

Training itineraries, the flipped classroom and “learning to learn”: possible approaches based on the (auto)biographical narrative of a future Mathematics teacher

Cícero Nachtigall

Universidade Federal de Pelotas

Pelotas, RS — Brasil

✉ ccnachtigall@yahoo.com.br

ORCID [0000-0003-3869-0062](https://orcid.org/0000-0003-3869-0062)

Maria Helena Menna Barreto Abrahão


Universidade Federal de Pelotas


Porto Alegre, RS — Brasil

✉ abrahamhmb@gmail.com

ORCID [0000-0002-1278-4098](https://orcid.org/0000-0002-1278-4098)



2238-0345 

10.37001/ripem.v15i1.3891 

Received • 08/04/2024

Approved • 17/10/2024

Published • 02/03/2025

Editor • Gilberto Januario 

Abstract: This study presents part of a doctoral education research work that is being developed at a public university in southern Brazil. The investigation operates with (auto)biographical narratives of undergraduate mathematics students, produced in a Research-Training Seminar. The methodology for analyzing narratives is based on the model of scenic understanding. In this text, we seek to carry out an analysis based on scenes shared by the collaborator Gustavo. The study allows the emergence of strategies, courses of action, awareness, and significant resilience in the teaching search. The research sheds light on a particular experience with the Flipped Classroom approach, which is central to the doctoral research on screen and carried out three years before the seminar. The reflections indicate that the workshop configured a privileged and unique training space, revealing the important contribution that research-training can offer to the training of teachers.

Keywords: (Auto)biographical Narratives. Flipped Classroom. Teacher Education.

Itinerarios formativos, el aula invertida y “aprender a aprender”: posibles enfoques a partir de la narrativa (auto)biográfica de un futuro profesor de Matemáticas

Resumen: El presente estudio presenta parte de una investigación doctoral en educación que se está desarrollando en una universidad pública del sur de Brasil. La investigación opera con narrativas (auto)biográficas de estudiantes de graduación en matemáticas, producidas en un Seminario de Investigación-Formación. La metodología de análisis de narrativas se basa en el modelo de comprensión escénica. En este texto buscamos realizar un ejercicio de análisis a partir de escenas compartidas por el colaborador llamado Gustavo. El estudio permite emerger estrategias, cursos de acción, concientización y resiliencia significativa en la búsqueda de la enseñanza. La investigación arroja luz sobre una experiencia particular con el enfoque Flipped Classroom, central en la investigación doctoral sobre pantalla y llevada a cabo tres años antes del seminario. Las reflexiones indican que el seminario configuró un espacio de formación privilegiado y único, revelando el importante aporte que la formación investigativa puede ofrecer a la formación de profesores.

Palabras clave: Narrativas (Auto)biográficas. Aula Invertida. Formación de Profesores.

Itinerários formativos, a sala de aula invertida e o “aprender a aprender”: tessituras possíveis a partir da narrativa (auto)biográfica de um futuro

professor de Matemática

Resumo: O presente estudo apresenta parte de uma pesquisa de doutorado em educação, que se encontra em desenvolvimento e envolve uma universidade pública do Sul do Brasil. A investigação opera com narrativas (auto)biográficas de estudantes de licenciatura em matemática, produzidas em um Seminário de Pesquisa-Formação. A metodologia de análise das narrativas apoia-se no modelo da compreensão cênica. Neste texto, buscamos realizar um exercício de análise apoiado em cenas partilhadas pelo colaborador denominado Gustavo. O estudo permite a emergência de estratégias, cursos de ação, tomadas de consciência e significativa resiliência na busca pela docência. A pesquisa lança luz sobre uma experiência particular com a abordagem Sala de Aula Invertida, a qual é central na pesquisa de doutoramento em tela e realizada três anos antes do seminário. As reflexões apontam que o seminário configurou um espaço formativo privilegiado e singular, revelando a importante contribuição que a pesquisa-formação pode oferecer à formação de professores.

Palavras-chave: Narrativas (Auto)biográficas. Sala de Aula Invertida. Formação de Professores.

1 Introduction

Many authors have problematized teacher formation from various perspectives (Diniz-Pereira, 2013). In a country like Brazil, where education faces many challenges, teacher formation is a strategy that sheds light on new and better horizons. The complexity of this theme indicates that the current initiatives will not be sufficiently satisfactory if guided by linearity and pragmatism or focused solely on repeating what is being done. Instead, they must offer alternative formative routes.

The autobiographical method designates an emerging paradigm detached from the epistemological/theoretical/methodologic conception of the considered classical models in education research (Passeggi, 2016). In this conception, the individual's life experiences take a privileged position as a fundamental component in the formative process. Through recollection and critical observation, the research-formation is inserted in an investigative perspective, once it allows and provokes the recreation of the personal/professional experiences, placing the subject in a unique web-like plot that involves past, present, and future (Bragança, 2014).

In effect, reflexivity emerges as a fundamental premise to human formation and to teacher training. According to Nóvoa (2010, p. 19), “the teacher instruction area cannot limit itself merely to technical and technological spheres, it needs a deeper comprehension of the processes through which people are formed.”

Passeggi & Souza (2017) state

What differentiates research-formation from traditional research is that the person that is being formed is added to the process of investigation, and assured to produce and not only regurgitate over them, granting democratic productive instances of knowledge. In the classical model, the objects of research aim at the results that optimize educational action, independently of the person who has reflected upon it. On the contrary, in research-formation, the discomposed practices and experimental experiences are highlighted (Passeggi & Souza, 2017, p. 14).

