Understanding creative insubordination as incommensurable conflict: implications of incidents in Financial Mathematics

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ABSTRACT

Creative insubordination is a recently introduced framework in Brazil that aims to promote alternatives to traditional teaching practices in the field of Mathematics Education and encourage reflections on social justice. This article outlines a theoretical understanding of the concept of creative insubordination based on the constructs of discursive theory and considers the potential implications for teaching and learning in Financial Mathematics. Example situations are used from teaching and research related to this discipline in Higher Education, but with the understanding that it can also be applied to other disciplines and levels of education. This study analyzes concepts such as **discourse, discursive expansion, discursive conflict, and incommensurability between discourses**, intertwining them with the concept of creative insubordination. The same examples are used as inspiration for possible discursive changes in the classroom. The article presents a definition of creative insubordination as the possibility for **discursive expansion** through **conflicts** that can remain **incommensurable** in different contexts, **coexisting** because of **intentional discursive change** with potential consequences in educational settings. Among the possibilities for expansion is the approximation of these environments with daily life and work environments, in addition to encouraging the practice of critical mathematics education.

KEY-WORDS: Creative Insubordination. Financial Mathematics. Discursive Conflict. Incommensurability. Coexistence. Educational Implications.

INTRODUCTION

This paper builds on a study published in the proceedings of the VIII SIPEM conference and seeks to provide a theoretical understanding of the concept of creative insubordination (D'AMBROSIO; LOPES, 2015) based on the constructs of Sfard's (2008) discursive theory and considering situations experienced during the teaching of Financial Mathematics. From these understandings, the paper assesses the possible implications for the teaching and learning in Financial Mathematics courses.

Similar to D'Ambrosio and Lopes (2015), this study considers that pedagogical and scientific knowledge is socially constructed and that educational institutions have not kept up with the social and technological changes that are occurring worldwide. Thus, the aim is to contribute to promoting creative insubordinate actions in teaching and research, as they offer alternative paths to address the mismatch resulting from interactions that generate debate on social issues.

By proposing possible insubordinate designs when teachers and students participate in the study of Financial Mathematics, Queiroz (2019b) argued that establishing theoretical bases for the phenomenon of creative insubordination could be helpful. Thus, this study presents some theoretical contributions to this concept, expanding on the work presented in the VIII SIPEM (2021), with an analysis of the implications of these concepts for insubordinate designs and the creative and reactive insubordinations discussed in Queiroz (2019a, 2019b).

In the classroom, the concept of **creative insubordination** (D'AMBROSIO; LOPES, 2015) is understood as a set of actions by the teacher that creatively and responsibly subvert traditional forms of teaching in a learning environment (SKOVSMOSE, 2000). It promotes the possible critical attributions of meaning by students through everyday situations and work environments.

Situations studied in Financial Mathematics are fertile ground for insubordinate educational experiences, which may emerge from the actions of teachers or students. According to several authors (KUHNEM; BAUER, 1996; BUDI, 2008; DRAKE; FABOZZI, 2009), Financial Mathematics is defined as any **practice** involving the study, calculation, or procedures with **dated values**, meaning that money and time are variables used in calculating values. Thus, objects studied in this course, such as operations involving interest, discounts, capital equivalences, annuities, and amortizations, among others, consider monetary value as a function of time.

The present study uses Wenger's (1998) concept of **practice** as an activity shared by people in social groups, acting and interacting according to that group's customs. It follows from this understanding that the practices involving Financial Mathematics in different contexts, such as banks, commerce, and educational environments, demonstrate qualitatively different ways in which the subjects involved can participate.

Variations between capital and time are made through rates used by the financial market to remunerate the creditor. For example, highlighting the rates involved in an operation and critically analyzing the differences between the rates practiced when financial institutions are creditors or when they remunerate their customers' deposits and applications (banking spreads) can be an insubordinate action. Rates provide essential parameters for decision making in financial

operations and are potentially crucial elements in forming a critical awareness of the objects under analysis.

Although decision making is frequent in Financial Mathematics work environments, exercises involving such situations are poorly explored in textbooks (ROSETTI JÚNIOR; SCHIMIGUEL, 2011; BARROSO; KISTEMANN JR., 2013; QUEIROZ; BARBOSA, 2015; QUEIROZ; BARBOSA, 2016). When they do occur, the decisions about what are considered **correct** alternative financial operations are **singular** and guided by Pure Financial Mathematics, disregarding different contexts. Textbooks compare rates or values on the same focal date, for example, using the concepts of Net Present Value (NPV) and Internal Rate of Return (IRR) for decision making (QUEIROZ; BARBOSA, 2015; QUEIROZ; BARBOSA, 2016). These standards are recognized as legitimate by academic practices; however, they disregard decision making contexts, such as budget restrictions of less privileged social classes. It is precisely through a responsible subversion of this principle that Financial Mathematics situations can potentially be used to inspire an understanding of the participation of subjects (teachers and students) in creative insubordinate educational practices.

