in Brazil. We understand that by investigating the aforementioned signs, important information on the characteristics of the assessment tool will emerge, as well as information that could help encourage this type of writing in mathematics teacher education.

³ For further information: <http://www.uel.br/grupo-estudo/gepema/>

School learning assessment and *vaivém*

The verb “to assess” has different meanings depending on the context it is part of. Its most popular meanings are: “1. to establish the value or price of; to decide the quantity of; to compute; 2. to have an idea about, to hypothesize about or to decide the quality, extension, intensity etc. of; 3. to appreciate the merit or value of; to cherish; 4. to take (sth) into account; to consider; to judge” (Houaiss, 2009, CD-ROM, our translation). According to Barlow (2006, p. 12, our translation), to assess is “to form a judgment about a reality that might be quantifiable (or not) after performing (or not) measurement, so it might be accurate or not accurate.”

In the scope of education, assessment can be linked to different aspects: institutional assessment, external assessment and the assessment carried out by the teacher in the classroom (in this text, this type of assessment is referred to as School Learning Assessment). Hadji (1994) states that assessment within an educational context aims to establish links and measure the distance between two realities: the one experienced by those who form a value judgment and the one experienced by those about whom the value judgment is formed. When the party about whom judgment is formed is the same person as the one who assesses them, it is called self-assessment (Hadji, 1994).

It is understood that School Learning Assessment has a main goal: to contribute to the processes of teaching and learning (De Lange, 1999; Hadji, 2001). In this sense, the information obtained through assessment tools and techniques should support and develop mathematics teaching and learning. Therefore, there are two facets to School Learning Assessment from this perspective: the facet that highlights signs of learning in students (called Assessment as an Investigative Practice) and the one that becomes an opportune occasion for the subjects involved in the process to learn (called Assessment as a Learning Opportunity). According to Esteban (2000, p. 11, our translation), Assessment as an Investigative Practice:

is characterized by the acknowledgment of multiple types of learnings, logic and values that permeate knowledge. In this sense, assessment is understood as a process that inquires into the presented results, the paths that were taken, the foreseeable routes, the relationships established among people, knowledge, information, facts and contexts.

The author understands that assessment is a process that reveals both students’ and teachers’ knowledge; both the answers that are considered right and the ones judged as wrong show signs of the different types of knowledge that has manifested (Esteban, 2002).

As for Assessment as a Learning Opportunity, Buriasco (2000, p. 167-168, our translation) states that:

any assessment from which teacher and student do not learn anything and which does not entail any modification in the pedagogical practice does not make any sense, unless it is not inserted into a formation context, which is not the case as far as educational assessment is concerned.

One of the most used tools in mathematics teaching is the written test, an assessment tool that contains questions chosen by the teacher and answered/solved by students in writing, individually, closed-book style, on a pre-scheduled date and within a specific time length. There are specific procedures related to creating, administering, correcting and communicating the results of a written test, with which students and teachers are familiar.

School Learning Assessment in Mathematics researchers criticize the institutionalized use of written tests, not because they are not a good assessment tool or because they should not be used by teachers, but because little (to no) information stemming from this tool has been used to improve the processes of teaching and learning. These authors understand that it is important that the information obtained from written tests assist students' learning somehow.

Buriasco (2000) states that the written tests that are traditionally given in schools:

are not very useful because they are based on a model that is more concerned with subtracting marks than with analyzing mistakes, more focused on ranking students than on identifying students' individual mastery level, more for a comparison among students than for their own comprehension. This type of test only penalizes students for the mistakes they make, and teachers do not seek means for understanding and working on them, which would transform them into learning strategies (Buriasco, 2000, p.175, our translation).

In this sense, when used in the classroom, a written test should not be a mere instrument for obtaining a score or grading students. Teachers could (and should) use it to obtain as many signs of students' learning as possible and propose didactical interventions based on what students know. Besides, a written test should not be the only assessment tool proposed by the teacher over the school term. Other instruments – based on observations or written productions – can boost other aspects of students' mathematics learning.

Hadji (1994) states that there are different types of assessment tools:

1. The **tools used to gather observations** are those that contribute more directly to the production of information for assessment. [...]
2. All “assessment” tools that are likely to help students to better understand what is expected from them and to contribute to their progression can be considered **tools to support a learner's work**, as well as all tests that, as listed above, can assist learning and its assessment simultaneously.
3. One of the hypotheses on which the notion of formative assessment is based is the belief that the more autonomous students become, the better they learn. The

representation of purposes and the appropriation of criteria are, simultaneously, the tools and the mark left by an achievement of autonomy. Moreover, wouldn't it be necessary, from the same point of view, to take into consideration the **tools whose function is to express and transcribe assessment results**? Also, it is about providing students with information so that they can appropriate it and use it in the self-regulation of their learning. [...]" (Hadji, 1994, p. 168-170, author's emphasis, our translation).

One of them is Vaivém, which is defined by Silva (2018, p. 59, our translation) as a:

tool [which] encompasses the establishment of a space in which a teacher and their students can communicate individually (in writing). In a general way, it is possible to say that, through Vaivém, the teacher asks the whole group a question, and every student answers the questions on a sheet of paper. Based on each student's individual answer, the teacher makes comments and asks the student further questions.