Marie-Christine Josso carried out a research work – particularly the research-formation seminars, one of the operational expressions of the (auto)biographical method – that represents real and potent possibilities to add quality to teacher instruction. The process of writing and

sharing experiences represents, to each participant, an important mediation tool to approach existential matters inherent to any formation process. Passeggi e Souza (2017) assert that autobiographical research:

escapes from the standards of analysis that focus on laws or general rules of human behavior, due to its complexity. It gives the researcher and narrator the necessary permission to come and go in search of heuristic tools as revolutionary as the “autobiographical turn” itself, subjective, interpretative, qualitative, and strange to the “hypothesis-verification” schemes of the positivist perspective (Passeggi & Souza, 2018, p.12).

Therefore, the authenticity of the research-formation methodology is “constantly concerned with whether the narrative authors can produce knowledge that is sensible to them and to insert themselves in a project that places them as individuals” (Josso, 2010, p. 33). Similarly, Abrahão (2011, p. 166) defends that the (auto)biographical narratives can be conceived “in three spheres: as a phenomenon (the act of narrating reflexively); as an investigation methodology (the narrative as the source of investigation); as a process (of learning, self-knowledge and (re)signifying the experience).”

Regarding the methodology of narrative research, Vieira & Silva (2023, p. 15) state that “the focus of the entire work cannot be detached from the narrative of oneself, and from how we construct our professional and formative experiences through our life story,” enabling the attribution of meaning to lived experiences. As Bolívar (2012) points out, this reconstruction of the narrative cannot be restricted to the mere sum of disjointed data or facts; it instead presents an opportunity to imbue one's life with meaning and to develop a narrative identity.

Nacarato, Moreira, and Custódio (2019) emphasize that research based on the (auto)biographical method, widely supported in the educational field, has also attracted attention in the area of Mathematics Education. In a study that systematically reviewed papers produced in the field from 2010 to 2018, the authors highlight a growing interest in (auto)biographical narratives, self-writing, and formation memorials by mathematics teachers. They add that these narratives — tools that guide the reflection of future mathematics teachers — help to signify and give meaning to their lives, learning, knowledge, and practices, opening new ways of understanding the learning process and mathematical formation. Similarly, Nacarato, Passos, and Lopes emphasize the importance of the narrative process in the formation of mathematics teachers but note that this movement must go beyond the standard process of listening. It must highlight the narrative's character and allow for the emergence of experiences that shape personal and professional paths.

2 A brief perspective on the doctoral research in progress

The present investigation is part of a doctoral research project in progress at the Postgraduate Program in Education at a public university in Southern Brazil. The group of participants includes seven students from the Mathematics degree and me¹, the first author of this text, in the role of participant/researcher. All participants experienced the Flipped Classroom method at an Integral Calculus course in 2019.

The Flipped Classroom is a form of Hybrid Teaching and Active Methodology in which the traditional roles of students are inverted. In this approach, students access basic information

¹ In this paper, the first person singular will be used to represent the first author's speech in the research work, in the quality of a doctoral student, under the guidance of the second author of the text.

outside of the classroom, usually through recorded lessons selected by the teacher. The in-person sessions are then used to clarify doubts, resolve exercises, discuss, and develop projects, among other activities aimed at deepening students' understanding of the topic in question (Bergmann & Sams, 2018; Talbert, 2019; Mattar, 2017).

The seven students participating in the ongoing doctoral research and I, the first author of this paper, tested the Flipped Classroom in a regular course in the Mathematics degree program during the second term of 2019 [N.T.: in Brazil, from August to December]. All lessons in the Calculus II course were flipped, and by the end of the term, exploratory research showed that the flipped approach provided students with an important opportunity to reflect on study planning, time management, self-confidence, motivations, and self-reflection (Nachtigall & Frison, 2020).

The use of technology as a pedagogical tool served two purposes. Firstly, it acted as an aid for learning specific topics in the subject. Secondly, it provided future Mathematics teachers with the opportunity to experience Hybrid Teaching. I understand that teacher education programs are privileged spaces where future teachers can explore new possibilities and, eventually, use them in their future professional practices. In the second term of 2019, none of us could foresee the pandemic context that would soon emerge for the next two years, not even its impacts, which led to moments of health, social, economic, and, particularly, educational chaos.

In 2022, the participants of the 2019 flipped classroom experience reunited, now in a Research-Formation Seminar (Josso, 2010) as part of the doctoral research we are partially reporting here.

3 The research-formation seminars and the scenic comprehension

The research-formation seminar mentioned in this study draws inspiration from the approach proposed by Marie-Christine Josso and provides a detailed description in Chapter V of the referenced work (2010). The author structures the seminars in four phases: the *phase of introduction to the construction of the story of the narrative of formation*; the *phase of the elaboration of the narrative*; the *phase of comprehension and interpretation of the written narratives*; and, finally, the *phase of evaluation of the teachers and participants*.

In the present investigation, we apply the scenic comprehension methodology (Marinas, 2007; Santamarina & Marinas, 1994; Bragança, 2014; Frison & Abrahão, 2019; Abrahão, 2023). The scenic comprehension model, according to Marinas (2007), proposes the analysis of the narratives through the interpretation of a repertoire of scenes, understanding each report “not as a linear, summative story” (Marinas, 2007, p. 118), and applying the principle of dialectical relation between the word given and the attentive listening (Bragança, 2014).

