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Three approaches to financial numeracy education in secondary mathematics textbooks

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ABSTRACT

This article examines the integration of financial numeracy in secondary mathematics textbooks. It addresses the gap in literature on how financial concepts are portrayed in textbooks, contributing to the establishment of financial numeracy as a field of research and practice. The study analyzed financial numeracy tasks in three published textbook collections from the Canadian Province of Quebec, using qualitative data software to code tasks by collection, grade, mathematical domain, and financial numeracy approach. The results revealed a higher frequency of financial tasks in early secondary grades compared to late (streamed) grades, with a shift in focus from contextual to conceptual approaches in later grades. Algebra and arithmetic domains contained most financial tasks, with significant differences among textbook collections. The findings suggest a need for textbooks to balance mathematical and financial aspects in tasks, and for teachers to receive support in content and pedagogy related to financial numeracy. The study advocates for a nuanced understanding of financial concepts in mathematics, approaching financial numeracy as sensemaking in financial situations (which goes solving problems with defined variables for decision making).

Keywords: financial mathematics, financial numeracy, financial education, mathematics textbooks

INTRODUCTION

Over the past two decades, several countries have moved to incorporate the teaching of financial concepts into secondary school curricula, particularly in mathematics. This trend has been propelled by many factors, such as the recognition of the complexity of financial systems and products. Furthermore, there have also been movements for (mathematics) education to become more relevant to students, preparing them not only for academic success but also for practical challenges they will face in their personal and professional lives. The teaching of financial concepts emerges as a crucial component in addressing both of these movements, offering students opportunities to make sense of an increasingly complex world.

Within mathematics education, various terminologies are currently in use to describe the integration of financial concepts in the curriculum: financial mathematics, financial capability, financial literacy, financial education, and consumer education. These terms differ in scope and emphasis. Inspired by a social practice interpretation (Yasukawa et al., 2018), I embrace these differences under the broad definition of financial numeracy, which encompasses the ways in which we produce, use, and communicate mathematical ideas and processes within financial or economic contexts (Savard & Cavalcante, 2021). By understanding financial numeracy as a broad category encompassing these various terminologies, mathematics education research can move forward with the establishment of a new field of research and practice.

In Canada, Quebec illustrates these multiple pathways to incorporate financial situations in mathematics. Financial numeracy is integrated in the provincial curriculum through three avenues. It is present in the *broad areas of learning* (Government of Quebec, 2004), addressing cross-disciplinary issues such as health, career planning, consumer rights and responsibilities, and citizenship. Since 2016, the mathematics curriculum also includes *financial mathematics* for grade 11 students pursuing the cultural, social, and technical (CST) sequence, focusing on foundational financial concepts such as simple and compound interest, appreciation and depreciation, and amortization (Government of Quebec, 2016). Students in other sequences, which emphasize university mathematics, do not study financial mathematics. Finally, *financial education* as a separate course was also created in 2017 to teach about financial products, post-secondary education, and workforce entry with less focus on quantitative information and more on rules and regulations (Government of Quebec, 2017).

This article contains parts of the author's doctoral dissertation which can be accessed at https://www.proquest.com/docview/2515792332

This article argues that financial numeracy education is part of mathematics curriculum in all grades of secondary mathematics and across all mathematical domains. Such an incorporation can be done in multiple ways that only recently have started to be theorized (Savard & Cavalcante, 2021). The goal of this paper is to investigate the depiction of financial numeracy through an analysis of artifacts that represent the first stage of enactment of the mathematics curriculum: classroom textbooks. The goal is to contribute evidence to support the conceptualization of the relationships between school mathematics and financial situations (financial numeracy).

The paper is structured in five main sections. The first section reviews the literature on mathematics textbook research and financial numeracy tasks and curriculum. The second section presents the analytical framework used in the study. Third, the methods section describes the procedures for collection and analysis of financial numeracy tasks from three published collections. The fourth section presents a descriptive analysis of the results by mathematical domain and approach. In the fifth and last section, the article discusses the meaning of those results and potential implications for financial numeracy education.

TEXTBOOK RESEARCH AND FINANCIAL NUMERACY TASKS

The role of textbooks in the teaching of mathematics, particularly in the context of a new curriculum in Quebec, is significant. As a potentially implemented curriculum (Schmidt et al, 1997), textbooks are situated within the interface between policy and practice (Pepin & Gueudet, 2020; Valverde et al. 2002): they translate the intended curriculum (policy) into the enacted curriculum (practice). They introduce learners to concepts that are not immediately obvious, providing an organized sequence of ideas and information that aims to guide understanding, thinking, and feeling. In the context of the updated Quebec curriculum, textbooks play a crucial role in enacting the vision of financial numeracy education of the revised curriculum into operations that teachers and students can carry out. They serve as mediators between the intentions of curriculum designers and the teachers providing instruction in classrooms.

Textbooks significantly influence mathematics teaching and learning (Glasnovic Gracin, 2018; Kilpatrick et al., 2001; Mesa, 2004; Son & Diletti, 2017). This is particularly true in financial numeracy, an area where many teachers lack formal training (Cavalcante, Savard & Polotskaia, 2024). Fan et al.'s (2013) categories of textbook analysis guided this paper's investigation of the relationship between mathematics and finance in Quebec secondary textbooks. The authors identified 5 categories of textbook analysis, out of which this paper related to 3: mathematics content presented in textbooks (e.g., Hong, 2022); pedagogical approaches and problem-solving (e.g., Basyal et al., 2022); sociocultural contextual features (e.g., Ju et al., 2015). Typically, financial situations are perceived as a contextual feature. However, financial concepts are now being incorporated as content to be taught in mathematics. Hence, this paper investigated the relationship between finance and mathematics by looking beyond the contextual features portrayed in the tasks, including the mathematical content and the types of questions and justifications.