Figure 1 shows the dynamics of Vaivém:

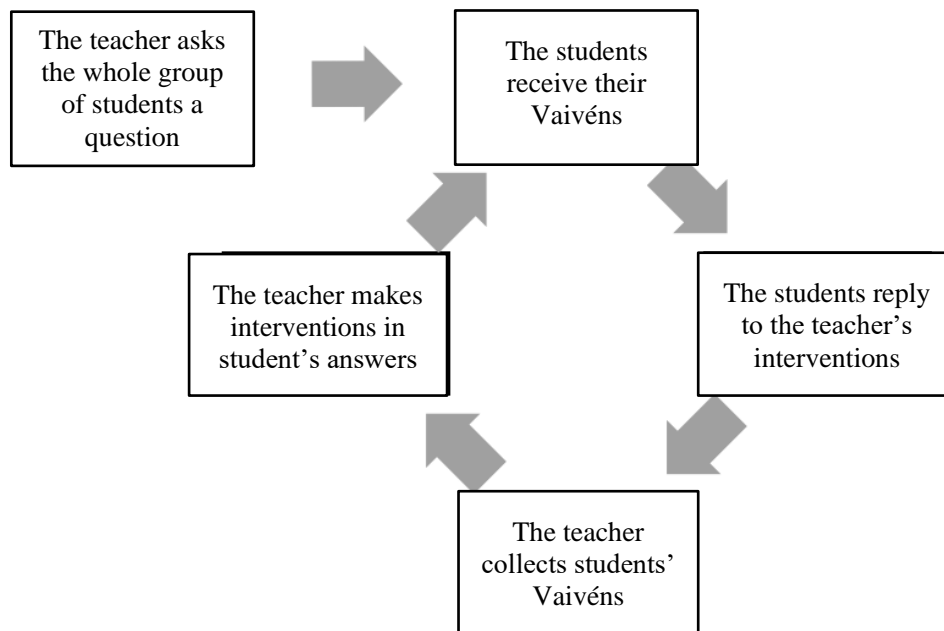


Figure 1.

The dynamics of Vaivém (Silva et al., 2022).

The initial question could be personal, related to the teaching context or to a mathematics task. However, the discussions might vary depending on students' answers, on the teacher's intentions, on the development of the subject etc. Table 1 presents some information on Vaivéns employed in teacher education based on the texts contained in the first column.

Table 1.

Some information from studies that used Vaivém

References	Subjects	Initial questions	Research focus
Silva (2018)	Students from a Geometry and Geometric Drawing subject at Universidade Estadual de Londrina.	“From your point of view, what should a good geometry class be like?”	The author defined Vaivém, used it in his classes, but he did not analyze student’s productions in his thesis.
Rodrigues (2019) Rodrigues and Cyrino (2020) ⁴	Students from Teacher Training subjects at Universidade Estadual de Londrina.	“How do you define yourself?”	The authors investigated aspects related to future mathematics teachers’ professional identity based on Vaivém productions, especially in terms of self-knowledge, one of the aspects of identity considered by the authors.
Silva et al. (2019)	Students from a Teacher Training subject at Universidade Estadual de Londrina.	Basic education mathematics questions ⁵ .	The authors analyzed aspects related to Realistic Mathematics Education contained in a student’s Vaivém.
Barreto (2022)	Mathematics teachers who have been working for less than five years in Basic Education.	“A mathematics teacher – a recent graduate – aims to prepare students so that they become aware citizens and contribute to society to the advance of Science and to the reduction of inequality. They want to transform students into people of value, so that they are honest, have good character and are able to inquire, reflect and have a critical eye. What does it mean to be a critical citizen or to have a critical eye?”	The author analyzed the interactions among teachers through Vaivém and interviews and highlighted aspects of the constitution of their professional identity.
Silva et al. (2022)	Students from a Teacher Training subject at Universidade Estadual de Londrina.	Basic education mathematics questions.	The authors analyzed what a student thought the intention behind the teacher’s questions was and the real intentions, as stated by the teacher, behind her interventions.
Silva et al. (2023)	Students from a Teacher Training subject at	Basic education mathematics questions.	The authors studied the questions asked by a

⁴Since it is a multipaper thesis, one of the articles belonging to Rodrigues’ (2019) thesis was published in 2020 in partnership with his supervisor in Zetetiké.

⁵The questions used by Silva, Bardeçon and Venturini (2019), Silva, Innocenti and Zanquim (2022) and Silva, Sampel and Trombini (2023) are available at <https://bit.ly/preteste2est314>.

References	Subjects	Initial questions	Research focus
	Universidade Estadual de Londrina.		student in Vaivém from the perspective of formative assessment.
Silva (in press)	Students from a Teacher Training subject.	“What are the characteristics of a good mathematics teacher?”	The author analyzed signs of self-assessment in future teachers’ written productions.

It is possible to notice that, in studies that make use of Vaivém in higher education, researchers can analyze the assessment tool from different perspectives, thus considering it a means for investigations into the field of mathematics or about its conceptions. All studies but Barreto’s (2022) investigated mathematics teachers’ initial education – and, in general, the tool proved to be efficient when it comes to the interaction between the professor and future teachers by boosting their learning and their formation as they communicated with the professor in writing.