As Inês Bragança states, scenic comprehension is based on “four poles in which the enunciation of words moves: *saying the whole*, the *silence*, the *given word* and the *empty word*” (p. 86). According to the author, the circuit of the *given word* and *attentive listening* entails a link between the narrator and the listener, in which both are formed and do not seek

the mere documentary record of the report, but creates a balancing movement, of mutual following, in the search for producing and giving meaning to the complexity of intrigues. In this way, we can affirm that the construction of oral narrative sources, by nature, potentially implicates the formation of those who join the narrative circuit, that is, narrator and listener (Bragança, 2014, p. 87).

As Frison & Abrahão (2019, p. 4) highlight, *listening* “demands respect for the sentiments revealed by the author; under this conception, the one who listens recreates the experience, increased by the words that the other gives when narrating. In this way, a circuit linking narrator and listener is created, involving the given word and the listening. *Listening and the given words* contribute to sharing and rethinking life.”

Emphasizing this methodology, Marinas (2007, p. 119) points out that the first scene:

[...] is the one that reunites the narrator and interviewer in the listening process. [...] Scene 2 consists of those that integrate part of the daily life of the narrator, with their position as sender and receiver returning to scene 1 according to the way it is updated. In this transition between scenes 1 and 2, it is possible to encounter the emergence of the reprimed or forgotten scenes.

Similarly, Frison & Abrahão (2019, p. 7-8) stress:

scene 1 (S1), motivated by *listening*, brings the sender and receiver closer together and integrates phenomena arising from the narrator’s core, as well as from the external aspects of the social contexts and discursive conditions that surround them. Scene 2 (S2) consists of scenes from the daily life of the narrator. The sender and receiver come back to S1, as the discursive elements in this space are updated.

Moreover, the authors state that “this vivid interplay in Scenes 1 and 2 is the possible step for scene 3 (S3) to emerge, revealing something that may have been forgotten, or that, for some reason, may not have been said, that may have been repressed, according to the author” (Frison & Abrahão, 2019, p. 8).

4 Formulating the first discussions

In this doctoral research work, the participants include seven future Mathematics teachers and me, the principal researcher of the investigation. The synchronous virtual meetings of the investigation took place in August (13/08 and 27/08), September (10/09), and October (1/10, 8/10, and 22/10) of 2022, each with an average duration of 2 hours. Beyond the group discussions conducted in the seminars, each student produced and presented their formation memorial to the other participants.

The meetings were recorded and later fully transcribed, totaling more than 220 pages which, along with the seven formation memorials written by the students, form the corpus of analysis for this research. These pieces integrate the corpus of analysis in this research work. The participants chose the following fictitious names that will be used in this work to assure anonymity: Gustavo, Maiara, Isabela, Dorothy, Lua, Joaquim, and Fernando F.

In this article, we will present and analyze Scene 1, with the oral and written narratives of the participant designated Gustavo. By oral narratives, we refer to the manifestations that happened during the meetings of the Research-Formation Seminar and, by written narrative, the memorial produced and presented by the participant to the group. The choice was due to the fact that he was the first to present his memorial of formation.

4.1 Scene 1: Enunciation

Scene 1 was characterized by the group’s reunion, after more than two years of separation due to the impossibility of face-to-face academic activities imposed by the COVID-19 pandemic. Before presenting the proposal for the Seminar and submitting it for the approval of the participants, we reserved part of the first meeting for the students’ report on how things

were going, about the social distancing period, and the remote lessons. Many students mentioned the period in which the flipped lessons were implemented, and the period immediately after, marked by remote lessons.

The established interaction and closeness seemed to indicate a safe space for sharing, which had been already experienced by the group three years before. The intermeshing and mutual trust built during the Calculus II course created a unique bond within the group, one that had already formed before the Research-Formation Seminars.

The uniqueness of the previous interaction gave the impression that everyone knew each other's formation path well enough. The experiences shared during the meetings and the presentation of the memorials revealed that this perception was not sufficient to accompany the group along this journey of discoveries – of the other and of the self.

The first meeting served as an important opportunity to present the ongoing work and to establish, with the group, agreements regarding *the introductory phase of constructing the narrative of the formation story* (Josso, 2010).

We added essential human elements to the agreements, such as the quantity, format, and duration of the meetings. Friendships, memories, and nostalgia for a time in which face-to-face and unrestrained interaction seemed to be a non-negotiable right, but the pandemic period revealed its fragility.

It was suggested that the participants construct their memorials around two poles, focusing on specific elements related to the flipped lessons, which are central to this research work. The first would be broad, rescuing memories from childhood, such as familiar, social, and school experiences, and it would also shed light on the choice for a profession and the degree in progress. The second would include memories associated with the experience with inverted lessons in the Calculus II course and its possible formative contributions. The group agreed to produce and share the memorials. Some questions regarding the memorials arose and were clarified.

The moment of enunciation allowed the group to share their perceptions of the experience with flipped lessons. While the participants applied and spoke about the topic, some expressions that gave this experience a unique role emerged. In this sense, Gustavo declared:

(...) for me, it was a turning point. Like when you turn on the car key. Then, the moment you turn that ignition key, it starts, that was the Calculus II lesson (Gustavo, oral narrative, second meeting).

Similarly, the opportunity to freely express their experiences during the pandemic allowed students to also share the challenges that they faced during the period of remote lessons. Corroborating Silva's (2023) findings, the speeches indicate that students and teachers underwent a compulsory and burdensome process, which revealed significant obstacles to developing competencies to use technological tools as a means of pedagogical mediation. From this perspective, Antunes et al (2021) identify and problematize, based on experiences with remote lessons, the lack of spaces destined for sharing teaching practices. The authors defend the offer of permanent spaces oriented to the sharing of faced challenges and implemented solutions, allowing the (auto)formation of teachers.