To date, five studies have analyzed financial numeracy in mathematics textbooks, arguing that they promote financial concepts learning even when neglected by the curriculum. Chinese students' success in the PISA, for example, has been partly attributed to textbook tasks that incorporated content that is complex and revisited over time (Cavalcante & Huang, 2022). Romanian textbooks incorporated financial decision-making into tasks following curriculum revisions, with tasks varying in complexity and encouraging critical thinking about financial practices (Caprioara et al., 2020). On the other hand, textbooks can also differ in routines and technologies from those used by banking institutions (de Queiroz & Barbosa, 2016; de Queiroz et al., 2018), demonstrating the need for a nuanced understanding of financial concepts and practices in educational contexts. Research has also explored the ideological dimensions embedded within the portrayal of financial numeracy in mathematics textbooks, identifying ideologies of capitalist consumerism in the constitution of good citizenship (da Silva et al., 2018).

Overall, these studies portray a picture of the affordances and constraints of incorporating financial situations in mathematics textbooks. Three of the studies focused on the authenticity of the situations depicted in the textbooks, while two studies focused on didactical aspects of the tasks at hand. However, beyond the five studies described here, research in financial numeracy education has discussed, in the past few years, how mathematical activities and tasks can develop critical understanding of financial concepts, products and practices. The next sub-section describes key ideas stemming from this emerging body of knowledge.

Tasks and Curriculum in Financial Numeracy Education

Most research situated at the intersection of mathematics and financial education (what I define as financial numeracy education) has focused on implications of incorporating financial situations in mathematics classes, curriculum, and professional development (e.g., Lucey & Maxwell, 2011; Makonye, 2020; Ozkale & Erdogan, 2022; Pournara, 2015; Savard, 2020; Sawatzki & Sullivan, 2017; Tanase & Lucey, 2017). A subset of this emerging field has evolved to investigate, more recently, tasks that can be used to develop students' understanding of financial concepts and practices.

Despite the absence of consensus on frameworks for task design, some proposals have emerged recently. Ozkale and Aprea (2023) developed tasks infusing financial concepts into an elementary mathematics curriculum in Turkiye that did not make explicit reference to this domain. Also focusing on elementary grades, Yeo (2016) emphasized financial numeracy education through a differentiation between content (algorithms and procedures) and strategic (reasoning and thinking) knowledge in mathematics. Cavalcante and Savard (2022) used the COVID-19 pandemic context to present tasks within a framework of contextual, conceptual, and systemic approaches to connect mathematics and finance (this framework is discussed in the next section). These proposals collectively contribute to framing and theorizing financial numeracy in task design.

Furthermore, several empirical studies have been conducted to understand the significance of tasks in the learning and teaching of financial numeracy. Sawatzki's (2017) study emphasized the importance of real-world contexts in financial numeracy tasks, arguing for a balance between authenticity and complexity. In Quebec, Savard and Cavalcante (2021) used tasks to prompt teachers' perspectives on curriculum revisions. The tasks integrated technology to alleviate cognitive load on calculations, increase processing power in simulations, and integrate input from students in authentic ways. Bansilal et al. (2012) studied teachers' engagement with tasks closer to formal mathematics, concluding that success in financial numeracy requires flexible participation in both mathematical and financial domains. Hopkins and O'Donovan (2019) designed a program for young adults with intellectual disability to develop procedural fluency in counting coins and notes, finding that conceptual understanding played a key role in developing procedural fluency.

Overall, these studies seem to converge on the notion that financial numeracy tasks need to be

(a) incorporated into mathematics education with clear intentional goals,

(b) portrayed in authentic ways, and

(c) presented and explored in authentic connection to mathematics.

This paper analyzes in what ways Quebec textbooks reflect this consensus. The goal is to investigate the relationship between mathematics and finance in the tasks from textbooks approved by the provincial Ministry of Education. To do so, it present in the next section an analytical framework that conceptualizes these relationships into three distinct approaches.

A FRAMEWORK OF FINANCIAL NUMERACY EDUCATION

In previous research, we have established an analytical framework to delineate three approaches[1] of financial numeracy education (Cavalcante & Huang, 2022; Cavalcante & Savard, 2022; Savard & Cavalcante, 2021). Inspired by the anthropological theory of the didactic (Chevallard, 2019), this framework recognizes multiples pathways toward financial numeracy in mathematics education. The three approaches serve to theorize different relationships between financial concepts and mathematical concepts in tasks and classroom practices. At the core of this framework lies

(a) the justifications for connecting financial situations and mathematical content (concepts, representations, and processes) and

(b) the intentionality in making such connections.

The first approach, the **contextual approach**, emphasizes using financial situations as a context for teaching mathematics. Within this approach, the goal is centered around teaching formal mathematics while making it motivating to students. It involves connecting mathematical concepts to practical scenarios such as doing groceries or paying bills . By grounding mathematics education in context, learners can gain a deeper understanding of how mathematics applies to their everyday lives. Research and practice rooted in the contextual approach include identifying practical applications of mathematical concepts with everyday financial scenarios. Textbooks should, therefore, encompass pertinent, relatable examples resonating with students' experiences while maintaining a focus on the mathematical content, complexity and depth.

The second approach, the **conceptual approach**, posits mathematics as a powerful tool for making sense of financial concepts. It reframes the focus from mathematics to financial concepts. In tasks or classroom practices that align with this approach, students explore mathematical models and principles that underpin financial phenomena. Understanding concepts like compound interest, risk assessment, and financial planning is therefore enabled by a mobilization of mathematics. Questions related to this approach include the effectiveness of textbooks in addressing financial concepts in depth through mathematics, the coherence of mathematical models and formulas presented, and the extent to which textbooks foster an authentic understanding of financial practices. Textbooks should strive for mathematical accessibility in caring for financial explorations within mathematics. That would entail employing clear explanations, visual representations, and reduced cognitive load on calculations to enhance conceptual learning.