What follows is a discussion of creative insubordination (D'AMBROSIO; LOPES, 2015), interwoven with concepts such as **discursive conflict** and **discursive expansion** (SFARD, 2008). These concepts are then used to analyze situations in Financial Mathematics that may inspire ideas about subjects' participation in discursive, creatively insubordinate practices and possible implications for the classroom. Although this study focuses on situations in Higher Education, it is understood that these ideas can be applied to similar contexts in Basic Education.

UNDERSTANDING CREATIVE INSUBORDINATION AS DISCURSIVE CONFLICT

Sfard (2008) explores human communication actions on objects and considers them responsible for enabling collective implementations of complex activities through coordinated interpersonal actions. Wenger (1998) would call it mutual engagement in practice. According to this author, these communication actions are responsible for the ongoing transformation of the ways in which humans do things, allowing for constant accumulations and becoming increasingly more complex in their actions. Wenger (1998) conceptualizes the word **discourse** as the different forms of communication that unite some individuals while excluding others. This understanding creates a distinction between practices, differentiating the subjects who feel a sense of belonging to a specific practice from those who do not. Thus, one can understand the mismatch between actions in educational environments and the social and technological changes discussed in the previous section as different discursive practices on the same objects.

Critical readings on **reified** curricula in traditional teaching practices through reflective processes that consider, for example, students' difficulties and perceptions of different contexts in the classroom, are precursors of creative insubordination (D'AMBROSIO; LOPES, 2015). As in Wenger (1998) and Sfard (2008), the concept of reification here is regarded as the result of socially and historically established experiences that are solidified in the form of objects, such as processes (coding, naming, reformulating) and products (laws, formulas), among others. Thus, **responsible subversions**, as expressed by D'Ambrósio and

Lopes (2015), are synonymous with creative insubordination and can be understood as stimuli for **intentional discursive change** (SFARD, 2008) that subverts reified practices in the classroom. This author suggests that discursive change can be somewhat difficult to achieve, depending on the power relations between the participants in the discourse, among other factors. Furthermore, it is because of these power relations, or ways of acting on them, that this theoretical discussion can offer educational alternatives inspired by the creative insubordination framework.

The idea here is to understand responsible subversion as a form of **discursive expansion**. Herein, this concept is used differently from how it is presented and interpreted in examples cited by Sfard (2008). Sfard defines them as an increase in the quantity and complexity of discursive routines or a proliferation of new discourses. For the author, an increase in the quantity and complexity of discursive routines is simply due to the evolution of discourse through their constant use (endogenous changes), like the historical growth of the extension and complexity of arithmetic procedures. On the other hand, proliferation is understood as resulting from the emergence of new discourses (exogenous changes), such as algebra, which Sfard considers discourse as an evolution of meta-discursive arithmetic activities. An illustration of algebra as exogenous discursive change is the expression $p + q = q + p$, where it is observed that, arithmetically, the sum of two numbers is discursively equivalent to the sum of these same two numbers in reverse order.

In contrast, the concept of **discursive expansion** is used in this article to understand creative insubordination as the proliferation of new discourses that can address socio-critical debates. It is considered exogenous, as it contemplates actions that are in principle external to traditionally established discursive practice. Used as such, this concept can support Mathematics Education practices that mobilize social, economic, political, and ethical issues, capturing the different types of Mathematics that emerge in distinct contexts. D'Ambrosio and Lopes (2015) show this emergence and unpredictability in environments where creative insubordination is encouraged, as they recognize that it arises from interaction and dialogue with participants in certain practices, such as listening to a student in the classroom or debating among colleagues, and are based on the subject's own reflective actions. These authors also point out that insubordinate actions require that mathematics educators take on new perspectives as conflicts emerge from this complexity in the classroom.

The conflict arising from the participation of subjects in practices that consider different Mathematics as they emerge from distinct contexts can be understood as **discursive conflicts** (SFARD, 2008). Discursive conflict is defined by Sfard (2008) as a situation in which different discourse participants act according to different sets of rules. As highlighted above, the mathematics that emerge through discursive actions that consider different contexts can be seen as discourses that are distinguished by different rules. Contradictions inferred as conflicts can emerge from these rules.

The following section addresses situations identified as possibilities for the proliferation of new discourses based on discursive conflicts and examines these concepts in processes of creative insubordination.