4.2 Scene 2: Daily life scenes

The repertoire of daily scenes shared by Gustavo spans from early childhood to the completion of the Degree in Mathematics, including the period of remote studies and flipped

lessons. The scenes identified in the analysis are organized into four spheres. The first, titled *The Choice to Teach Mathematics and the Path to the Degree*, highlights Gustavo's early steps as a student and his decision to pursue a career as a mathematics teacher.

The second sphere, *The Beginning of the Academic Journey*, presents scenes featuring Gustavo's in his first semesters in the course, the main challenges he faced, and the sources of motivation he found to give continuity to his studies during his undergraduate course.

The third sphere, titled *the experience with the Flipped Classroom*, includes scenes from the period of flipped lessons in the Calculus II course and their contribution to his development. The fourth sphere titled *The Flipped Classroom and "Learning to Learn"*, explores elements related to learning strategies during a period of flipped lessons and the period immediately subsequent, characterized by remote lessons due to the need for social isolation during the Covid-19 pandemic, lasting from March 2020 to July 2022.

4.3 The choice to teach Mathematics and the path to the degree

Recalling various scenes from his daily life, Gustavo attempts to attribute meaning and organize his memories in a web-like format. He recalls his desire to become a mathematics teacher since his childhood, in many restored images. His teacher's approach to mathematics in the first grade of elementary school, with games and playful activities, has awakened his interest in the subject.

Later, not even the need to repeat the seventh year, due to difficulties in mathematics did not change his decision. Gustavo points out that he became engaged with mathematics precisely at that moment, despite the significant challenges he faced when learning the subject. In the next year, one teacher's practice was decisive and would become a reference to him. Despite not being in his area (she was a History teacher), she contributed to Gustavo enhancing his interest in mathematics over the next two years. Gustavo had his first experience as a teacher by teaching mathematics to his classmates, because of the influence of this teacher and his classmates.

In high school, Gustavo became a reference for mathematics within his group. He reinforced his interest in the area because of his good relationship with his mathematics teachers, and the opportunity to help his mates. In one of the scenes, Gustavo shares an important memory of the period:

Sometimes, we would leave school at 9:30 or 10 p.m., and I would go to a classmate's house nearby. Then we would gather, and I would teach about ten to fifteen people. I remember this clearly. I was able to teach them in a very calm manner. Now I see, I realize that. And always willing to do a degree in mathematics. Some teachers encouraged me: "Do the entrance exam, study mathematics, do it because you like, you're good, you'll like it!" (Gustavo, oral narrative, third seminar meeting).

The reported scene allows us to identify the first initiatives of a future mathematics teacher. The apparent simplicity of this scene masks two motivational paths in his developmental journey. The first of them is related to the pleasure of helping classmates in need to understand mathematics better, and the second, to the stimulus of classmates and teachers to become a mathematics teacher.

Sarmiento (2013) explains that the (auto)biographical narratives are privileged instruments for revealing key choices, including the decision to pursue a career as a teacher during the school years. The author highlights that interaction and socialization with teachers at this stage of their studies enable students to envision themselves as teachers. She adds that

teachers' narratives often include references to influential teachers, as well as the impact of friends, classmates, and family.

The scenes shared by Gustavo also reveal the knowledge essential to his development as a teacher: mathematical knowledge and pedagogical knowledge. It is important to note that, although initial teacher training refers to the start of a teacher's professional education, the process actually begins before entering a degree program. As a future teacher, Gustavo had been observing and interacting with his mentors, teaching and learning alongside his classmates since basic education. By instructing his classmates, Gustavo experiences teaching and, being encouraged by his teachers, invests in his formation.

Twelve years separated Gustavo's high school graduation from his enrollment in the mathematics degree program in 2009, from which he graduated thirteen years later in 2022. During this period, before starting the degree program, he moved to another city and enrolled in a degree course, as required by the company where he worked. Among the available options, he chose to pursue a Mathematics degree. However, balancing work during the day and studying at night was not his only challenge. Gustavo reorganized his plans, redirected his efforts, and postponed his goal due to integration difficulties and a sense of not belonging.

The following narrative, shared by Gustavo, allows us to observe the scene in which he decides to return to his hometown and pursue his career as a mathematics teacher.

Staring at that group of 45 students, I thought: 'What am I doing here?' Because that was not my reality. It was a group of young folks, who were arriving at university with their dreams. But I didn't belong with them, to that world. Then I, very upset, resigned from the company and said: "Ah, I won't dare face it, I can't cope with it" and went back to my hometown. I remember that when I returned, I said: "I will join university!" So I did the entrance exam, and got in! It was the last! (Gustavo, oral narrative, fourth seminar meeting).

The speech recalls what Josso (2010, p.90) calls hinge-moment. According to the author, a hinge moment can be called a "watershed", designing "facts that split, separate and articulate the steps in life". For Dominicé (2014, p. 208), the hinge moments are moments of regulation that "reorientates existence according to a largely mature decision, which may impose itself abruptly".

Recalling and sharing the scene with the seminar group demonstrates Gustavo's effort to articulate these two important moments in his life. The trust established among the participants was fundamental in making everyone comfortable bringing up intimate and unique memories.

4.4 The beginning of the academic journey

Gustavo's return to his hometown marked an important reorientation of his plans, to become a mathematics teacher. This brave decision led to his admission to the Degree in Mathematics in 2009. Due to the need to work during the day, Gustavo chose a night course, available since 2008.

When he entered the course, Gustavo faced a common issue, which is present today: a high rate of dropout in the early semesters. Once again, the challenges prevented him from continuing the course after his initial enrollment in 2009, leading to a new academic pause. Nine years later, in 2018, Gustavo returned to university and graduated in 2022.