The third approach, the **systemic approach**, recognizes that financial situations are intricately connected to broader epistemological systems, including ethics, values, beliefs, culture, and politics. It goes beyond calculations and delves into the systemic implications of financial decisions. By considering systemic factors, learners can develop a holistic view of financial situations, recognizing their impact on society and the environment. From this angle, textbooks should address ethical dilemmas related to finance, integrate systemic factors into financial discussions, and promote critical understandings of finance at personal and societal levels.

In summary, these approaches help us understand the diversity of tasks associated with financial situations we observe in mathematics textbooks. By using this framework, this study acknowledges that

(a) financial numeracy is already a reality in most mathematics classrooms,

(b) there is no consensus on what it means to incorporate financial numeracy, and

(c) the relationship between mathematics and finance is complex and multi-faceted.

This paper presents a quantitative account of the tasks present in Quebec textbooks according to each approach to financial numeracy education. The next section describes the methods employed to collect and analyze data for the study.

[1] Originally, I defined these approaches as dimensions. The latter seems more appropriate for reflecting different ways of integrating financial and mathematical concepts.

METHODS

This study tackled the following research question: What are the relationships between mathematics and finance depicted in Quebec secondary mathematics textbook tasks? Data was gathered from the textbook collections approved by the Ministry of Education[2]. Three publishers have been approved: Les Editions CEC, Éditions Grand Duc, and Chenelière, respectively referred to as collections A, B, and C. However, collection C does not publish books for the science (NS) and technical and scientific (TS) sequences; hence, to ensure consistency in the analysis, only collection A and collection B for grades 10 and 11 were considered.

A total of 40 books (an average of two books per academic year per grade) were analyzed using the software *Atlas.ti 8*. Every task that contained a financial situation was identified, for a total of 1,372 tasks: these included tasks that discussed money matters, represented numbers through currency or referred to financial practices (selling, purchasing, investing, etc.). Each task was coded by attributing a code in each of the following categories: collection; grade; mathematical domain (arithmetic, algebra, geometry, probability, statistics or financial mathematics); and financial numeracy approach. To define the approach, the complexity (step to solving) and the role of the financial situation (whether the tasks required an understanding of the financial situation) were considered. The next section presents a descriptive statistical analysis by comparing the incidence of financial tasks across different collections, grades, domains and financial numeracy approaches. Furthermore, each individual financial numeracy approach is presented by comparing differences in collections, grades and domains.

RESULTS

Every volume reflects a semester period and is typically divided into four chapters (units to be taught in the span of just over a month). In all volumes, a contextualized introduction provides real life situations and poses open-ended questions that make students reflect and wonder about the content that is to come. The development of concepts within a chapter happens through the exposition of theory followed by tasks that are used to apply the mathematical concept at hand. Tasks keep a balance between procedural and conceptual aspects of how the concept models a real-life situation. Integrative activities at the end of the chapter integrate the mathematical concepts explored in the whole chapter (which sometimes involve more than one domain of mathematics). Contextualized word problems and integrative projects (requiring several hours or days to complete) are the most common integrative activities.

With regards to the organization of mathematical domains in the textbooks, collection C explicitly separates each mathematical domain per chapter and presents these domains in a linear sequence, therefore precluding teachers from revisiting the same domain throughout the year if they follow the textbook order. Collection B and collection C, on the other hand, embed different domains within the same chapter, enabling teachers to follow the order of the book and still vary the content of their teaching throughout the year.

Within the textbooks from all three collections, a total of 1,372 financial numeracy tasks were collected, for an average of 64.9 tasks in each grade of secondary school per collection. To present and discuss the findings of the tasks, secondary grades were separated into two groups: unified and streamed secondary mathematics. Unified mathematics refers to grades 7, 8, and 9 and represents the years in which students have only one mathematics curriculum. Streamed mathematics refers to grade 10 and grade 11 (last two grades of the Quebec secondary education system) and represents the years in which students pursue only one of the three options, CST, NS, or TS. The reasons for separating the grades into unified and streamed are twofold. First, the division of students into mathematics streams occurs in grade 10 and grade 11, representing a more significant transition than any other moment in secondary school. It is also at this moment that students take provincial exams. Second, the structures of the textbooks are similar to a significant degree (despite differences in title), so grouping them in the unified grades does not represent a threat to the validity of the study.

Among the 1,372 talks, 704 were situated in the unified secondary grades and 658 were situated in the streamed grades. Although these numbers seem to imply some balance between unified and streamed grades, such a comparison is misleading since students only pursue one of the three sequences in grade 10 and grade 11. Accounting for this difference, an average of 78.2 financial tasks are presented per grade per collection in unified grades, and 54.8 in streamed grades. Consequently, financial tasks were 42% more frequent in the unified grades of secondary school compared to the streamed grades even though financial mathematics is taught in grade 10 and grade 11 (streamed secondary grades). **Figure 1** and **Figure 2** illustrate the total and percentage distribution of tasks across different collections and domains.

Across different domains of mathematics, an average of 63% of all financial numeracy tasks were situated within algebra in each collection. In the unified grades, arithmetic was also likely to have a higher percentage of financial tasks (40% on average per collection). Geometry, on the other hand, was the domain with the least financial tasks: on average 3% of the financial tasks in each collection were situated within the domain of geometry.

The three sequences in the streamed grades also had large disparities. NS was noticeably the sequence with the least incidence of financial numeracy tasks, about 42% less tasks than CST even when excluding tasks from financial mathematics chapters, and 44% less than TS. This is explained by the lower incidence of financial numeracy tasks in algebra in the NS collections and the lack of probability in the curriculum of that sequence.