Reflective Writing

Recently, some studies in the field of teacher education have investigated reflective writing by using different instruments and highlighted their potential (Fioravante, 2014; Galiazzi & Lindemann, 2003; Gardin & Santos, 2021, 2022; Passos, 2008; Pontes, 2011; Silva & Passos, 2016).

Miné (2011) considers written language efficient both to professors’ and students’ learning because both “build mathematical knowledge while they speak, draw, express their ideas, and reflect on their own words, thus establishing relationships through writing” (Miné, 2011, p. 6-7, our translation). From this perspective, reflective writing involves:

(...) observing a situation or an object in order to perform an analysis. It is a customized way of writing through which authors-professors [the ones who write about their own practice] express “their own self”, their view of the world, their feelings, their personal interpretations (Pontes, 2011, p. 2, our translation).

According to a document produced by the University of Birmingham (2015), reflective writing enables critical thinking on the writer’s own skills or practice in order to improve and learn them.

Pontes (2011, p. 4) states that individuals “become authors, reconstruct their relationship with writing and rebuild their identity”. According to the researcher, the authorship exercised by future teachers can be defined as “the ability teachers develop to

(re)create their pedagogical practice with autonomy, critical thinking and a theoretical foundation” (Pontes, 2011, p. 2, our translation).

In this sense, it is possible to observe the relevance of reflective writing within the context of initial teacher education, by whatever instrument is used, because there is not only one way of creating this type of record (Fioravante, 2014). In Gardin’s and Santos’ studies (2021, 2022), for example, reflective writing was produced based on future teachers’ reflections after the end of each class in a Mathematics Teaching degree program, and records were kept through an instrument called “reflective classroom notebook”. In other studies, like the ones by Galiazzi and Lindemann (2003) and by Pontes (2011), reflective writing took place in diaries called “pre-service training diaries” and “reflective diaries”, respectively. In pre-service training diaries, the authors proposed that students record their experiences in pre-service training, and, at specific moments, the researchers made interventions in students’ productions. As for reflective diaries, a study and formation group was formed. In the group, reflective writing was produced based on participants’ experiences in school situations. The expression “reflective diary” was also used by Passos (2008) and Silva and Passos (2016) in the scope of pre-service training in a Mathematics Teaching degree program.

To develop different dynamics based on reflective writing, it is also relevant to share the writing that has been produced, since “by socializing experiences and backgrounds, new perspectives emerge, and new reflections are generated” (Passos, 2008, p. 20).

Within a teacher training context, especially in the scope of mathematics, reflective writing can foster the learning of mathematical content and theoretical and practical knowledge related to teaching (Passos, 2008; Miné, 2011; Pontes, 2011; Fioravante, 2014) as future teachers organize their thoughts and reveal knowledge and understanding related to the contents and aspects of teaching practice. This type of writing can also encourage the dialogue between professors and future teachers, the expression of feelings and personal theories (Galiazzi & Lindemann, 2003).

Critical thinking on practice (Fioravante, 2014; Pontes, 2011) can also be harnessed through reflective writing while one questions reality and searches for ways of transforming it, if necessary. Moreover, this type of writing can promote the regulation of learning when students reflect on their own learning, identify their mistakes and difficulties and design strategies to overcome them (Gardin & Santos, 2021; 2022).

Methodological Procedures

This is a qualitative investigation with an interpretative approach, in which the source of the data are the writing productions developed by five students from a Mathematics Teaching degree program at Instituto Federal do Paraná, Capanema Campus, in Brazil, through a Vaivém produced in 2022 in a pre-service training subject⁶. As in every qualitative study, the following characteristics are considered for this investigation:

(a) its results are transitory; (b) it is impossible to establish an *a priori* hypothesis whose research goal would be to verify or refute it; (c) the non-neutrality of the researcher, who, in an interpretative process, makes use of their previously established perspectives and filters, of which they cannot get rid; (d) the constitution of its comprehensions is not obtained as a result, but through a path along which these comprehensions – and the means of obtaining them – can be (re)configured; and (e) it is impossible to establish regulations in procedures that are systematic, previous, static and general (Garnica, 2019, p. 74, our translation).

The author of this article, who was responsible for collecting the data, was a professor at Instituto Federal do Paraná, in Brazil, in a Mathematics Teaching degree program. The researcher initially invited five students to participate in the experience based on the use of Vaivém as an assessment tool in a pre-service training subject focused on middle school. The initial Vaivém question was: “In your opinion, what are the characteristics of a good mathematics teacher?” All five students agreed to participate in the research and signed an informed consent agreement to authorize the use of their productions for research purposes, as long as they remained anonymous. In order to conceal the students’ identities, they were instructed to choose a nickname⁷ to be used in their Vaivéns. Table 2 presents some characteristics of the students.

Table 2.

Presentation of research participants

Nickname	Birth	Schooling	Mathematics Teaching degree program starting date
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⁶This article is part of a research project called “Um estudo sobre autoavaliação a partir das produções de futuros professores de Matemática em um Vaivém” (CAP20210002), which was approved by the Capanema campus collegiate board at Instituto Federal do Paraná and by its Research and Extension Committee.

⁷The Mathematics Teaching group was formed by 5 female students. When choosing their nicknames, one of them chose Miguel, so, when referring to this student, we will use male pronouns.