During this time away, the encouragement from his teachers played a crucial role in motivating Gustavo to return to the course. In one scene, Gustavo recalls a conversation with

three of his professors, who frequently visited his workplace and encouraged him to return to university.

(...) How can a teacher care for a student, a student who is not even at university anymore, an ex-student, right? And I felt important. One of the teachers that had also been there said: “Make a way to return to university! We are waiting for you, we need you!” And that was... I saw it like a movie on graduation day. (Gustavo, oral narrative, third seminar meeting).

Gustavo’s connection between the teachers’ encouragement and his graduation, as described in the excerpt above, highlights the intensity of this interaction and its crucial role as a motivational source throughout his academic journey. Sarmento & Costa (2019, p. 65) point out that “the person/professional is transformed through the external context, through the interaction between what is hers (beliefs, knowledge, values, practices) and what is from the context (social conditions, established knowledge, global orientations, ...)”.

The scenes Gustavo recalled highlight various kinship bonds — transgenerational, generational, and professional (Josso, 2006) — and their significance in the formation process. The support from friends, family, classmates, and teachers was crucial to maintaining his resilience in this long journey of more than two decades.

During the seminars, Gustavo recalled various memories reflecting his dedication to his degree in Mathematics. He emphasized the support given to incoming students so they could face the hardships he also faced at the beginning of his degree in a smoother way. Gustavo participated in many projects and collaborated in the organization of important events, such as academic weeks and welcoming initiatives to the incoming students, aiming specifically to face evasion from the Mathematics degree.

It is worth noting that the academic dropout mentioned by Gustavo in his narrative is not solely related to the difficulties he faced in staying at the university. Silva et al. (2022) indicate that the first year at university can be a big obstacle that students face, especially in exact sciences courses. In this sense, Honorato & Borges (2023, p. 13) highlight the importance of engaging and building learning communities to face evasion from university. The authors elect the classroom as a privileged space for welcoming practices, particularly when reaching working students who study at night. They also alert, however, that “it is in the process of teaching and learning that the institutional policies should focus urgently, rethinking pedagogical-didactic formation for university teachers”.

Gustavo’s manifestations affirm that participating in extracurricular activities and teaching practices contributed significantly to his permanence and progress in the course. Gustavo learned and taught basic mathematics, which was essential to complement his specialized training in mathematics, through interactions with colleagues and students from public schools.

4.5 The experience with the Flipped Classroom

Gustavo shared many memories and scenes during the seminar meetings, highlighting his experience with flipped lessons. It is important to note that, during this term, Gustavo was taking the Calculus II course for the fourth time. In previous attempts, the course followed the traditional format of teacher-led lectures and written tests. The successive course failures, within a rigid curriculum structure based on prerequisites, left little room for further failure.

The following scene illustrates a break from what Gustavo had experienced in previous lessons of the same course.

When you joined the group and understood, Isabela followed one path to gain mathematical knowledge, Gustavo took another, and Joaquim pursued yet another. Then you can deal with different thoughts through only one method: "Ah, you need to study! This is the subject!" The new approach was much more dynamic, which was necessary to move away from the traditional format of board, chalk, and lists, and to foster genuine comprehension. Now, when I look at something to solve it, I may need to review it first, but I'll be able to understand it. (Gustavo, oral narrative, second meeting).

The statement suggests that the flipped classroom experience helped Gustavo, as a future teacher, consider the various paths students can take to understand a given subject. The repertoire of scenes indicates that the approach attended to the requisites pointed out by Mattar (2017, p. 33-34) to make the Flipped Classroom a proper space for inverted learning. The author comments that flipped learning consists of four pillars: *flexible environment; learning culture; intentional subject; and professional teacher*.

Consoante Mattar (2017), a reference in inverted learning, considers the flexibility of the learning environment a fundament. Students are constantly motivated to choose when, how, where, and with whom they will learn, in face-to-face meetings as well as in their previous studies. The author defends that this flexibility must be reflected also with respect to each student's learning rhythm and in the evaluation process.

Gustavo considers the particular settlements of flipped lessons in a scene shared in his formation memorial:

I remember some moments in the classroom, a small group chatting with one another and solving exercises, others reconsidering what the group was studying, but all that in a learning environment. I think that this atmosphere was significant at that moment because I have studied this course before and failed, so I can say that I haven't had that experience before, where students have an important role in learning and teaching in class. We had the liberty to go to the board and learn with a classmate, with the teacher's support. (Gustavo, written narrative).

Mattar defines the change in learning culture compared to the approach focused on the teacher and is traditionally used in educational practices, as the second fundament of inverted learning. For the author, the technique focused on the student creates new possibilities and makes the learning process better, stimulating a more adequate comprehension of the subjects. The third basis of flipped learning, according to the author, is connected with the proper comprehension of the concepts and the process of learning. Thus, he adds that it is fundamental to experience active learning strategies focused on the student.

In one of the scenes, Gustavo recalls when he became aware of the importance of an adequate comprehension of the ideas, giving meaning to his learning. In this fragment, he recalls a conversation between me and Isabela in the classroom.

(...) There's one thing, look, that I remember at the moment of your lesson when you arrived and said that that subject must make some sense. If I'm not mistaken, you even said it to Isabela. And then, from the moment it starts making some sense to you, you'll make it clearer. And that I absorbed. As I've done in Calculus II other times, and it didn't make much sense, I think that the comprehension and how we were doing before, I just couldn't understand, I couldn't find any meaning in some way other than the one I was already doing. (Gustavo, oral narrative, second meeting).