[2] The list of approved collections is available at: http://www1.education.gouv.qc.ca/bamd

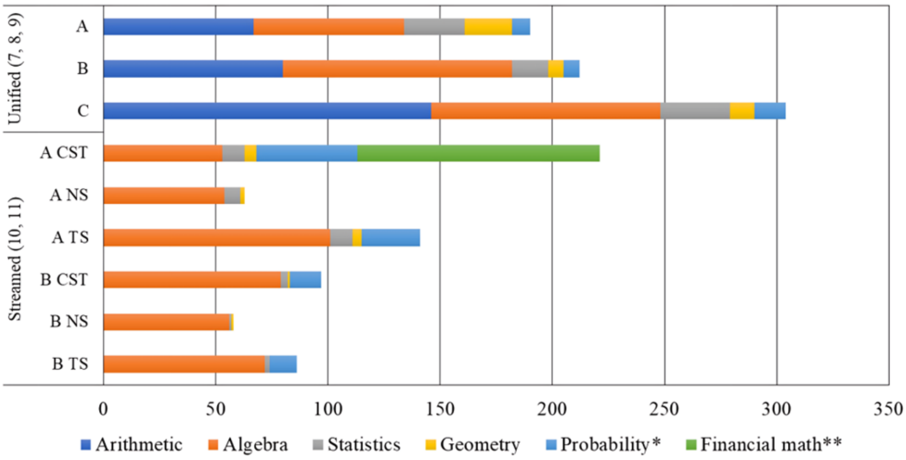


Figure 1. Total distribution of financial numeracy tasks by mathematical domain (*the Quebec curriculum does not allocate any probability content in the NS sequence & **this domain is only integrated in the CST curriculum and at the time of this research, textbook collection B had not yet included the new domain) (Source: Authors' own elaboration)

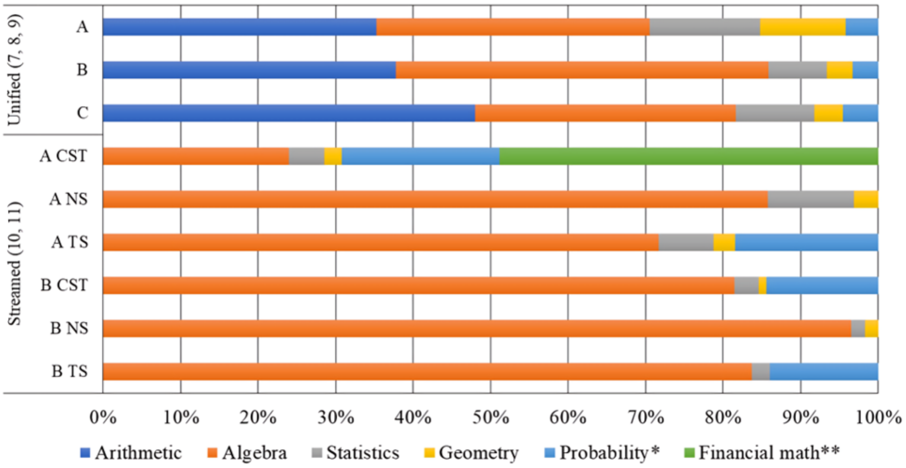


Figure 2. Percentage distribution of financial numeracy tasks by mathematical domain (*the Quebec curriculum does not allocate any probability content in the NS sequence & **this domain is only integrated in the CST curriculum and at the time of this research, textbook collection B had not yet included the new domain) (Source: Authors' own elaboration)

The contextual approach was reflected in tasks in which the financial situation had little to no relevance. These tasks targeted mathematical content that happened to be in the context of money-related activities, but such activities did not play a significant role in the understanding and solution of the task. The tasks typically posed only one question or required only one mathematical procedure to be solved. The conceptual approach was reflected in tasks that required students to make sense of the financial situation at hand. Consequently, the situation itself played a role (often important) in the solution of the task. These tasks typically required multiple steps (which involved calculating, representing, predicting, and explaining) to be solved. The systemic approach was reflected in tasks that offered some openness to students' personal experiences or values in addition to mathematics. The main point that characterizes these tasks is the type of questions that they pose. In this category, students could draw on their prior experience to justify their answers. School mathematics acted as one tool to help them figure out and make sense of something they (potentially) already experience in their daily lives.

On average, the contextual approach represented 32.5% (55.4) of the financial numeracy tasks of each collection, whereas the conceptual and systemic approaches averaged 51.4% (69) and 16.1% (26.9), respectively. **Figure 3** and **Figure 4** illustrate the total and percentage distributions of tasks across different collections and approaches.

These numbers, however, do not reflect the distribution imbalance that exists between the unified and streamed secondary grades. For the unified grades, tasks from the contextual approach represented an average of 48.8% (115) of the total in each collection. For the streamed grades, the average was significantly lower, 24.4% (25.7). The conceptual approach, in contrast, was more prominent in the streamed grades. It represented an average of 31.9 % (73.3) of tasks in each collection within unified grades, whereas the average was 61.2% (66.8) in the streamed grades. The remaining category, systemic approach, contributed similarly across unified and streamed secondary, 19.2% (47) and 14.5% (16.8), respectively. **Figure 4** illustrates the percentage distribution of tasks across different collections and financial numeracy dimensions.

