Exploring the Intricacies of Differentiated Instruction: Problem-Solving through the Multiagenda Model

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Abstract: In Quebec, the primary school mathematics curriculum emphasizes problem-solving as a core competency. This study investigates how teachers anticipate differentiated instruction to teach problem-solving skill, crucial for fostering equitable learning opportunities. By conducting explicitation interviews with 4 teachers from Montréal, we explore their strategies for adapting instruction to meet diverse student needs. Utilizing the Multiagenda Model, we analyze key teaching gestures—such as atmosphere, steering of tasks, scaffolding, and learning objects—that facilitate inclusive problem-solving. Findings reveal that teachers employ a variety of methods to create supportive environments, encourage collaboration, and scaffold learning, thereby enhancing students' engagement. However, they would benefit from rethinking their support in order to enhance each student's problem -solving competence.

Keywords: differentiated instruction, solving word problems, primary school, explicitation interviews

Internationally, it is widely acknowledged that problem-solving is pivotal for individuals to become engaged citizens in their society, primarily owing to the ubiquitous integration of technology in everyday life.

> Problem-solving stands as one of the paramount competencies that humans require in a world characterized by constant change, uncertainty, and surprises. This proficiency is indispensable in situations where no customary response is readily available. Problem-solving necessitates the astute exploration of our surrounding world, it requires strategies for efficient knowledge acquisition in unfamiliar circumstances, and it mandates the creative application of the knowledge accessible or acquirable during the process" (Dossey, 2017, p. 15).

In the province of Quebec, the curriculum for primary schools is centered around competencies. In Québec's curriculum, in the field of mathematics, there are three core competencies, one of which is solving mathematical problems (Gouvernement of Québec, 2001). Furthermore, the curriculum also outlines a few overarching competencies, among which lies the general competency of problem-solving. (Gouvernement of Québec, 2001))

In this particular context, competency is defined as the ability to act, mobilize, and utilize an efficient array of resources (Gouvernement of Québec, 2001). The ability to act entails the students' capacity to employ diverse resources and knowledge when confronted with complex situations that require the combination of several operational steps to resolve the issue at hand. Consequently, within the framework of the Quebec program, it becomes imperative to master the skill of problem-solving. In this context, it's pertinent to know how to adequately teaching solving-problem in math.

Context

Students don't merely need to acquire knowledge; they must also adapt to their rapidly changing environment (Dossey, 2017). Solving problems is considered one of the key 21st-century competencies due to its demands on cognitive, social, and emotional abilities (Garay & Quintana, 2020). Teaching problem-solving has evolved into a pressing social concern (Rubel, 2017). It has significant implications for future employability (Hart, 2019). Primary schools must strive to ensure equity among learners, providing them with equal learning opportunities and the same prospects in life (Ainscow, 2020) and it is necessary to ensure this equity in teaching solving mathematics problems, especially, regarding its importance to become an engaged citizen in society.

Unfortunately, in most countries, learning opportunities are often distributed unequally in most classrooms (Cai et al., 2020). Specifically in mathematics, teachers encounter difficulties in providing equitable learning opportunities to all students (Cai et al., 2020). According to these authors, it remains uncertain when a student is truly benefiting from a high-quality learning opportunity (Cai et al., 2020). They propose two approaches to address this question: seeking input from the students or inquiring with the teacher about their intended instructional strategies. For this study, we chose to interview primary school teachers.

Specifically, despite problem-solving's longstanding position within the Quebec curriculum (Lajoie & Bednarz, 2012), students continue to struggle with mastering it. According to the Program for International Student Assessment

(PISA) orchestrated by the Organisation for Economic Co-operation and Development (OECD), only 83.7% of fifteen-year-old Canadians achieve a basic level of proficiency in problem-solving (OECD, 2016).

Furthermore, studies indicate that the expectations for teaching this competency have increased over the years (Lajoie & Bednarz, 2012, 2014). Today, these expectations have reached a high threshold. Teachers are now expected to develop mathematical thinking capacities, explore and construct mathematical concepts, and ensure the learning of the problem-solving process (Lajoie & Bednarz, 2014). Additionally, problem-solving assumes a very specific form in official final exams in Quebec and strongly influences the way it is taught in primary classrooms (Bergeron et al., 2022; Lajoie & Bednarz, 2016). Similar reports have been made in other countries, including France (Demonty & Fagnant, 2014) and the USA (Kingsdorf & Krawec, 2016).

This is why Quebec is a compelling case for investigation, offering insights into how teachers can effectively teach problem-solving, navigating the constraints and expectations associated with this competency. Indeed, the Quebec program not only emphasizes the importance of mathematical problem-solving skills, but the expectations for teachers are also complex and demanding. Interviewing Quebec teachers would therefore help to identify several challenges in teaching this skill in an inclusive manner.