The ability to read and comprehend mathematical subjects, autonomously, was elected one of the main products of the experiences with the flipped lessons. The student's initiative, one of the requisites of flipped learning (Talbert, 2019; Bergmann & Sams, 2018) is present in

many of Gustavo's manifestations, as it is noticed in the scene that follows.

In fact, you didn't take away our responsibility, that we were there to learn, right? So you simply made us roll up our sleeves and do it, sit down, and study. In other words, you made us the main actors. We took on the primary roles of studying, acting, solving the exercises, right? And raising questions. And you were monitoring us. (Gustavo, oral narrative, third meeting).

Talbert (2019) highlights that the Flipped Classroom allows the reorganization of time and space, shifting the initiative to the students and transforming teachers into tutors. However, Gustavo reflects that this sense of ownership gave him more freedom to choose the paths he considered most effective, but it also required greater responsibility, as seen in the following narrative.

But at some point, I felt that, in reality, I was the main actor in this story, there wasn't another one. The teacher had a secondary part. But I was the main actor. So, if I was the protagonist, I should bear my responsibility, right? Of learning, reading, knowing, and searching. So, at some point, I felt the weight of responsibility. (Gustavo, oral narrative, second meeting).

Gustavo's speech allows the understanding that the student does not always feel responsible for his learning in the traditional educational process. While flipped learning can represent a challenge and a break from what students are accustomed to, Gustavo indicates that the experience was both unique and significant. During the years of remote learning, he emphasizes that flipped learning boosted his self-confidence and empowered him to learn autonomously.

Gustavo also expressed his intention to integrate flipped lessons into his daily repertoire in the classroom as a teacher, as illustrated in the following excerpt:

(...) Today, as a teacher, there is something like this method. I prepare some activities, and think of always bringing a flipped lesson, right? I'll start with some subjects they study at home and after I'll do this study in the classroom (Gustavo, oral narrative, second meeting).

The fourth and final pillar suggested by Mattar (2017) refers to the teacher's willingness to act, reflect upon their practices, accept constructive critiques, and create a collaborative and effective classroom environment with students. Mattar asserts that the teacher is a crucial element in the process, even though their role may often be less visible.

In his written memorial, Gustavo emphasizes that the teacher's role is fundamental in completing the flipped learning approach. He explains that the conversations about planning studies were key to his organizational skills and that the availability of teachers to guide and support students was essential to maintaining motivation and directing efforts toward flipped learning.

I believe that some considerations are essential because I am specifically addressing the teacher's role in this context. My previous education – my master's and doctorate in mathematics – did not seem sufficient to address some of the challenges I encountered in the classroom. From the path that started with my second master's degree, in Mathematical Education, I could learn and experiment with the Flipped Classroom approach. This allowed me to reframe my teaching practice, blending theory with practice in the classroom. The flipped lessons with the Calculus II group, in 2019, as well as with other Calculus groups, enabled me to rediscover myself as a teacher.

The new perspective I gained is the result of over a decade of reflections and insights accumulated through my university teaching experience. The intensity of the memories shared and reflected upon during the seminars provided a profoundly formative space and time.

4.6 The Flipped Classroom and “learning to learn”

When Gustavo recalled the period of flipped lessons, he reflected on it with the comprehension he has now. It is possible to identify manifestations in which learning strategies such as attention monitoring, maintaining focus, and managing available time emerge. Encouraging future mathematics teachers to reflect on the practice of learning strategies contributes to two equally important goals: promoting these processes in their future students and improving their own learning. In this area, both degree students and their future students benefit, as they gain greater awareness of the psychological processes through which they learn (Boruchovitch, 2014). Once at the center of the educational process, students move from being mere receptors of information to becoming the agents of their own learning, gaining a better understanding of how and in which circumstances they learn. More than learning a specific subject, it is about creating opportunities for the students to effectively learn how to learn (Frison & Burochovitch, 2020).

The necessary planning for advanced study, for example, involves the active engagement of the student with their learning. The classroom meeting, in this new setting, represents a space for sharing and interaction, fostering debate and enhancing the learning experience. Gustavo reports that he felt responsible for studying in advance, as assigned, as we can observe in the following account.

(...) for me, we need to be more disciplined in the flipped lessons. Why? Because, as Isabela mentioned, we need to prepare beforehand. Right? We go to class, to raise doubts and clarify them there. And, if I don't have doubts, what am I doing in the classroom? (Gustavo, oral narrative, second meeting).

The following discourse indicates an effort to focus on the subject to be learned in the flipped lesson in an academic context, which at the time was full of assignments from other projects and courses. The narration further suggests that this experience could be transferred to different contexts.

(...) I consider it to be a way of making us focus, there, in that moment. I have an hour to study and this hour will be productive. So the flipped lessons created this need for fitting and framing in that time. And later, it also helped me. (Gustavo, oral narrative, second meeting).

This narrative demonstrates the use of learning strategies to comprehend themes from the Calculus course. According to Góes and Boruchovitch (2020, p. 7), “learning strategies are procedures used to make the learning process easier”. The authors classify the learning strategies into cognitive and metacognitive categories. While cognitive strategies include rehearsal, preparation, and organization, the metacognitive strategies are subdivided into planning, monitoring, and regulation.

Since the flipped lessons required the elaboration of an individual report on the subject during the previous study, this was one of the strategies Gustavo chose during the research-formation meetings. He also implemented another strategy, the possibility of explaining the theme to the classmates. He had used this procedure since elementary school, but the flipped approach enabled him to practice it in face-to-face meetings.