Overall, there is a noticeable shift in the transition from unified mathematics to streamed mathematics. Financial numeracy seems to shift in focus from the contextual approach to the conceptual approach from earlier grades to later grades in secondary mathematics. The trend holds for all three sequences (CST, NS, and TS) of mathematics in the streamed grades. In the CST stream,

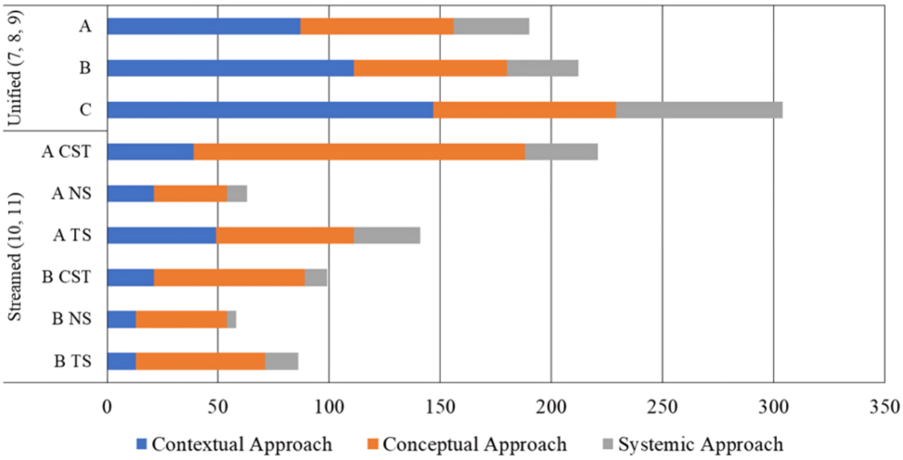


Figure 3. Total distribution of financial numeracy tasks by financial numeracy approach (Source: Authors' own elaboration)

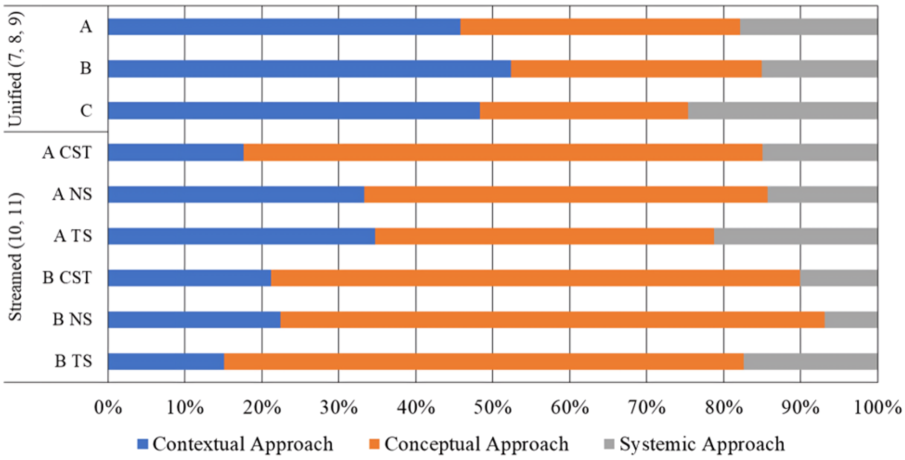
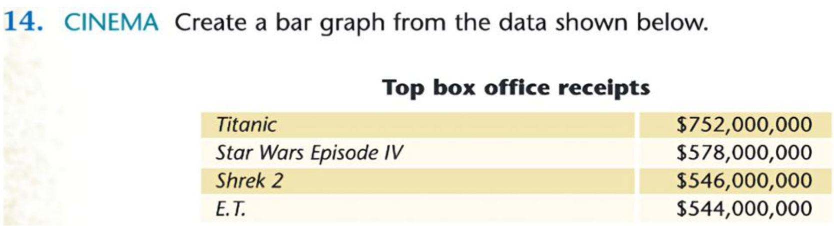


Figure 4. Percentage distribution of financial numeracy tasks by financial numeracy approach (Source: Authors' own elaboration)



14. CINEMA Create a bar graph from the data shown below.

Top box office receipts

Titanic	$752,000,000
Star Wars Episode IV	$578,000,000
Shrek 2	$546,000,000
E.T.	$544,000,000

Figure 5. An example of a task from a contextual approach (collection A, grade 7) (Cadieux et al., 2005)

68% of tasks on average are situated within the conceptual approach. In NS, the proportion is 62%, and in TS, 54%. The lower percentage in TS is perhaps balanced by a higher incidence of tasks in the systemic approach, 21% (almost double that of the other two sequences). In all three streams, the systemic approach was the least frequent.

The next three sub-sections present a detailed account of the nature and results of each of the financial numeracy approaches along with examples of tasks that reflected such approaches.

Contextual Approach

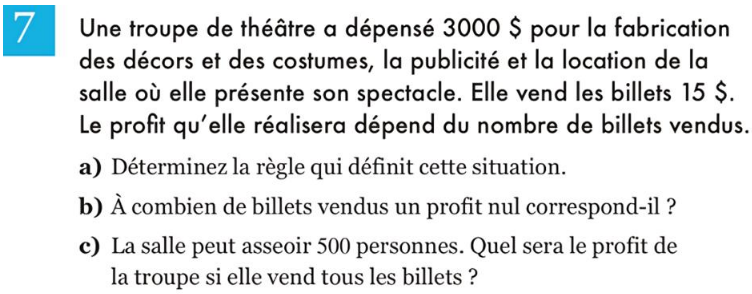
The tasks that reflect the contextual approach were mostly composed of short word problems that provided a simple context for students to carry out calculations. They served to reinforce the procedures related to mathematics concepts. These word problems did not require a deeper understanding of the situation being represented and would look rather similar if the financial situation was replaced by another context (biological, physical, etc.). **Figure 5** illustrates one of these tasks.

In this task, students were asked to change the representation of financial information from one mode (table) to another (bar graph). Understanding what box office receipts represent is not necessary: in changing the table to a bar graph, each row stands for one statistical observation in which the first column represents the independent variable (name of the movie) and the second column represents the dependent variable (numerical value of box office). To construct the bar graph, students can merely rely on their knowledge of data representation. If the task had reflected a different, non-financial dependent variable (such as audience numbers or length of the movie), nothing would change in reaching the goal of the problem.