Antonia	Year: 1990 City: Capanema, Paraná (PR), Brazil.	Elementary, middle and high school (Educação de Jovens e Adultos) at public schools in Capanema (PR).	In 2019, six years after graduating from high school.
Beatriz	Year: 2000 City: Capanema, Paraná (PR), Brazil.	Elementary and middle school at public schools in Capanema (PR) and a Technical Course in Cooperativism integrated into a high school program at IFPR Capanema.	In 2019, right after graduating from high school.
Lollipop	Year: 2000 City: Santa Maria da Feira (Portugal)	Elementary school in Portugal, middle school and high school at public schools in Realeza (PR).	In 2019, right after graduating from high school.
Miguel	Year: 2000 City: Capanema, Paraná (PR), Brazil.	Elementary and middle school at public schools in Capanema (PR) and a high-school-level teacher training program in the same city.	In 2019, right after graduating from high school.
Sílvia	Year: 1973 City: Constantina, Rio Grande do Sul (RS), Brazil.	Elementary, middle and high school at public schools in Capanema (PR).	In 2019, 27 years after graduating from high school.

The duration of the Vaivém experience was one academic term which started on March 9, 2022 and ended on July 7, 2022. At some moments, the Vaivém questions were sent by e-mail when the professor was away on business trips.

After the Vaivém experiment ended, the students' productions were scanned, and their names hidden by redaction marks. Then, according to Content Analysis parameters (Bardin, 2016), we performed a floating reading of the Vaivéns in order to identify their main characteristics. While reading, it was possible to notice that the texts presented reflective characteristics in almost all of their stages, so we highlighted some parts that contained signs of reflection beyond the direct answers given to the questions asked by the professor. Furthermore, we employed the characteristics proposed by Pontes (2011), such as the reading

grid, to identify signs of reflective writing in the selection of excerpts. For each selected excerpt, we drew inferences about the characteristics of the reflections presented by each future teacher, especially aiming to highlight the type of reflection.

In this article, we decided to present students' productions individually, without any form of grouping, since the Vaivéns contained individual dialogues between the professor and the students, with particular characteristics, due to the interactions that occurred. Thus, we preferred not to group them so as to preserve the individualities of each Vaivém.

Signs of reflective writing in antonia's vaivém

Antonia's Vaivém has a more personal nature because she reported aspects of her life several times – among other things, she wrote about her history, dreams and family. One passage that displays reflective characteristics was found in an answer to the following question asked by the professor: “Among the characteristics [of a good teacher] that you mentioned, which one is the most important?”. Antonia's answer was:

It was hard to choose one among these characteristics, but as a student, I think it's important for my professors to have charisma. I've always had good relationships with ALL teachers I've had. When teachers have charisma, they capture students' attention during the class, the content becomes interesting, and students feel comfortable to ask questions, so the teaching and learning process flows in a satisfactory way on both sides (Excerpt 1 from Antonia's Vaivém).

In the extract presented above, Antonia added a reflective character to her writing when she mentioned that, among all the aforementioned characteristics, she considered it important for professors to have charisma and added: “(...) I've always had good relationships with ALL teachers I've had”. In her statement, Antonia established a relationship between having charisma and developing good relationships with students based on the experiences she had with her teachers. In this sense, we understand that reflective writing occurred because Antonia went beyond what was asked by the question and established a connection with her **personal experience**.

In response to Antonia's answer, the professor asked the following question: “Is charisma something that a person is born with, or can it be developed? What should a non-charismatic teacher do to be good?”.

According to the dictionary, charisma is a natural gift. I agree with this statement, but I think it is possible to develop, to strengthen this quality. And how can a teacher develop charisma? I think by listening to their students, feeling proud of what they achieve and showing it to them, treating them as individual beings, not as a group. I don't know if a

teacher who's not charismatic or friendly can actually be good. They might achieve results (above-average grades), but I believe that achieving good results and enjoying their students' friendship makes daily routine more pleasant. I don't even want to imagine what it's like to teach a group formed by 40 students who don't like me. (Excerpt 2 from Antonia's Vaivém)

In excerpt 2, it is possible to notice that Antonia explained what she found in a dictionary, but she believes one can develop and strengthen their charisma. By doing that, the student expressed her **feelings** through reflective writing by saying: "I don't even want to imagine what it's like to teach a group formed by 40 students who don't like me." In addition to having a reflection on the need for a teacher to have charisma, she expressed a feeling about her own future practice.

Another passage in which it was possible to identify a reflection that Antonia had was contained in her answer to the question: "What type of teacher do you not want to be?"

According to my husband and my cousin, I'll be a strict teacher, with little patience. Maybe they're right because they're the ones who spend the most time with me, the ones who really know me. So, this is an important aspect that I need to work on because (now answering question 2) I don't want to be the teacher everyone is afraid of, the strict teacher who harms everyone and who students don't want to be friends with, but I don't want to be the lenient teacher who can't control a group and who can't teach any content because students don't take her seriously. I'll try to find a balance. The conversation we had with the teachers who teach mathematics through games inspired me a lot. I'll try to be the kind of teacher whose class students look forward to having and feel comfortable to talk to about anything. (Excerpt 3 from Antonia's Vaivém)

Antonia started her answer saying that, according to her husband and her cousin, she will be a strict teacher, but she emphasized that this is an important point that she will need to work on (Excerpt 3). This statement expresses an aspect of **critical thinking on her practice**, which shows the need for change. Besides, she presented a reference to what she would like to be:

I'll try to find a balance. The conversation we had with the teachers who teach mathematics through games inspired me a lot. I'll try to be the kind of teacher whose class students look forward to having and feel comfortable to talk to about anything. (Excerpt 3 from Antonia's Vaivém)

This part contains aspects related to Antonia's **professional expectations** by showing the type of teacher that she would like to be and presenting what she considers essential to her work as a teacher.