DISCURSIVE CONFLICT IN FINANCIAL MATHEMATICS SITUATIONS

The author experienced an incident when teaching Financial Mathematics in a Mathematics Education Undergraduate Program particularly for practicing teachers in Bahia, Brazil, shortly before beginning their studies in Mathematics Education. This was the first time the author taught the course in an undergraduate teaching program since her area of expertise is in Administration. It was an unexpected situation in the classroom when **Sonia** (pseudonym used to protect the student's identity) raised her hand and made a statement regarding an exercise in decision making related to financing: "Professor, it is no use for anyone to tell me that it is better to pay in cash because I will always choose the alternative to pay it in more installments". The exercise created a situation of semi-reality, defined by Skovsmose (2000) as an invented situation inspired by what he refers to as real life. In this exercise, the cash payment alternative was more advantageous from a Pure Financial Mathematics point of view. At that moment, Sonia's argument sounded like careless insubordination, resulting from a possible lack of knowledge about the principles of the discipline being taught. Situations like this are uncommon in Business Administration classes, which may be related to the profile of the students in the program who are generally younger, less experienced, and more curious to understand the rules of the financial market than the teachers already working in the profession, some for several years. Carefully, the author responded by saying that she understood that consumer choices are motivated by specific contexts but that the role of Financial Mathematics was to provide insights into **correct alternatives** based on the point of view of the discipline.

Only after developing a more in-depth understanding of Mathematics Education did the author realize that this response was a defensive strategy related to tradition and authority in the classroom (D'AMBROSIO; LOPES, 2015). This position was inspired by the author's career which, until then, was predominantly oriented by discursive practices related to Pure Mathematics. Thus, historically constituted knowledge about Financial Mathematics was used to ratify her authority in the classroom. These actions are aligned with discursive practices that, despite considering and respecting students' participation, positioned the professor as an authority for disseminating scientific and academic knowledge. Based on the stance of the professor, Mathematics was understood as unquestionable, a vehicle of unique and absolute truths. This situation highlights some of the rules of school mathematical discourse (SFARD, 2008) that regulate its practice.

According to Sfard (2008), rules arising from within, or outside, discursive practice regulate discourses and differentiate them. For example, some rules relate to school/academic practices in a Mathematics classroom. At the same time, rules come from the discourse of the scientific field of Mathematics, which guides school/academic mathematical discourse. This set of rules shapes the discourse. Although teachers and students interactively constitute the reality of the classroom, discursive principles do not originate there (SFARD, 2008). According to Sfard, variations are inevitable when new teachers and new students enter a classroom, but their choices are only partially autonomous. They follow the rules of historically established school mathematical discourses.

The privileged discourse at the time of this situation did not create space for contributions from outside the classroom, which were not given any weight in the mathematicians' discourse. The fact that the author was acting following these rules gave her confidence in the answer given at that time. In the words of Sfard (2008), violations in the rules of a discourse evoke attempts by its interlocutors to **correct** the behaviors considered inappropriate.

However, knowing that the financial constraints of a substantial portion of the population could drive many of these people to make decisions different from those they learned in educational contexts, the author also felt challenged to reflect critically on her actions. Shortly after, when beginning to study the field of Mathematics Education and, more specifically, Critical Mathematics Education, she began to understand that incident in a new light, guided by new discursive practices with which she was engaging.

According to Sfard (2008), participants in a discourse follow its rules almost automatically, even in cases where they do not have an explicit justification to do so. These rules allow participants to recognize what is, and is not, appropriate in each situation. Thus, it is common for two different experts in a discursive practice to have almost indistinct forms of participation with similar results. The ideas of creative insubordination challenge these assumptions by questioning the rules and enabling other possibilities. For example, exercises in Financial Mathematics textbooks usually present a single correct answer (ROSETTI JÚNIOR; SCHIMIGUEL, 2011; BARROSO; KISTEMANN JR., 2013; QUEIROZ; BARBOSA, 2015; QUEIROZ; BARBOSA, 2016). When we start to reflect on alternatives that consider the contexts of those involved in the financial transaction, as in the case described above, we realize that other possibilities must be analyzed.

For a participant in a discourse to be able to analyze other possibilities that arise in practice, she must be an insider (SFARD, 2008) in this discourse to understand what is in **disagreement** with what can be said. An insider is understood as an active member of a given discursive practice. In the words of Wenger (1998), an insider is a central participant in a practice. For example, the professor of a course, generally considered an expert, would be an insider. On the other hand, following Sfard (2008), it is also necessary to be flexible to understand the perspective of the outsider (a person who does not belong to a specific group) and the possible alternative interpretations of those who do not act as expected, according to the rules established in a particular discourse. Understanding the professor of a course as an insider is almost common sense.

Given the countless possibilities that can unfold when a professor interacts with his/her students, understanding the possible perspectives of an outsider can be challenging. In the situation with Sonia, at that moment of her statement she could be considered an outsider to the academic Financial Mathematics discourse, and the flexibility to understand her insubordination was lacking. As a natural authority in the classroom, the author understood, at that moment, the situation as something inappropriate for the discourse and used her authority to resist the attempt to break the rules of the discourse she aimed to teach.