Gustavo's report during the seminar also highlighted the use of two additional strategies in the flipped lessons: time management and asking for help. He explains that the demands that the Flipped Classroom encouraged him to develop a weekly planner, identifying times and places available for prior study, and better utilizing the time he had. The weekends were reserved for the Calculus II and Arithmetics courses because they had the heaviest workload during that term. Panadero & Alonso-Tápia (2014) list effective time management as a fundamental component of outcome expectations and self-efficacy beliefs, which in turn influences student's learning motivation.

Asking for help, equally considered an important learning strategy, emerged as a facilitating element in Gustavo's learning narrative. He shared many photos and videos from the flipped lessons period with the group when presenting his memorial. In one of the videos, Fernando F. solves an exercise involving integration by cylindrical cells. Gustavo stressed that this interaction happened at 3 a.m. and that the video was sent via a messaging application. He highlighted that the group was very generous and studied hard for the Calculus II course that term. The rooms where Gustavo held project meetings were also designated spaces for the groups' meetings. However, their homes were used as alternative spaces when the university facilities were unavailable, such as on some nights.

In another narrative, Gustavo recalls Isabela's help in the classroom:

(...) I felt more comfortable with everyone, and I'll tell you more, I didn't care about that one student who knew better. For example, Isabela, she would always sit by my side and help me. But I can't see it, Isabela! So come here to the board, let's do it this way... Then, in a way, I would listen to her, because she knew it, and I was comfortable. However, in other courses, I wouldn't be like that. (Gustavo, oral narrative, second meeting).

Gustavo emphasized that the previous study provided the "leveling" of the group, so the exchanges were enhanced during the face-to-face meetings.

The feeling was different from the feeling in every other course in the degree. Why? I don't know if we were all leveled with the same subject, in the same way, so we felt comfortable talking to each other and explaining things to one another, and this prevented us from diminishing ourselves. (Gustavo, oral narrative, second meeting).

For Mazur (2015), the interaction between equals is essential. Consulting the teacher is a resource only in cases where the group cannot agree during a discussion. According to Mazur, this setting occurs because the students who "just learned this idea are still aware of the difficulties they faced in understanding the concept. Consequently, they know exactly what to emphasize in their explanations" (Mazur, 2015, p. 13).

Gustavo's narrative indicates that he had already used the strategy of explaining the topic to his classmates to enhance his learning before the flipped lessons. Despite not fully developing this strategy during the term in question, we can observe that the lessons' environment contributed to its application, as shown in the following excerpt:

My strategy was to have someone, a "guinea pig" classmate. Why? Because the moment I am teaching, I am learning twice. So, with this method of studying beforehand, when I was in the classroom, I would need a "guinea pig" classmate, a "guinea pig" student. Besides that, I would work on my self-confidence, so I learn what comes next. I've used this tactic since I came back to university. I just needed to use it. Because when I am using it and have this practice—not only training but comprehending and making sense—I am also helping someone else, and it gives more meaning to everything. (Gustavo, oral narrative, second meeting).

meeting).

According to Góes & Boruchovitch (2020, p. 19), summarizing and teaching the subject to others are elaborative cognitive strategies because they involve “adding or changing the learning material in some way, attempting to make it more significant and likely to be remembered.” The collective recollections and reflections provided by the seminars also allowed us to demonstrate three fundamental types of knowledge stressed by the authors: identifying different strategies (declarative knowledge), using them properly (processual knowledge), and choosing the most appropriate strategies for each context (conditional knowledge).

5 First considerations

Gustavo’s narrative allows us to identify strategies, action paths, awareness processes, and significant resilience in the teaching search. The research sheds light on a particular experience with the Flipped Classroom approach, key to this research work, and carried out three years before the seminar. The scenes that were represented indicate that the flipped lessons supported the development and usage of learning strategies.

This research proposal is a space that prompts the future teacher to reflect upon how he learns. The possibility of gradually and systematically adding this element to the calculus courses represents an important dimension for students applying this experience in their professional realities after graduation.

The reflections indicate that the seminar was a privileged formative space, which revealed the singularity of the formative path of each individual. The power of *sharing*, of the *given word*, and *attentive listening*, reveals the important contribution of the research-formation to the instruction of future mathematics teachers.

Producing meaning and knowledge for both the narrators and the researcher is the essence of the research-formation. Beyond that, this research work highlights the life story of a representative of a significant group of working degree students who study at night and seize the opportunity to practice as teachers.

Incidentally, Gustavo had already completed his Mathematics degree when the Seminar meetings took place and, at the time of writing this work, he is enrolled in the Master’s degree program in Mathematical Education at the same institution from which he graduated. A complete investigation and analysis of the other participants will be available upon completion of this ongoing research.

References

- Abrahão, M. H. M. B. (2011). Memoriais de formação: a (re)significação das imagens-lembranças/recordações-referências para a pedagoga em formação. *Educação*, 34(02), 165-172.
- Abrahão, M. H. M. B. (2023). Biografização/heterobiografização: elaboração memorialística de uma personagem auto(hetero)biográfica em formação docente. *Linhas Críticas*, 29, e47664.
- Antunes, G. O., Paula, M. C. de, Moustapha-Corrêa, B. & Matos, D. (2021). Os encontros temáticos da licenciatura em Matemática da Unirio como espaço de (auto)formação de formadores de professores. *Revista Internacional de Pesquisa em Educação Matemática*, 11(3), 57-75.