Table 1. Contextual approach tasks

Domain	Unified mathematics (grades 7, 8, & 9)			Streamed mathematics (grade 10 and grade 11)					
	Collection A	Collection B	Collection C	Collection A			Collection B		
				CST	NS	TS	CST	NS	TS
Arithmetic	31	48	75	NA	NA	NA	NA	NA	NA
Algebra	28	42	44	15	19	35	14	11	11
Statistics	8	8	11	2	0	5	1	1	0
Probability*	6	7	8	17	NA	5	5	NA	2
Geometry	14	6	9	5	2	4	1	1	0
Total	87	109	147	39	21	47	21	13	13

Note. *The Quebec curriculum does not allocate any probability content in the NS stream


7 Une troupe de théâtre a dépensé 3000 $ pour la fabrication des décors et des costumes, la publicité et la location de la salle où elle présente son spectacle. Elle vend les billets 15 $. Le profit qu'elle réalisera dépend du nombre de billets vendus.

a) Déterminez la règle qui définit cette situation.

b) À combien de billets vendus un profit nul correspond-il ?

c) La salle peut asseoir 500 personnes. Quel sera le profit de la troupe si elle vend tous les billets ?

Figure 6. An example of a conceptual task (collection B, grade 10) (Translation: A theater troop spent $3,000 on decoration and costumes, publicity, and renting a room where they presented their spectacle. They sell tickets for $15. The profit they will make depends on the number of tickets sold: (a) Determine the rule that defines this situation, (b) How many tickets sold would correspond to a zero profit?, & (c) The room can seat 500 people. What will the profit of the troop be like if they sell all the tickets?) (Guay et al., 2009)

In terms of distribution, this approach to financial numeracy was not restricted to one mathematical domain. As we can see in **Table 1**, there was indeed a concentration of contextual approach tasks in arithmetic and algebra in all grades of secondary school, but all mathematical domains had at least a handful of tasks that reflected this approach, particularly in the unified grades.

In the unified grades, it is noticeable how collection C stood out with almost 35% more tasks in the contextual approach than collection B and 69% more than collection A. This was mostly due to the higher incidence of arithmetic tasks in collection C. On the other hand, despite Collection A's lower incidence in algebra and arithmetic, it had a significantly higher incidence of tasks from a contextual approach in geometry, more than double that in collection B and 55% more than that of collection C. All other mathematical domains seemed to be balanced across different collections.

In the streamed grades, collection A had on average 136% more tasks when compared to collection B (comparing each stream individually). Across different streams of mathematics collections, both CST and TS collections had 76% more tasks from the contextual approach when compared to the NS collections. The TS collection A contained significantly more arithmetic tasks from this approach, whereas CST collection A concentrated on probability tasks. It is also noticeable that, unlike the unified grades, some mathematical domains (statistics and probability) in the streamed curriculum did not have any tasks in this approach for the TS and NS sequences.

Conceptual Approach

The tasks that reflected the conceptual approach invite students to analyze financial situations instead of solving them right away. For the majority of them, the entirety of the task is concentrated in the financial situation and multiple questions are asked about it. In other cases, the financial situation was a smaller component within a bigger task that integrated other life situations. In both cases, the tasks typically required multiple mathematical processes in order to make sense of the situation, and at least some understanding of financial practices was necessary to successfully complete these tasks. In fact, these tasks could also be interpreted as opportunities for students to learn about the very financial situation they portray. In this approach, tasks often required students to translate a real-life situation into mathematical language that included but was not limited to equations, graphs, tables, calculations, and drawings. Based on these different processes, students were then asked to draw conclusions that relate back to the financial situation portrayed in the task. All tasks from the financial mathematics chapters fell into this category. **Figure 6** illustrates an example of such a task.

The first question prompts students to construct a linear function to represent the situation described in the problem. However, students can only enact mathematical modeling if they first understand the concept of profit: profit (P) is the difference between revenue (R) and costs (C), where the revenue grows at a rate of $15 per ticket (T) sold and costs remain fixed (in other words, $P = R - C$, or $P = 15T - 3{,}000$). The second question implicitly prompts students to develop the concept of a break-even point (at which revenue and costs are equal, and there is no deficit or surplus). It is important to notice, however, that the question was phrased in mathematical language (equating one of the variables to zero), hence the opportunity to formalize the concept of break-even point depends on the enactment of this problem in class (whether the teacher would talk about this concept explicitly). The last question extends this analysis by prompting students to consider the maximum profit possible under the circumstances described in the problem (full house).

Table 2. Conceptual approach tasks

Domain	Unified mathematics (grades 7, 8, & 9)			Streamed mathematics (grade 10 and grade 11)					
	Collection A	Collection B	Collection C	Collection A			Collection B		
				CST	NS	TS	CST	NS	TS
Arithmetic	25	18	36	NA	NA	NA	NA	NA	NA
Algebra	27	49	36	29	30	55	58	41	51
Statistics	11	2	6	3	3	4	1	0	0
Probability*	1	0	3	9	NA	3	7	NA	4
Geometry	5	0	1	0	0	0	0	0	0
Financial math**	NA	NA	NA	108	NA	NA	NA	NA	NA
Total	69	69	82	149	33	60	66	41	55

Note. *The Quebec curriculum does not allocate any probability content in the NS stream