After studying the discourse of Critical Mathematics Education, the author understood that alternative interpretations are possible, especially when considering specific contexts. That is, the author began to enter a discourse that challenged the infallibility of Mathematics, accepting other possible rules to

legitimize the discourse of school Mathematics. Situations involving a range of possibilities and solutions to a mathematical problem became part of her practice as a professor. According to Sfard (2008), a discursive change is necessary to understand new possibilities that enable new ways of seeing. Thus, understanding the incident with Sonia was only possible when the author began engaging with the Mathematics Education discourse, allowing her to reflect on the same episode with a new theoretical lens.

Faced with this new understanding, the author began to modify activities in the classroom, proposing mathematical modeling situations and taking advantage of exercises involving decision-making processes that consider multiple solutions and contexts. In Financial Mathematics, this is fertile ground in both business financial decision making, which is the focus of courses taught in Business, as well as the analysis of personal finance. Although unaware of this agenda at the time, the author also began to promote socio-critical debates, as a means of encouraging Financial Education in the context of this course, which can be understood as responsible subversion. According to D'Ambrosio and Lopes (2015), reflective processes arising from confrontations with students' dilemmas and difficulties, for example, can be precursors of creative insubordination insofar as they create an inconvenience for mathematics teachers.

However, resistance from some students began to emerge from this change in practice, creating new discursive conflicts in the opposite direction. Students more associated with social practices that ratify academic mathematical discourse demonstrated resistance to this **new discourse** which considered contexts in solving decision-making problems related to everyday situations and work environments. For example, two students (one who previously graduated in Engineering in the Business Administration program, and one Mathematics undergraduate, a course oriented by Pure Mathematics, during a lecture on creative insubordination) questioned examples of solutions to exercises that considered the decision-making context.

Given the possible trajectories, this resistance is understood as natural and generally associated with more traditional contexts of Mathematics teaching. The author began to deal with this resistance but continued the practice as a professor with this new vision, especially in Financial Education. Although unaware of the term **creative insubordination**, as the framework was introduced in Brazilian Mathematics Education discourse shortly afterward, the author was already weaving it into the classroom. Despite being a conscious choice, it was not yet a topic of research for the author until 2018.

In this study, Sonia's situation is used to illustrate creative insubordination as discursive conflict (SFARD, 2008). From this new perspective, we can understand that it is consistent with practice in managing personal finances. Experts in Pure Financial Mathematics would say that Sonia mismanages her money; however, Sonia's decision to "always pay in as many installments as possible" was guided by satisfying her needs in the face of scarce financial resources. A more critical and humane look at the financial constraints that less privileged segments of society experience makes it clear that it is not always possible to make decisions that are consistent with academic Financial Mathematics. On the other hand, creating possibilities for people to reflect consciously on their consumption can be considered in the practice of this course insofar as it can promote Financial Education.

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Different mathematical practices in their particular contexts guided different perceptions of this situation. Following Sfard (2008), it is understood that the discursive conflict emerged from conflicting narratives, originating from discourses embodied by different rules. This author considers these discourses **incommensurable**; they do not share the same criteria when endorsing certain narratives. Therefore, the decision about what is legitimate in a discourse depends on the characteristics that differentiate it. Moreover, although they may sound contradictory, as in this incident, they are not mutually exclusive (SFARD, 2008). Contexts of financial constraint are rarely considered in Pure Financial Mathematics discourses, hence the incommensurability between discourses and, consequently, the discursive conflict that became evident.

The following section discusses the paths proposed by Sfard (2008) to resolve these conflicts and presents an alternative creative insubordination to her vision. The example of this situation with Sonia shows that insubordinate actions are opportunities for socio-critical analysis by understanding discursive conflicts from the point of view of their incommensurability. In this sense, it is important to consider the possibilities for resolving these conflicts.

DO DISCURSIVE CONFLICTS NEED TO BE RESOLVED?

Following Sfard's (2008) argument on discursive conflicts and her ideas on the flexibility to understand the role of the outsider in the discourse and the incommensurability between discourses embodied in different practices because they are non-excluding, a different outcome was expected in her theory about conflicts. Sfard (2008) suggests that these are not resolved by confirming one of the statements and refuting the other, but by **choosing** one of the conflicting discourses and **abandoning** the other. According to a chart presented by the author, the way to resolve a discursive conflict (called a cognitive conflict in her framework) is given "by student's acceptance and rationalization (individualization) of the discursive ways of an expert interlocutor" (SFARD, 2008, p. 258). Precisely because a different outcome is expected in terms of possible solutions to discursive conflicts, a challenge to Sfard's conclusions is presented herein, with potential consequences for understanding creative insubordination as a framework in Mathematics Education.