Differentiated instruction in teaching math problem-solving could allow teachers to tailor their instruction to meet the diverse needs of students. This approach help ensure that all learners can engage with the material at their own level and develop their problem-solving skills effectively. The need for differentiated instruction is universal across all competencies. In primary school classrooms, lessons should be designed to account for individual differences among students, and teachers must utilize interaction as a mean to tap into the richness of their ideas (Prud'Homme et al., 2016). When it comes to problem-solving, it is recommended to create opportunities for students to share their perspectives, allowing each student to construct their understanding (Selling, 2016). However, the sharing of perspectives does not guarantee that every student will seize the opportunity to learn (Deunk et al., 2018; Faber et al., 2018; Selling, 2016). Nevertheless, diverse viewpoints within a classroom setting offer the potential for rich exchanges, contributing to the development of problem-solving competencies (Bednarz et al., 2017; Selling, 2016).

Regrettably, the concept of differentiated instruction remains a source of confusion for both researchers and practitioners. The concept emerged as a practical solution to address the issues stemming from one-size-fits-all teaching, which left some students behind in terms of academic success. Researchers have endeavored to identify practical strategies to bridge this equity gap. However, contemporary studies indicate a lack of precision in explaining how to effectively integrate all these strategies (Moldoveanu & Grenier, 2020). There remains a lack of clarity concerning whether the observed strategies are deliberately planned or occur spontaneously. For instance, many studies conclude that differentiated instruction is at play when they observe students grouped in various ways in a classroom setting, but they do not delve into what specific adaptations are being made to cater to the unique needs of each learner (Deunk et al., 2018). It appears to be challenging to ascertain what takes place beyond the inclusive gestures (Deunk et al., 2018; Frerejean et al., 2021; Prast et al., 2015; van Geel et al., 2019). The research objective that guided our study is to understand how teachers implement differentiated instruction to address the needs of all their students when teaching math problem-solving.

Theoretical Context

In order to understand how teachers anticipate differentiated instruction when planning solving math problems, we decided to use the didactic model of Multiagenda (Bucheton & Soulé, 2009) and we focused on two concepts: differentiated instruction and adaptation.

The Multiagenda Model (Bucheton & Soulé, 2009)

Our uniqueness lies in our choice of a didactic model to elucidate differentiated instruction. The choice was dictated by the need to find a way to describe a complex teaching strategy. Indeed, teaching solving math problems requires skills in mathematics didactic and teaching it in an inclusive manner adds the need for skills in pegadogy. We needed a model able to describe the entire teaching practice. The Multiagenda Model allow us to discern each gesture involved in the steps taken to cater to the needs of individual students or groups. Indeed, the study of teaching requires an examination of not only how various bodies of knowledge and different types of learning intersect but also how the diverse gestures employed by teachers merge. This was the essence of the Multiagenda Model by Bucheton & Soulé (2009), which we found particularly pertinent in explicating all the gestures required to implement the differentiated instruction.

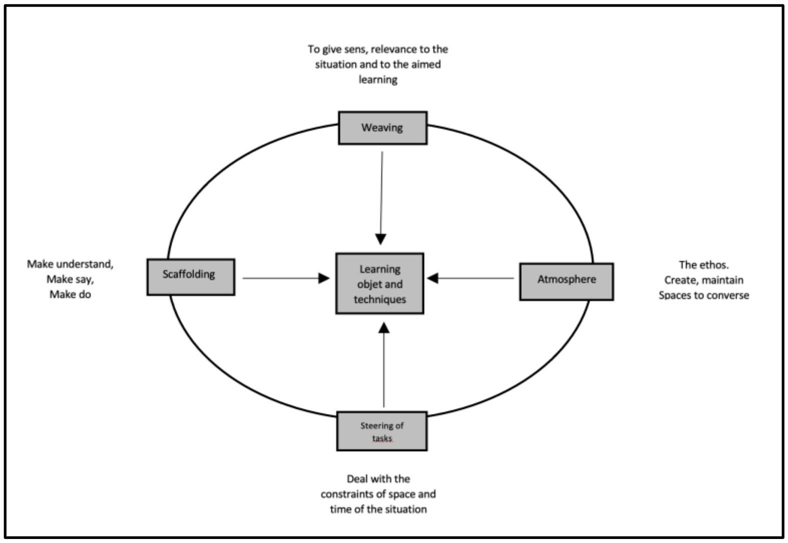

Figure 1: The Multiagenda Model
Source: Bucheton & Soulé (2009), translated by the author.