Antonia also presented a reflection on herself – she expressed her **expectations** when she was asked why she chose to take a Mathematics Teaching degree program. She said that

it was not the course she had always dreamed of, but her will to take an undergraduate course at a quality federal institution – which is public and free – motivated her to take the degree program.

Another moment of reflection was presented when the student was asked about her dream course:

I always wanted to study LAW. In the beginning (in my childhood), I used to see it on TV, especially on the soap operas my mom used to watch, and I thought it was amazing. When I was a teen, I wanted to be a federal police chief, something I could achieve by studying law, but life was never easy, we were always short on money, and my plans had to be adapted to the point that my goal became to take an undergraduate degree program at a public institution. In order to achieve the goal, I spent 8 years away from here. Those were tough times. One day I got tired of it and decided to come back home. At that time, I didn't know there was a Federal Institute campus here in town. I only knew that when I was on the bus coming back to my hometown. It took around 3 years for the degree program to be available here, and here I am, feeling really proud of myself. I am the first person in my family to take a degree program at a public university. I have cousins who study at private schools, but they can afford the expensive fees. I can't. And there's one more thing I'd like to tell you: my parents aren't that proud of the fact that I'm studying. They think I should be at home in the evening taking care of XXXX [my son]. My biggest supporter is XXXX [my husband]. Once a psychologist said we tend to be to our kids what our parents were to us. I remember that every day, so that I can make it different. Please, don't think there's some kind of problem between us. That's not the case. I love them and I take care of my mom. I just have a different way of thinking. (Excerpt 4 from Antonia's *Vaivém*)

Antonia revealed that she wanted to study Law and expressed her frustration when she was telling her story:

(...) but life was never easy, we were always short on money, and my plans had to be adapted to the point that my goal became to take an undergraduate degree program at a public institution. In order to achieve the goal, I spent 8 years away from here. Those were tough times. One day I got tired of it and decided to come back home. (...) and here I am, feeling really proud of myself. I am the first person in my family to take a degree program at a public university. (...) And there's one more thing I'd like to tell you: my parents aren't that proud of that fact that I'm studying. They think I should be at home in the evening taking care of XXXX [my son]. (...) Once a psychologist said we tend to be to our kids what our parents were to us. I remember that every day, so I can make it different. (...). (Excerpt 5 from Antonia's *Vaivém*)

In the passage, Antonia explained the reason why she could not take a different degree program and added that she felt proud of studying at a public university, albeit a different degree program from her initial desire. Besides, she expressed her feelings about her parents not feeling proud and said she wanted to do things differently regarding her son.

Another sign of **venting** could be observed in a passage where Antonia, at the request of her professor, wrote a summary of what she had learned from teaching practice and from Vaivém:

This term hasn't been easy for me. It's been the first in-person term in which, besides my job, my home and my family, I have XXXX [my son]. He needs me, and I need to be with him, too. I feel guilty sometimes although I'm always there for him. (Excerpt 6 from Antonia's Vaivém)

In excerpt 6, the future teacher reported her difficulty in being a mother and taking a degree program in teaching simultaneously, and she admitted feeling "guilty sometimes". In the following section, we will present signs of reflective writing in Beatriz's Vaivém.

Signs of reflective writing in beatriz's vaivém

Unlike Antonia's production, Beatriz's Vaivém contains more direct answers. We highlighted some parts in which we identified reflections on her personal experiences related to school life.

A passage in which it was possible to observe a reflection is her answer to the following professor's question: "Do you consider yourself a good student? Why?". In the first excerpt from her Vaivém, Beatriz started by saying that she considered herself a good student, justified her answer and added:

I've learned to be more reflective since middle school, especially. My teachers were very important at that stage of my life. I could say 90% of the teachers I've had throughout my life were good. Besides, as I went to the Capanema Federal Institute high school, this aspect was even more emphasized in the development of my character. (Excerpt 1 from Beatriz's Vaivém)

In the extract, in addition to showing signs of reflection on herself, she established a relationship between herself and aspects of her school-related **personal experience**.