A possible outcome regarding solutions to conflicts did not materialize in the author's theory; however, it did inspire a new perspective of possible solutions. If we suppose that two distinct narratives are said to be incommensurable because they are part of different discourses, we have two other possibilities do not necessarily require a single and definitive solution to the conflict by accepting one over the other. One of them will continue coexisting with both, emphasizing a possible suitability of one or the other in a given context. Another possibility is maintaining a continuous debate about these different possibilities, which may or may not reach a final consensus.
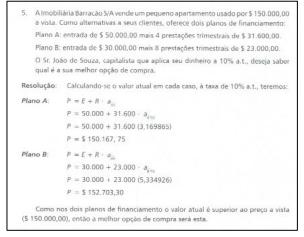
Returning to **Sonia's** incident as an inspiration, there are cases in which it is not always possible to make the **best financial decision** given the possible solutions. For example, a definitive defect in a refrigerator, an essential item in most households today, even those considered the most vulnerable, can represent an urgent need for consumption. In cases like this, the role of Financial

Mathematics, and particularly Financial Education, is to guide possible solutions, even if it is not the "most correct" one, from the point of view of academic Financial Mathematics. On the other hand, another role of this discipline can be to stimulate debates about conscious consumerism. A decision guided by the principles of academic Financial Mathematics may be preferred, for example, when consumption is expendable, postponable, or even superfluous. Thus, maintaining the incompatibility between discourses and analyzing parallel alternatives, which may eventually consolidate into a single decision linked to a specific context, can create an environment in which learning considers social justice.

There are also cases where the **best decision** from the point of view of academic Financial Mathematics is very easily questionable in the face of similar alternatives. In these cases, a more critical look at the "so-called best solution" can show its fragility, which is easily questioned, even considering the internal logic of the discipline. For example, in the exercise solved on page 204 of the book by Mathias and Gomes (2011), presented in Figure 1, a situation of semi-reality is given (SKOVSMOSE, 2000), which involves a decision-making process and presents a single answer as correct. This is an example where discursive conflicts can emerge, as analyzed below.

Figure 1: Exercise involving decision-making processes

5. A Imobiliária Barracão S/A vende um pequeno apartamento usado por $ 150.000,00 à vista. Como alternativas a seus clientes, oferece dois planos de financiamento:

Plano A: entrada de $ 50.000,00 mais 4 prestações trimestrais de $ 31.600,00.

Plano B: entrada de $ 30.000,00 mais 8 prestações trimestrais de $ 23.000,00.

O Sr. João de Souza, capitalista que aplica seu dinheiro a 10% a.t., deseja saber qual é a sua melhor opção de compra.

Resolução: Calculando-se o valor atual em cada caso, à taxa de 10% a.t., teremos:

Plano A: $P = E + R \cdot a_{\overline{n}|i}$
$P = 50.000 + 31.600 \cdot a_{\overline{4}|10}$
$P = 50.000 + 31.600 (3,169865)$
$P = \$ 150.167,75$

Plano B: $P = E + R \cdot a_{\overline{n}|i}$
$P = 30.000 + 23.000 \cdot a_{\overline{8}|10}$
$P = 30.000 + 23.000 (5,334926)$
$P = \$ 152.703,30$

Como nos dois planos de financiamento o valor atual é superior ao preço à vista ($ 150.000,00), então a melhor opção de compra será esta.

Source: Mathias and Gomes (2011, p.204)

The difference between the cash payment option and plan A (R$167.75) represents, in terms of capital value, only 0.1% when compared to the total amount of R$150,000.00 on date zero. In business and personal financial decisions, lower payments that do not require sudden withdrawals of capital can guarantee the **financial health** of business/personal finance. Thus, plan A could represent a better decision alternative in some contexts. Particularly in the case of business, it is standard practice in cases of cash flow management to maintain working capital consistent with the size of the company, to be able to honor commitments in unexpected situations. This is a scenario that occurred during the recent COVID-19 pandemic; it was widely reported that companies that did not have financial support to pay their employees, for example, shut down operations and remained without income until government agencies established financial aid programs; nevertheless, many companies ended up closing their doors permanently.

Expanding discourses and considering new possibilities can serve social justice issues and bring academic contexts closer to everyday practice and work

environments, as mentioned above. The idea is to challenge the existence of a single solution, understanding that decision-making contexts, both in everyday life and work environments, are too complex to be answered through simplistic solutions. The **best financial decision** may depend on a more complex analysis than a single answer can provide. We agree with Sfard (2008) when she says that classroom norms may seem to guide mathematical learning more quickly but may not be compatible with the norms of the external world. The exercise discussed in Figure 1 provides such an example. Adopting everyday practices and work environments in the classroom can offer much more complex situations for professors and students to analyze, which may point to a reason why some are resistant to such a practice.

Another example of these complex situations in the teaching of Financial Mathematics, involving everyday practices and work environments in an investigative scenario (SKOVSMOSE, 2000), is working with spreadsheets from financial institutions. In general, these spreadsheets are challenging to understand, even among students and professors of Financial Mathematics. Queiroz (2019b) discusses how their use in the classroom can enhance socio-critical debates, promoting a learning environment where contextual considerations emerge from scenarios of contracting loans or financing. In these cases, discursive expansion can be intentionally fostered to assess the power of these institutions and promote debates about social justice. Consequently, discursive conflicts emerge, not always with a single solution, but with a wide range of possibilities that can be considered in different contexts.