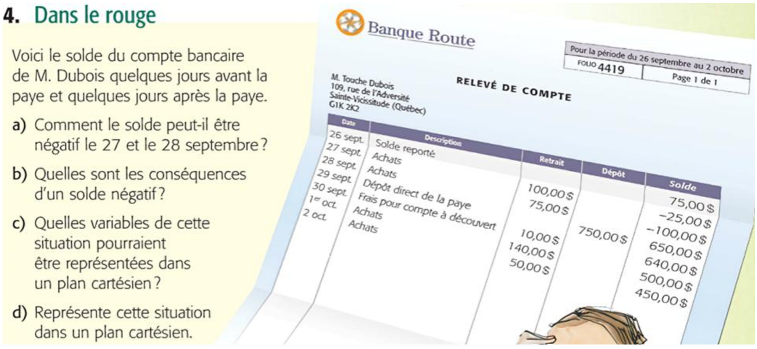


Figure 7. An example of a systemic task (collection C, grade 8) (Translation: Check Mr. Dubois's bank account statement before and after payday: (a) How can the balance be negative on September 27 and 28?, (b) What are the consequences of a negative balance?, (c) What variables in this situation can be represented in a Cartesian plane?, & (d) Represent this situation in a Cartesian plane) (Coupal, 2006)

In terms of distribution, the conceptual approach had an even higher concentration of tasks in arithmetic and algebra (**Table 2**) than the contextual approach. In the unified grades, an average of 87% of tasks in each collection fell within either of these two mathematical domains. For the streamed grades, that figure jumped to 92% if we included financial mathematics. However, despite the heavier concentration, all mathematical domains except geometry had at least a handful of tasks that portrayed financial situations in the streamed grades.

In comparison to the contextual approach, the three collections were less discrepant. In the unified grades, collection C had only 19% more tasks from the conceptual approach than the other two. That was mostly due to the higher incidence of arithmetic tasks in this collection. Collection A and collection B compensated by having more tasks in statistics and algebra, respectively. In fact, despite collection B having 81% more algebraic tasks than collection A, they both showed the same overall figures. That is because collection B only had 2 statistics tasks and none in geometry and probability.

In the streamed grades, not accounting for financial mathematics, collection B had on average 19% more tasks from the conceptual approach when compared to collection A (comparing each stream individually). The comparison does not include financial mathematics because collection B had not updated its CST textbook at the time of data collection. However, all collections had a very low incidence of tasks in probability and statistics, with no more than 4 statistics and 9 probability tasks. In some cases, such as the NS and TS versions of collection B, no statistics tasks were situated within the conceptual approach.

Across different streams of mathematics, the TS collections seemed to portray 55% more financial situations through a conceptual approach compared to the NS collections. These two were not compared with the CST stream because collections A and B did not have equivalent numbers (financial mathematics tasks would significantly skew the data).

Systemic Approach

The tasks that reflected the systemic approach entailed more open-ended problems that required a student to make sense of their personal experience in relation to the financial situation being portrayed. A minority of the tasks were comprised of complex projects that could be developed over the course of several weeks. These tasks were usually introduced at the beginning of a unit and served to authentically engage students with mathematical content. The majority of the systemic approach tasks, however, were made of word problems that posed several, strictly mathematical questions followed by an invitation for the student to share their thoughts and ideas. In most of these cases, students were directed to give their personal views based on the mathematical results that came up with previous questions. However, they could also provide other forms of reasoning that endorsed or challenged the mathematical information. This is the systemic aspect of such tasks: the possibility of making sense of how financial information or products are constructed and communicated. **Figure 7** illustrates an example of a systemic task.

In this problem, students were prompted to make sense of a typical representation of financial information (bank balance) and, most importantly, provide meaning to the situations that lead someone to have a negative balance and its consequences. A reasonable answer to the first and second questions might stem from a range of epistemological systems: personal experience from parents or family, emotional responses from times of hardship, ethical or moral beliefs about financial behavior, or

Table 3. Systemic approach tasks

Domain	Unified mathematics (grades 7, 8, & 9)			Streamed mathematics (grade 10 and grade 11)					
	Collection A	Collection B	Collection C	Collection A			Collection B		
				CST	NS	TS	CST	NS	TS
Arithmetic	11	14	35	NA	NA	NA	NA	NA	NA
Algebra	12	11	22	9	5	11	7	4	7
Statistics	8	6	14	5	4	1	1	0	2
Probability*	1	0	3	19	NA	18	2	NA	6
Geometry	2	1	1	0	0	0	0	0	0
Total	34	32	75	33	9	30	10	4	14

Note. *The Quebec curriculum does not allocate any probability content in the NS stream

sociopolitical standpoints related to social inequality. In any of these cases, both finance and mathematics can converge to enable conversations around these systems and how students situate within them. The third and fourth questions, on the other hand, were strictly mathematical, prompting students to identify variables (e.g., independent: time and dependent: balance) and represent them appropriately (line graph in the Cartesian plane).

In terms of distribution, the systemic approach kept with the trend of higher concentration of tasks in arithmetic and algebra (**Table 3**), but it also had a comparatively higher incidence of tasks in statistics in unified secondary, especially when compared with the conceptual approach. An average of 20% of the unified secondary tasks per collection in this approach were situated in the domain of statistics. For the streamed grades, probability had a higher incidence of systemic approach tasks, with an average of 42%. However, similar to the conceptual approach, the streamed secondary collections did not have any systemic financial numeracy tasks. As for the other mathematics domains, at least a handful of tasks incorporate financial situations.

Similar to the contextual approach, the three collections of unified mathematics seemed to have a large discrepancy when compared to each other. While collections A and B had a similar number of tasks from the systemic approach, collection C had more than double. This is largely due to its overall higher number of tasks in arithmetic, algebra, and statistics. Particularly in the arithmetic domain, collection C had more than three times the amount of systemic approach tasks than collection A and 2.5 times the amount of collection B.

In the streamed grades, collection A had on average 107% more tasks in the systemic approach when compared to collection A (comparing each stream individually). This is mostly due to the higher numbers of probability tasks in the CST and TS streams of collection A, whereas collection B did not have many in either stream.