The five focal points—namely, atmosphere, steering of task, weaving, scaffolding, and learning object and techniques—have been selected for their significance in prior research and their central role in teachers' planning, spanning from preschool to university (Bucheton & Soulé, 2009). According to the authors, "these five focal points serve as cornerstones in the everyday act of teaching, encompassing professional knowledge, experience, and competencies" (Bucheton & Soulé, 2009, p. 18, translated by the author). Adopting this model provided us with an opportunity to pose questions that span the entirety of teaching and the planning processes of our participants.

Atmosphere pertains to the creation of a shared space within the classroom that facilitates intersubjectivity, especially in situations where the group is required to share viewpoints for the purpose of learning (Bucheton & Soulé, 2009). Atmosphere plays a pivotal role in maintaining students' affective and cognitive engagement. Gestures are utilized to sustain attention and enable all students to participate.

Weaving is described as the methods teachers employ to connect the classroom with the world outside school (Bucheton & Soulé, 2009). It involves linking with prior knowledge and offering a glimpse of future knowledge. Weaving is particularly vital for "at-risk" students who struggle to contextualize their learning.

Steering of task should aim to coordinate lessons for maximum efficiency (Bucheton & Soulé, 2009): teachers must address the different learning paces of students by structuring tasks to ensure that comprehension is accessible to all; this entails employing manipulative objects and notes on the board, as well as presenting the material in a manner consistent with the curriculum. Teachers must also demonstrate the ability to vary communication methods and encourage student-to-student communication.

Scaffolding is regarded as the linchpin among all the focal points (Bucheton & Soulé, 2009). Building on Bruner's (1966) heritage, the authors defined scaffolding as the array of gestures teachers employ to assist all students. It emphasizes the importance of identifying obstacles in the learning process and errors committed by students, enabling teachers to provide timely and precise guidance to aid in the construction of knowledge. According to the authors, examining scaffolding gestures allows for an in-depth understanding of teaching, encompassing both didactic and pedagogical skills. Scaffolding is didactic in that it aligns with the acquisition of specific knowledge and pedagogical in that it dictates the pathway to knowledge acquisition (Bucheton & Soulé, 2009).

Learning object and techniques can exhibit a wide range of heterogeneity, and the primary concern for the authors is to thoroughly grasp their complexity and the way they interact to ensure accessibility for all students.

Differentiated Instruction and Adaptations

Even after 50 years of research, differentiated instruction is still challenging to define because it can be understood as a philosophy, a way to approach learning and think about adaptation, or as a toolkit of strategies available for teachers to adapt. This confusion explains the difficulty in translating it into practice (Moldoveanu & Grenier, 2020; Nilholm, 2021). Therefore, it's common to find studies indicating that teachers struggle to provide a clear definition of the concept (Roditi, 2003; Kingdorf & Krawec, 2016). However, when questioned, they actually use multiple strategies to adapt in their everyday practices. The situation becomes relevant when studies avoid asking about differentiated instruction and instead focus on indicators of inclusive practices (Goddard et al., 2015; Nilholm, 2021; Roditi, 2003).

On the other hand, some studies show that some teachers think they're differentiating when, in reality, they're only focusing on the production or structure of tasks and not truly adapting access to knowledge for all their students (Deunk et al, 2018). Some even confuse adaptation with making tasks less difficult for "at-risk" students (Kingsdorf & Krawec, 2016). However, the literature is very clear in asserting that the concept of differentiated instruction implies that high expectations must be maintained for all students to ensure equity in the classrooms (Tomlinson, 2018). To define the concept, we align ourselves with Hattie, who describes differentiated instruction as a way provided by teachers "to ensure that learning is meaningfully and efficiently directed to all students, achieving the intentions of the lessons [...] thus, teaching the "whole class" is unlikely to tailor the lesson correctly for all students" (Hattie, 2012, p.109).

To achieve this objective to differentiate for every student, studies describe two extremes of a spectrum (Celik, 2019) id the ability to simultaneously create challenges for some students and provide support for others (Dulfer et al., 2021). Differentiated instruction involves designing didactic situations that allow the maximum number of students to make progress, determining variations in class resources, and adapting the curriculum content. Differentiated instruction encompasses both practices and attitudes (Finkelstein et al., 2021); it requires flexibility (Frerejean et al. , 2020; Moldoveanu et al., 2016), and the teacher must employ critical thinking (Wright, 2018). This explains why planning differentiated instruction in solving problems entails dealing with several constraints.