Finally, the question that leads this section can be answered by suggesting that discursive conflicts do not need an immediate solution. They can represent alternatives for contextualized future decisions, and a range of open, non-excluding possibilities, especially in educational contexts, that run parallel to debates that recognize the diversity of actions in different social contexts.

IMPLICATIONS IN THE FINANCIAL MATHEMATICS CLASSROOM

The classroom is complex in that it involves actors (teachers and students) who bring with them trajectories related to their participation in social practices (WENGER, 1998), which are distinct in different contexts and always expanding. Thus, the classroom can be understood as a potential source of discursive conflict. Some of the incidents described herein may reinforce this idea. If, on one hand, a professor can encounter resistance to academic mathematical discourse (as in the case of Sonia), on the other, he or she may also encounter resistance when trying to move beyond traditional discourse (as in the case of the student with an Engineering degree).

Traditionally, the primacy of school mathematics discourse over other competing discourses in the classroom is expected, as seen from the very idea of conflict resolution in Sfard (2008). However, this same author recognizes that classroom norms may not be completely compatible with the norms of the external world, leading to the conclusion that contemplating different solutions in varied contexts can be the role of the professor with the aim of giving meaning to the mathematics discussed in the classroom.

However, textbooks (particularly those in Financial Mathematics) usually present a single correct answer (ROSETTI JÚNIOR; SCHIMIGUEL, 2011; BARROSO; KISTEMANN JR., 2013; QUEIROZ; BARBOSA, 2015; QUEIROZ; BARBOSA, 2016), even in exercises involving decision-making processes. Thus, considering that textbooks inspire teachers to prepare their classes (QUEIROZ; BARBOSA, 2016), how can we develop educational practices that subvert these standards?

According to Baroni (2021), in the specific case of Financial Mathematics, the limitations in early training to deal with the subject and the lack of knowledge about the financial world in everyday life may be factors that restrict the possibilities for teachers to move beyond the limits of curriculum materials.

However, teachers can transform the use of textbooks (QUEIROZ; BARBOSA, 2016) by promoting alternative paths in the classroom, for example, by analyzing other possible answers to an exercise in the book that gives a single correct answer (QUEIROZ; BARBOSA, 2015). This is characterized by Queiroz (2019a) as **reactive** insubordination. In his thesis, Baroni (2021, p. 242) also argues that professors can "subvert the approach of Financial Mathematics textbooks" in how they are used.

Thus, taking as an illustration the textbook exercise shown in Figure 1, the professor can transform the exercise, promoting debates in the classroom that challenge the single solution. This can be done with various textbook exercises, especially those that present situations that require decision making and that generally provide a single solution (QUEIROZ; BARBOSA, 2015). By explaining everyday situations and work environments, as discussed in the previous section, the professor promotes discursive expansion that includes other possibilities for solutions that may be more appropriate in different contexts.

In addition to reactive insubordination, the possibility of real creative insubordination are also discussed (QUEIROZ, 2019a), characterized as those associated with tasks in scenarios being analyzed (SKOVSMOSE, 2000). In these cases, the actions of students and the professor are considered emerging and local (QUEIROZ, 2019a) due to the very nature of the activities and may constitute a natural source of discursive conflict and create a questioning environment.

For example, the use of spreadsheets from bank amortization systems, mentioned above, can be considered creatively insubordinate. These worksheets represent boundary objects (WENGER, 1998), as they come from a work environment through which professors can organize interconnections between practices. By bringing an object of banking practice to the classroom, an educational environment, the teacher can promote interconnections between these practices; this lack of interconnection has been recognized in the Mathematics Education literature (QUEIROZ; BARBOSA, 2016) as a gap in traditional disciplinary mathematics. Furthermore, discussions about the power of banking institutions and issues of social justice may emerge, as detailed in previous studies (QUEIROZ, 2009; QUEIROZ, 2019b).

Although the examples cited here represent objects of Financial Mathematics and Financial Education practiced in Higher Education classrooms, the analysis of other cases of creative insubordination in Basic Education is possible.

Cases of creative and reactive insubordination (QUEIROZ, 2019a) are understood as situations in which, naturally or intentionally (articulated by the professor), discursive conflicts emerge. Although the conflicts may or may not be

resolved, they are discussed in all their dimensions (broad or narrow) and contexts. These conflicts can happen without necessarily privileging the expert's voice, in this case the professor, but the professor does play a central role in giving a voice to the various actors and fostering discussions about possible solutions based on their contexts.

One can imagine a classroom that expands beyond its walls, preparing students for the challenges that society and the world of work impose on them. In this way, we must admit that academic mathematics and, in this case academic Financial Mathematics, may not always manage to provide answers applicable to all different contexts.

CONCLUSIONS

In this study, the theoretical notions of discourse and discursive conflict in Sfard (2008) are used to understand insubordinate actions. However, the conclusions and outcomes related to solutions to discursive conflicts in Mathematics Education are insufficient to explain the complexity of these conflicts in the classroom, especially considering examples understood as creative insubordination.