- Bergmann, J. (2018). *Sala de Aula Invertida: Uma metodologia Ativa de Aprendizagem*. LTC.
- Bolívar, A. (2012). Dimensiones epistemológicas y metodológicas de la investigación (auto)biográfica. In M. H. M. B. Abrahão & M. da C. Passeggi (Orgs.), *Dimensões epistemológicas e metodológicas da pesquisa (auto)biográfica* (Tomo 1, pp. 27-69). EDUFRN; EDUNEB; EDIPUCRS.
- Boruchovitch, E. (2014). Autorregulação da aprendizagem: contribuições da psicologia educacional para a formação de professores. *Psicologia Escolar e Educacional*, 18(3), 401–409.
- Bragança, I. F. S. (2014). Pesquisa-formação (auto)biográfica: reflexões sobre a narrativa oral como fonte e a compreensão cênica como caminho de análise. In M. H. M. B. Abrahão, I. F. S. Bragança & M. S. Maurice (Orgs.), *Pesquisa (Auto)biográfica: fontes e questões* (pp. 79-95). CRV.
- Diniz-Pereira, J. E. (2019). A construção do campo da pesquisa sobre formação de professores. *Revista da FAEEBA - Educação e Contemporaneidade*, 22(40), 145–154.
- Dominicé, P. (2014). O que a vida lhes ensinou. In A. Nóvoa & M. Finger (Orgs.), *O método (auto)biográfico e a formação* (pp. 177-210). EDUFRN.
- Frison, L. M. B. & Abrahão, M. H. M. B. (2019). Compreensão cênica: possibilidade interpretativa de narrativas de (auto)formação de ex-pibidianas. *Educação e Pesquisa*, 45, e190102.
- Frison, L. M. B. & Boruchovitch, E. (2020). *Autorregulação da Aprendizagem: Cenários, desafios, perspectivas para o contexto educativo*. Vozes.
- Góes, N. & Boruchovitch, E. (2020). *Estratégias de Aprendizagem: Como promovê-las?* Vozes.
- Honorato, G. de S. & Borges, E. H. N. (2023). Permanência na educação superior brasileira: contribuições de Vincent Tinto. *Linhas Críticas*, 29, e46400.
- Josso, M. C. (2006a). As figuras de ligação nos relatos de formação: ligações formadoras, deformadoras e transformadoras. *Educação e Pesquisa*, 32(2), 373–383.
- Josso, M. C. (2010). *Experiências de vida e formação*. PAULUS/EDUFRN.
- Marinas, J. M. (2007). *La escucha en la historia oral. Palabra dada*. Síntesis.
- Mattar, J. (2017). *Metodologias ativas para educação presencial, blended e a distância*. Artesanato Educacional.
- Mazur, E. (2015). *Peer Instruction: A Revolução da Aprendizagem Ativa*. Penso.
- Nacarato, A. M., Moreira, K. G. & Custódio, I. A. (2019). Educação matemática e estudos (auto)biográficos: um campo de investigação em construção. *Revista Brasileira de Pesquisa (Auto)biográfica*, 4(10), 21–47.
- Nacarato, A. M., Passos, C. B. & Lopes, C. E. (2019). Percursos narrativos em educação matemática. *Revista Brasileira de Pesquisa (Auto)biográfica*, 4(10), 14–20.
- Nachtigall, C. & Frison, L. M. A. (2020). A Aprendizagem Autorregulada potencializada em um ambiente de Sala de Aula Invertida: uma experiência em uma turma de Cálculo Integral. *Currículo & Docência*, 2(3), 65–83.
- Nóvoa, A. (2010). Prefácio. In M. C. Josso, *Experiências de Vida e Formação* (pp. 19-25).

PAULUS/EDUFRN.

- Panadero, E. & Alonso-Tapia, J. (2014). ¿Cómo autorregulan nuestros alumnos? Modelo de Zimmerman sobre estrategias de aprendizaje. *Anales de Psicología / Annals of Psychology*, 30(2), 450–462.
- Passeggi, M. C. (2016). Narrativas da experiência na pesquisa-formação: do sujeito epistêmico ao sujeito biográfico. *Roteiro*, 41(1), 67–86.
- Passeggi, M. C. & Souza, E. C. (2017). O Movimento (Auto)Biográfico no Brasil: esboço de suas configurações no campo educacional. *Investigación Cualitativa*, 2(1), 6-26.
- Santamarina, C. & Marinas, J. M. (1994). Historias de vida y historia oral. In J. M. Delgado & J. M. Gutiérrez (Orgs.), *Métodos y técnicas cualitativas de investigación en ciencias sociales* (pp. 259-285). Síntesis.
- Sarmiento, T. (2013). Aprender a profissão em diferentes espaços de vida. *Revista de Educação PUC-Campinas*, 18(3), 237–348.
- Sarmiento, T. J. & Leal da Costa, C. (2019). O que fazemos com o que fazemos conosco... trilhar caminhos em interação. *Revista @mbienteeducação*, 12(2), 237–348.
- Silva, D. B. da, Ferre, A. A. de O., Guimarães, P. dos S., Lima, R. de & Espindola, I. B. (2022). Evasão no ensino superior público do Brasil: estudo de caso da Universidade de São Paulo. *Avaliação: Revista da Avaliação da Educação Superior (Campinas)*, 27(2), 248–259.
- Silva, S. R. P. (2023). Ensino remoto no curso de Licenciatura em Matemática da Universidade Federal do Acre: perspectivas, dificuldades e possibilidades futuras. *Revista Internacional de Pesquisa em Educação Matemática*, 13(3), 1-12.
- Talbert, R. (2019). *Guia para utilização da aprendizagem invertida no ensino superior*. Penso.
- Vieira, A. R. L. & Silva, F. O. da. (2023). Ka ríba tí ye: entre vivências e aprendizagens experienciais na docência em Matemática. *Revista Internacional de Pesquisa em Educação Matemática*, 13(4), 1-17.