In another extract, when Beatriz was asked a question about the most important element to her formation (good concepts, participation in classes or being able to analyze the current social situation), she stated that

the most important thing is to be able to analyze the social situation and to criticize the reality in which you live because "good concepts" could be just a reflex of an exhaustive process of study or even of memorization, and participation in classes could be just momentary and solely represented by the student's personality. That is, it is more important to understand your reality based on what you learn in the classroom than to just listen to something in class, write it down and/or comment it and just leave it in

your memory without putting it into practice in your daily life. (Excerpt 2 from Beatriz's Vaivém)

In the extract (Excerpt 2 from Beatriz's Vaivém), there are signs indicating that Beatriz performed a reading of the factors that might be behind good concepts and participation in classes and linked them to individuals' personal characteristics, thus presenting her **world view**. In excerpt 3, Beatriz stated that:

These 3 factors [critical thinking, autonomy and questioning skills] were the ones that especially drew my attention during my teaching practice. Regarding autonomy, students helped each other more solicitously during the last class, and they also asked to go to the board and solve the task. That is, they started to feel more comfortable to want and to like to help and learn. Therefore, considering that such autonomy was developed within the group in 3 weeks, I wonder what could be done in a year or more. In the beginning, many students preferred other subjects, but in the past few days, they were asking for more activities. (Excerpt 3 from Beatriz's Vaivém)

In this piece of writing, Beatriz reflected on her **teaching practice** through training by offering a description of a situation experienced at school and concluding with a statement-reflection: "(...) considering that such autonomy was developed within the group in 3 weeks, I wonder what could be done in a year or more". In the next section, we will present signs of reflective writing in Lollipop's Vaivém.

Signs of reflective writing in lollipop's vaivém

Lollipop's Vaivém also contains more concise writing. Her answers were always direct, merely answering what was asked without expanding her writing towards more personal aspects. However, it was possible to highlight some parts in which Lollipop expressed her feelings and what she learned.

When she was asked about being a teacher, lollipop expressed her feelings by writing about her uncertainty over becoming or not a teacher and explaining how she dealt with the possibility of choice:

With regard to the question as to whether I want to be a teacher, I haven't decided it yet, and I know there's still a lot to happen, but if I had to make a decision today about becoming or not a teacher and maybe having to quit my job in order to teach, my answer would be no. It's not that I would leave teaching behind, but the perfect scenario would be to share my time between my current job and maybe teaching in the evening. In other words, today I see teaching as my second option. But like I said before, there's still a lot to happen. (Excerpt 1 from Lollipop's Vaivém)

In another passage, when she was asked a question as to why she chose to take a Mathematics Teaching degree program, once again Lollipop expressed her feelings about the theme:

When I was in high school, I had no idea what degree program I'd take or the field I'd choose, and it freaked me out a little bit. In my third year of high school, I won a scholarship to college prep school and as the year was going by, I started to take more interest in math. At the end of the year, some Capanema Campus IFPR students went to my school in Realeza to present the mathematics teaching degree program, which was a new course here in my area. I loved it! It came at the right time for me! The fact that it was a degree program focused on teaching was a plus because I admired teaching and sharing knowledge with other people since I was a little girl. (Excerpt 2 from Lollipop's Vaivém)

It is possible to identify the **expression of feelings** in her writing as follows: "When I was in high school, I had no idea what degree program I'd take or the field I'd choose, and it freaked me out a little bit." Moreover, the student expressed her **world view** by saying that "the fact that it was a degree program focused on teaching was a plus because I admired teaching and sharing knowledge with other people since I was a little girl".

With regard to her experience in teacher training practice, Lollipop described how it helped her and presented signs of reflection by imagining hypothetical situations that she will possibly experience in the classroom:

I can say that pre-service teaching practice helped me a lot as a future teacher by showing what awaits me in the future, and it was through practice that pre-service training allowed me to put into practice what I know, but always keeping in mind that I'm in the middle of a process. I might be comfortable now and know what I'm going to do, what I'm going to explain and what tasks I'll propose to students, for example, but I'll always have to study more. Unexpected situations will come up, moments when I'll have to rethink a lesson plan to adapt it to a specific group or I might feel that a lesson plan I devised doesn't represent anything that will happen in the classroom, and it'll be all right. We never stop learning. (Excerpt 3 from Lollipop's Vaivém)

In the extract above, there are signs of learning related to **teaching practice** in terms of lesson plan flexibility. The following section contains signs of reflective writing on Miguel's Vaivém.

Signs of reflective writing on miguel's vaivém

Another Vaivém that also presented answers of a more direct nature is Miguel's. However, it is possible to notice a constant rethinking of his previous answers. In answer to the first question asked by the teacher ("In your opinion, what are the characteristics of a good mathematics teacher?"), Miguel wrote: "Good teachers don't have knowledge of

mathematics exclusively. They have total understanding of the content and of the group of students so that they can teach the contents in the best possible way for students to learn them”. After his first answer, Miguel wrote in response to another question asked by the teacher about his views on mathematics. It was the first passage in which it was possible to identify some rethinking because after giving his answer, Miguel had a reflection in relation to the answers he had written before:

Thinking of it now, I think I was a little unrealistic in some of the perspectives I shared before, for example, about knowing all students very well. It's not always possible to have that level of control because there are many student groups, each group formed by many students, and sometimes the teacher will change schools or groups every year. Because of that, mastering the content and the way it'll be presented are enough to characterize a good mathematics teacher, in my opinion. (Excerpt 1 from Miguel's Vaivém)

In another passage, Miguel **vented** by saying “(I'm really confused about all of it)” when he was writing about teachers needing to have more knowledge of the content that they are teaching than the students who will learn it (Excerpt 2 from Miguel's Vaivém). Miguel's statement reveals constant reflection about the topic under discussion (a good mathematics teacher's characteristics). In this sense, Miguel presented signs that the first question in the Vaivém continued generating reflection in the future, although it had been asked weeks before, thus revealing that the tool has continuity.