In the section on whether discursive conflicts need to be resolved, an alternative view was presented that promotes a more appropriate framework. When discussing teaching and learning processes, Sfard (2008, p. 282) argues that "if commognitive conflict is to become a gate to the new discourse rather than a barrier to communication, both the newcomer and the oldtimers must be genuinely committed to overcoming the hurdle" and goes on to say that "the conflict will not be resolved if each of the participants goes on acting according to his or her own discursive rules" (SFARD, 2008, p. 283). That is, the author recognizes that the forms of newcomer participation must be appreciated and considered, stimulating their creativity and performance. However, the apparent primacy of the discourse of the expert in the "solution" of the conflict is always ratified, through the concept of **leading discourse**, for example. Furthermore, she suggests that there should be a consensus among the participants of the discourse (newcomer and experienced) as to the final objectives of the learning process. Herein, this consensus is considered as not readily achievable, mainly because the learning objectives can be quite different.

Returning to the incident with Sonia, understanding how a conflict is **solved** can vary depending on how the expert deals with power relations in social practice, in this case, the classroom. When the incident occurred, the perception of the expert (the author of this article), seemed to be consistent with the perspective of Sfard (2008). That is, Sonia's participation was considered and discussed, however, it was naturally abandoned as it did not represent what was expected from the rules of the context's dominant Financial Mathematics academic discourse. The **leading discourse** was ratified. However, there are no clues if Sonia and the other students generally understood that moment as the solution to a conflict. It is possible that Sonia understood that there is a discourse with rules that differ from those she practiced. Nevertheless, she was not necessarily willing to change her practice outside the classroom, even if she provided the correct answer in an assessment for which she had learned the expected response.

Considering learning, understood as changes in the way subjects participate in social practice as discussed by Wenger (1998), we can hardly imagine that, in Sonia's case, this learning materialized in practice outside the classroom, given her statement. The outcome might be different if the expert had been trained in promoting Financial Education by evaluating possible scenarios and offering alternatives for analysis without necessarily aiming to resolve this conflict by imposing academic Financial Mathematics. That is, if other alternatives, such as those presented in the previous sections, were critically discussed, it is possible that Sonia would begin to reflect on her actions. Thus, classroom learning could encourage changes in her practices as a consumer. In subsequent classroom contexts, the way the expert deals with similar conflicts has changed. Instead of trying to **solve** the conflict, the author understands that different possible solutions are always welcome in the debate.

Therefore, the idea is to challenge the need for a discrete solution to a conflict and that there must be a single outcome for learning to occur. We can understand creative insubordination as a conflict that does not necessarily have a solution precisely because different possible solutions may be appropriate in different contexts and are guided by objectives. The potential implication of this understanding in teaching and learning is the stimulation of insubordinate actions by professors and students as a way of introducing socio-critical debates, offering solutions that can coexist or be selected according to adaptations to the different contexts considered. Everyday situations and work environments can broaden the understanding that there is not always a single answer to a mathematical problem. As a corollary, it also challenges the idea that mathematical discourse guarantees an easy solution to problems involving decision-making processes.

In conclusion, **creative insubordination** is understood as possibilities of **discursive expansion** through **conflicts** that can continue to be **incommensurate** in different contexts. Thus, they can **coexist** because of **intentional discursive change** in critical mathematics education. As an implication, the Financial Mathematics classroom can become a site of insubordinate action that aims to bring educational contexts closer to external contexts, while also enabling a reflection on social justice in a discipline that inherently addresses such situations through socio-critical debates.

UNDERSTANDING CREATIVE INSUBORDINATION AS INCOMMENSURABLE CONFLICT: IMPLICATIONS OF INCIDENTS IN FINANCIAL MATHEMATICS

ABSTRACT

Creative insubordination is a recently introduced framework in Brazil that aims to promote alternatives to traditional teaching practices in the field of Mathematics Education and encourage reflections on social justice. This article outlines a theoretical understanding of the concept of creative insubordination based on the constructs of discursive theory and considers the potential implications for teaching and learning in Financial Mathematics. Example incidents are used from teaching and research related to this discipline in Higher Education, but with the understanding that it can also be applied to other disciplines and levels of education. This study analyzes concepts such as **discourse, discursive expansion, discursive conflict, and incommensurability between discourses**, intertwining them with the concept of creative insubordination. The same example incidents are used as inspiration for possible discursive changes in the classroom. The article presents a definition of creative insubordination as the possibility for **discursive expansion** through **conflicts** that can remain **incommensurable** in different contexts, **coexisting** because of **intentional discursive changes** with potential consequences in educational settings. Among the possibilities for expansion is the approximation of these environments with daily life and work environments, in addition to encouraging the practice of critical mathematics education.

KEY-WORDS: Creative Insubordination; Financial Mathematics; Discursive Conflict; Incommensurability; Coexistence; Educational Implications.