Across different streams of mathematics, the NS collections seemed to portray around 74% less financial situations through a systemic approach compared to the CST collections. When compared to TS, this figure is around 70%. This data can be explained based on the higher incidence of probability tasks for the other streams: according to the curriculum in Quebec, students taking the NS mathematics sequence do not study probability.

DISCUSSION AND CONCLUSION

The textbook analysis revealed a significant presence of financial numeracy tasks. With an average of 64.9 tasks per secondary grade level, the data provides evidence that the discourse surrounding financial numeracy education in mathematics is not a matter of incorporation, but rather of how such an integration is conducted. To contribute to this discourse, I proposed a descriptive analysis of financial numeracy tasks by mathematical domain and financial numeracy approach.

The domain-driven analysis revealed that all mathematical domains were represented in financial numeracy tasks. However, arithmetic and algebra were disproportionately represented compared to other domains. This emphasis could be attributed to two potential reasons. Firstly, the Quebec curriculum itself emphasizes arithmetic and algebra, resulting in fewer learning expectations in other domains. Accounting for this factor poses a challenge, as not all textbooks explicitly categorized their content into the domains outlined in the provincial curriculum. Secondly, the emphasis could reflect a deterministic epistemology of financial numeracy, which views financial situations from a problem-solving perspective with defined variables and relationships. This deterministic thinking was manifested in precise modeling and simulation, as exemplified by the theater task presented in **Figure 6**. An alternative to a deterministic epistemology can be envisioned in the third most common domain of financial numeracy tasks, statistics. By incorporating variability, uncertainty, and data representation, statistics can support students in making sense of often unclear or imprecise financial information. This alternative epistemology enables students to understand that financial situations often involve risk and uncertainty and that mathematics provides a valuable reasoning tool for making informed decisions, a task more challenging in arithmetic and algebra. Regardless of the underlying epistemology, however, these findings bolster the argument that financial numeracy education has the potential to span across all domains of school mathematics.

The analysis of financial numeracy approaches revealed that all three approaches were represented in the textbooks. The contextual approach, which aims to make mathematics more meaningful and foster motivation, was more prevalent in the earlier grades. Conversely, the conceptual approach was more frequent in the later grades. This approach seeks to develop an understanding of financial situations in everyday life. That includes financial practices (buying, selling, advertising, planning, etc.) but also products offered by financial institutions (retirement products, savings accounts, credit cards, loans, etc.). However, in both grade levels, the systemic approach was the least frequent. This approach aims to develop a critical stance on financial situations through mathematics, providing a personal perspective on issues that extend beyond strict numerical solutions and enabling students to reflect on their own experiences and related societal issues. The limited presence of this approach in textbooks is hardly surprising, given the historical interpretation of mathematics as a neutral subject. As the consensus for integrating financial numeracy in mathematics education grows, it becomes increasingly important to attend to its goals and assess whether they extend beyond mere applications of mathematical principles.

Furthermore, financial numeracy garnered more attention in the earlier secondary grades than in the final two years. This is somewhat paradoxical, considering that financial mathematics is explicitly taught as a distinct domain only in grades 10 and 11. This phenomenon can be attributed to three potential reasons. First, the earlier grades encompass arithmetic learning expectations (percentages, ratios, decimals, and negative integers) that can be readily linked to everyday financial practices (discounts, change, promotions, and financial fees). Second, in the textbook collections, the earlier grades are considerably more contextualized and less reflective of formal mathematics. In contrast, the textbooks for the later grades are more focused on formal, abstract concepts to prepare students for post-secondary studies. Third, the curriculum in these later grades is less conducive to connections with financial situations: most of the content in algebra does not easily translate to financial practices (apart from exponential and linear functions) and statistics is scarcely incorporated into these grades (the minimal content presented is taught in connection to function analysis, such as constructing a linear function from data points).

The implications of these results prompt an inquiry into whether the importance of financial numeracy arises from consistent exposure throughout secondary school, or explicit instruction in a distinct domain. Future research should explore this question to comprehend the influence of these two divergent curriculum pathways on student learning and retention. Furthermore, the findings suggest a lack of intentionality regarding financial numeracy education among the three collections: the content appeared scattered, with no clear delineation of which collection prioritized or concentrated on one financial numeracy approach more. Predominantly, however, if we embrace the perspective that financial numeracy refers to interpreting financial situations (in diverse ways) rather than mastering formulas or complex concepts, it is evident that Quebec textbooks have extensively incorporated financial numeracy.

In this article, I approached financial numeracy beyond the constraints of financial mathematics as delineated by the Quebec curriculum. It encompassed the interpretation of financial situations through mathematical concepts from the whole curriculum (as expressed in the textbooks). Consequently, it is crucial to acknowledge the significance of the broad areas of learning in the provincial curriculum when analyzing the integration of financial numeracy in secondary textbooks. Had this study been confined to the financial mathematics chapters from the collections, a substantial amount of information would have been omitted from these results.

The limitations of the study include the ambiguity of a total of 1,372 tasks. It is unclear how much they represent the total number of tasks in each textbook collection. Since the focus was to investigate the tasks that did incorporate financial situations, information on the number or nature of other tasks depicted in the collections was not collected. Secondly, I acknowledge that the frequency of these tasks being used in class is contingent upon the teachers' discretion. Often, financial numeracy tasks offer opportunities for learning and discussing financial issues, but this is largely dependent on the teachers' instructional strategies and their enactment of discussions about the situations in the tasks. Lastly, while the three approaches are not mutually exclusive, for the sake of clarity in the analysis, the approach that was most evident in the tasks was prioritized. Future research should consider a systematic analysis of the questions posed in each domain to comprehend the role of different mathematical concepts in the development of financial numeracy. A qualitative, in-depth analysis of these tasks, including the financial practices, mathematical concepts, and types of questions asked, will be explored in subsequent publications.

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