I believe that to teach something, it's necessary to have more knowledge of the content being taught than those who'll learn it. Not in a general way, because there are always new concepts to be learned, but to learn something, you need to understand concepts that haven't been mastered yet, usually from someone who has knowledge of them, or not, in the case of self-taught people, or in other cases (I'm really confused about all of it). (Excerpt 2 from Miguel's Vaivém)

Another passage in which it was possible to identify signs of reflection was when Miguel stated, at the end of his writing, after being asked if a teacher needs to have total mastery of the content (or greater than those who will learn it): “I rule out the possibility of knowing it ALL about something. → Oh, Professor Silva,” (Excerpt 3 from Miguel's Vaivém). In this passage, there are signs of **rethinking** his theories, a reflection encouraged by the question the professor asked.

Actually, it is essential to know more about the content being taught than those who are learning it, but I also believe that people should learn more about what will be taught than just what's essential, especially the teacher. I rule out the possibility of knowing it ALL about something. → Oh, Professor Silva, (Excerpt 3 from Miguel's Vaivém)

Once again, Miguel presented a change of opinion (**rethinking**) – which could be a response to the reflections encouraged by the professor’s questions – when he wrote:

In fact, I believe teaching is providing paths for learning. Therefore, yes, you taught it, which debunks my belief that you should master the content before teaching it. But in case of students who have poorer conditions to search for knowledge, the situation could be harder, but not impossible! (Excerpt 4 from Miguel’s Vaivém).

In the next section, we will present signs of reflective writing identified in Silvia’s Vaivém.

Signs of Reflective Writing in Miguel’s Vaivém

Silvia’s Vaivém contains longer answers, which offer examples based on her experience. When she was asked by the professor why one should consider content knowledge the first essential characteristic of a good teacher, Silvia introduced a reflection and gave examples based on her **personal experience** related to what other teachers said.

I heard my Portuguese teachers say a lot of times that they ‘don’t know anything about math’, so having knowledge of what you’re going to teach is an essential characteristic to be good teacher, otherwise you’ll not reach your goal and will be considered a bad teacher (Excerpt 1 from Silvia’s Vaivém)

In another part of her Vaivém, when Silvia was asked if a teacher can teach something they do not know, she reflected on the importance of contents and linked what she was saying to her **personal experience** as an undergraduate student:

In college, we are taught knowledge related to mathematical contents, and methodologies are acquired with practice. I put them in second place just for ordering purposes, not due to a lack of importance. Because of my classes and training practice, day after day I notice that teaching methods are key, especially these days when kids aren’t passive like they were back when I was a kid. If today we have kids that know how to choose what they want, educators must teach by using interesting methods. (Excerpt 2 from Silvia’s Vaivém)

In the statement above, Silvia went beyond the context of teaching and included her own experience as a student. In addition, she wrote:

Because of my classes and training practice, day after day I notice that teaching methods are key, especially these days when kids aren’t passive like they were back when I was a kid. If today we have kids that know how to choose what they want, educators must teach by using interesting methods” (Excerpt 3 from Silvia’s Vaivém)

This extract connects the discussion to her **world view** on children’s current reality. When she was asked to explain her statement about children not being passive like they were

in the past, Silvia wrote an explanation by describing her view on childhood today and added a reflective comment about the value judgment contained in her description:

Children currently have free access to information. Everything is shown and explained to them, so we have more active kids. They do what they want and like to do, and they question what we show them. And it isn't wrong. On the contrary, it's good, but it requires that professionals develop more strategies for teaching, engagement and motivation to happen. And that's one of the main reasons I understand as difficulties in teaching and learning, students' lack of interest, because they have their own interests. Parents', teachers' and the school's needs and interests take second place. (Excerpt 4 from Silvia's Vaivém)

With regard to pre-service training, Silvia **vented** her feelings by describing a situation in which she faced disrespect and disappointment:

It was supposed to be a good moment, a moment to have contact with other professionals, to feel the school environment, teach and learn from the kids, but it was a tough and stressful moment, which didn't allow me to enjoy it as I intended to. (Excerpt 5 from Silvia's Vaivém).

The next section contains an analysis of the signs of reflective writing identified in the selected Vaivéns.

An analysis of the signs of reflective writing identified in the Vaivéns

When analyzing Antonia's, Beatriz's, Lollipop's, Miguel's and Silvia's Vaivéns, we observed some aspects that individualized each piece of writing. While Lollipop's Vaivém is the briefest one, Beatriz's and Miguel's are more direct, and Antonia's and Sílvia's are more descriptive and offered more examples. Furthermore, the reflections shared by the students contained distinct characteristics such as venting/expression of feeling, expectations, personal experiences, views on teaching practice, rethinking and world views.

Venting/expression of feelings could be observed when the students expressed their emotions by writing, for example, about frustration, fears and uncertainty. Personal experiences were identified when they shared perceptions that were directly related to what they experienced. Their views on teaching practice could be identified when the students revealed their understanding of professional practice and when they questioned the reality of their practice in order to find ways to transform it. Rethinking means establishing a constant dialogue with one's own writing, which shows that it is always possible to reflect and reconsider your conceptions. World views were detected when the students recorded their pre-established ideas and concepts. In Table 3, there is a summary of the characteristics of reflective writing identified in the students' Vaivéns.

Table 3.