REFERENCES

BARONI, A. K. C. **Educação Financeira no contexto da Educação Matemática**: possibilidades para a formação inicial do professor. 2021. 253f. Tese (Doutorado em Educação Matemática) – Instituto de Geociências e Ciências Exatas, Universidade Estadual Paulista, Rio Claro. Available at: https://repositorio.unesp.br/bitstream/handle/11449/202819/baroni_akc_dr_rcla.pdf?sequence=3&isAllowed=y.Accessed on: Set. 03rd, 2021.

BARROSO, D. F.; KISTEMANN JR., M. A. Uma proposta de curso de serviço para a disciplina Matemática Financeira. **Educação Matemática Pesquisa**, v. 15, n. 2, p. 465-485, 2013. Available at: https://revistas.pucsp.br/index.php/emp/article/view/13194. Accessed on: May 24th, 2017.

BUDI, F. **Financial Mathematics**. Jakarta: Salemba Empat, 2008. 262p.

D'AMBROSIO, B.; LOPES, C. Insubordinação criativa: um convite à reinvenção do educador matemático. **Boletim de Educação Matemática**, v. 29. n. 51, p. 1-17, 2015. Available at: https://doi.org/10.1590/1980-4415v29n51a01. Accessed on: Jun. 10th, 2021.

DRAKE, P. P.; FABOZZI, F. J. **Foundations and applications of the time value of money**. New Jersey: John Wiley & Sons, 2009. 300p.

KUHNEN, O. L.; BAUER, U. R. **Matemática Financeira aplicada e análise de investimentos**. São Paulo: Atlas, 1996. 517p.

MATHIAS, W. F.; GOMES, J. M. **Matemática Financeira**. São Paulo: Atlas, 2011. 416p.

QUEIROZ, M. R. P. Caracterizando e analisando insubordinações criativas e reativas em designs educacionais e ambientes de aprendizagem. **RIPEM**, v. 9, n. 3, p. 68-83, 2019a. Available at: https://doi.org/10.37001/ripem.v9i3.2182. Accessed on: Jun. 22nd, 2020.

QUEIROZ, M. R. P. Planilhas de amortização dos bancos x planilhas de amortização da literatura. *In*: CONFERÊNCIA NACIONAL SOBRE MODELAGEM NA

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Brazilian Journal of Science Teaching and Technology, Ponta Grossa, Special Edition, p. 1-18, Dec. 2022.

EDUCAÇÃO MATEMÁTICA, 6., 2009, Londrina. **Anais** [...] Londrina, 2009. p. 1-12. 1 CD-ROM.

QUEIROZ, M. R. P. Um design insubordinado no ensino de Matemática Financeira. **REnCiMa**, v. 10 n. 2, p. 176-187, 2019b. Available at: https://doi.org/10.26843/rencima.v10i2.2330. Accessed on: Nov. 01st, 2019.

QUEIROZ, M. R. P.; BARBOSA, J. C. Exercícios de livros didáticos de Matemática Financeira e suas fronteiras com situações do cotidiano e de ambientes de trabalho. *In*: SEMINÁRIO INTERNACIONAL DE PESQUISA EM EDUCAÇÃO MATEMÁTICA, 6., 2015, Pirenópolis. **Anais** [...]. Pirenópolis, 2015. p. 1-12. 1 pen drive.

QUEIROZ, M. R. P.; BARBOSA, J. C. Características da Matemática Financeira expressa em livros didáticos: conexões entre a sala de aula e outras práticas que compõem a Matemática Financeira disciplinar. **Bolema**, v. 30, n. 56, p. 1280-1299, 2016. Available at: https://www.scielo.br//j/bolema/a/cTKYbLRf8dyD8WHHCj4b5MJ/?format=pdf&lang=pt. Accessed on: Jul. 08th, 2017.

ROSETTI JÚNIOR, H.; SCHIMIGUEL, J. Estudo de modelos de Matemática Financeira em bibliografia básica. *In*: CONFERÊNCIA INTERAMERICANA DE EDUCAÇÃO MATEMÁTICA, 13., 2011, Recife. **Anais** [...]. Recife, 2011. p. 1-6. Available at: https://xiii.ciaem-redumate.org/index.php/xiii_ciaem/xiii_ciaem/paper/viewFile/2421/708. Accessed on: Sep. 29th, 2013.

SFARD, A. **Thinking as Communicating: human development, the growth of discourses, and mathematizing**. New York: Cambridge University Press, 2008. 324p.

SKOVSMOSE, O. Cenários para investigação. **Bolema**, v. 14, p. 66-91, 2000. Available at: https://www.periodicos.rc.biblioteca.unesp.br/index.php/bolema/article/view/10635. Accessed on: Aug. 07th, 2010.

WENGER, E. **Communities of practice: learning, meaning, and identity**. New York: Cambridge University Press, 1998. 318p.