Reflective writing characteristics identified in Vaivéns

Reflective writing characteristics	Identified Vaivéns	Example
Venting/Expression of feelings	Antonia Lollipop Miguel Sílvia	“It was supposed to be a good moment, a moment to have contact with other professionals, to feel the school environment, teach and learn from the kids, but it was a tough and stressful moment, which didn’t allow me to enjoy it as I intended to” (Sílvia).
Expectation	Antonia	“I don’t want to be the teacher everyone is afraid of, the strict teacher who harms everyone and who students don’t want to be friends with, but I don’t want to be the lenient teacher who can’t control a group and who can’t teach any content because students don’t take her seriously” (Antonia).
Personal experience	Antonia Beatriz Sílvia	“I’ve learned to be more reflective since middle school, especially. My teachers were very important at that stage of my life. I could say 90% of the teachers I’ve had throughout my life were good. Besides, as I went to Capanema Federal Institute High School, this aspect was even more emphasized in the development of my character” (Beatriz).
View on teaching practice	Antonia Beatriz Lollipop	“These 3 factors [critical thinking, autonomy and questioning skills] were the ones that especially drew my attention during my teaching practice. Regarding autonomy, students helped each other more solicitously during the last class, and they also asked to go to the board and solve the task. That is, they started to feel more comfortable to want and to like helping and learning. Therefore, considering that such autonomy was developed within the group in 3 weeks, I wonder what could be done in a year or more” (Beatriz).
Rethinking	Miguel	“Thinking of it now, I think I was a little unrealistic in some of the perspectives I shared before, for example, about knowing all students very well” (Miguel).
World view	Beatriz Lollipop Sílvia	“The fact that it was a degree program focused on teaching was a plus because I admired teaching and sharing knowledge with other people since I was a little girl” (Lollipop).

Some of the characteristics displayed in Table 3 were presented by Pontes (2011) and Gardin e Santos (2022). Nevertheless, the use of Vaivém as an assessment tool enabled the

identification of a particular characteristic in addition to the ones identified in the literature we adopted: rethinking. Since Vaivém is an assessment tool in which communication occurs through written comments and questions based on students' previous answers, it allows students to revisit their own writing as an object of reflection. Thus, students can constantly rethink their writing, which generates *a reflection of their own reflection*.

Moreover, Antonia's, Beatriz's, Lollipop's, Miguel's and Sílvia's Vaivéns from Table 3 contain characteristics that individualize them, even though the initial question was the same to all of them. With regard to reflective writing characteristics, the ones related to **venting/expression of feelings** generally express aspects of the future teachers' private lives. According to Rodrigues and Cyrino (2020), this characteristic of Vaivém is linked to the confidentiality that is inherent to the dynamics of the tool.

Likewise, the **professional expectations** that were presented encompass projections of students' professional lives. Regarding **views on teaching practice** and **world views**, it is possible to state that the students shared their conceptions and thoughts on subjects related to teaching practice and other school aspects. It corroborates what Silva et al. (2022) stated when arguing that Vaivém creates a space for teachers to have individualized dialogues with students, which allows teachers to deal with each student's particular characteristics.

Miguel frequently stated that he had "changed his mind", which characterized **rethinking**, a recurring aspect in his written production. About rethinking, Silva et al. (2022) argued that the selected tool provides a space so that answers can be rethought, reconstructed, revisited and complemented. Therefore, rethinking constitutes an important characteristic of reflective writing that is harnessed by the dynamics of Vaivém.

Conclusion

This article aimed to investigate signs of reflective writing in Vaivém-based written productions created by future teachers from a Mathematics Teaching degree program at Instituto Federal do Paraná, Capanema Campus, in Brazil. To do so, we used productions written by five future mathematics teachers within the context of a pre-service teacher training subject. Each Vaivém was analyzed in order to identify passages that contained reflections. After that, the aforementioned reflections were characterized.

It was possible to notice that the reflections shared by the future teachers contained aspects of venting/expression of feelings, professional expectations, views on teaching practice, rethinking and world views. The differences among the Vaivéns were highlighted through the different characteristics observed in each production.

Even though Vaivém was not used for the same purposes as other assessment tools like pre-service training diaries (Galiazzi & Lindemann, 2003), reflective diaries (Passos, 2008; Pontes, 2011; Silva & Passos, 2016) and reflective classroom notebooks (Gardin & Santos, 2021, 2022), it was possible to observe that the dynamics proposed by Vaivém enabled future teachers to produce reflective writing. It is important to highlight the part played by the interventions made by the professor, which encouraged individualized dialogues and the possibility for future teachers to explore aspects of their professional and personal lives.

Furthermore, written records proved to be an essential element to the manifestation of reflective writing, since future teachers' objects of reflection could also be their own productions. For example, while Sílvia reflected on her pre-service teaching practice by saying that "it was supposed to be a good moment, a moment to have contact with other professionals, to feel the school environment, teach and learn from the kids, but it was a tough and stressful moment, which didn't allow me to enjoy it as I intended to", Miguel reflected on the answers he himself had given in his Vaivém when he wrote "Thinking of it now, I think I was a little unrealistic in some of the perspectives I shared before, for example, about knowing all students very well". This study was not specifically focused on future teachers' objects of reflection, but further studies could explore it in detail.

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