For us, adaptation is an action taken to help one or more students understand the knowledge. It involves adjusting for a short or long period of time and is a form of assistance rather than a reduction of knowledge (Shumm, 1999). To categorize the adaptations described by our interview participants, we decided to classify them into two categories: gestures for general adaptation and gestures for specific adaptation for one or more students. This approach provides a clear overview of the adaptations made by participants and allows us to precisely describe the concerns of their multiagenda.

Methodology

We describe teaching math problem-solving and implementing differentiated instruction as complex teaching skills. The aim of our study was to understand how teachers deal with these complexities and how they manage to address the needs of all their students. The research is a qualitative study. It's a descriptive and interpretive one (Gallagher & Marceau, 2020) as we wanted to understand teaching practices and identify the underlying needs of the teachers to take into account the diversity in their class. The research consisted of four interviews with primary school teachers in Montreal, Quebec. We opted to ask expert teachers to select a situation they were planning to teach in their classrooms and explain what they anticipated doing for their students. The teachers were recruited through groups of teachers on social media or were recommended by their school principals. According to their experience, plus the fact that they all underwent extra training, we considered them experts in this research. They all have between 12 and 15 years experience and they all took at least two extra courses in professional development program.

To get a sense of their practices, we initially requested that they write a profile of their class for the problem-solving competency. We conducted explicitation interviews (Vermersch, 2006) and analyzed the profiles and the chosen situations prior to the interviews. Our questions were designed to understand the choices they were about to make to enable all students to find a solution for the given situation. Firstly, we inquired about the reasons behind the names in the profiles. Then, using our own understanding of the situation and its challenges, we asked about the methods they were planning to employ in supporting the students identified during the lesson. Our interviews followed the chronology of the lessons, explicitly referring to the students in the profile or addressing the obstacles we had identified.

The results presented are the product of a content analysis following the Miles and Huberman's model (2003). We used QDA Miner (6.0) to help us categorize the discourse using the five elements of Bucheton & Soulé's model. Considering the importance of the teachers' voices in this qualitative research, this process allowed us to find emerging categories too, such as the importance of reading the situation before letting the students work, for example.

Results

Participants indicated their intention to make adjustments in all aspects of the Multiagenda's Model. The QDA analysis of the frequency of codes related to the Multiagenda's gestures reveals that these gestures play a crucial role in the teaching of problem-solving. In the majority of cases, we find explanations pertaining to atmosphere, followed by scaffolding, in teachers' statements. We believe this highlights the complexity of differentiated instruction in teaching problem-solving. Teachers provide numerous explanations to meet the needs of each student. They describe how they create classroom conditions that foster autonomy, collaboration, and more personalized moments of exchange.

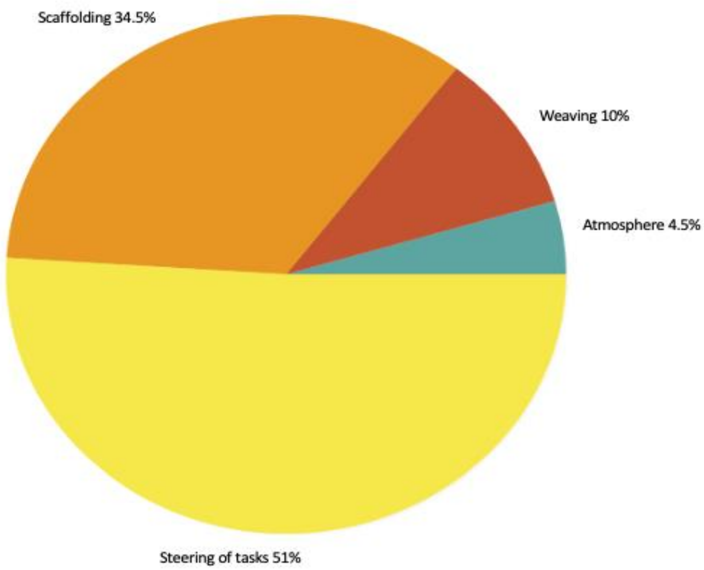

Figure 2: Proportion of Speeches Evoking the Professional Gestures of the Multiagenda
Source: Author.

Atmosphere (atmosphère)

Atmosphere refers to the share space in class between teachers and students and to the gestures teachers use to engage students in participating (Bucheton & Soulé, 2009).

Teachers explain that they will take time to create a class where it is easier to concentrate and to work all together or in small groups. Teacher 1 says that often, she "separates the group" and makes sure that everyone has his material before starting the task. Most of the adaptive gestures are in the student's intervention plan. All the participants explain they have to make sure that it's in place before: earmuffs, vocal synthesis, place to sit for specific students,

Teacher 2 precise the importance for her to create an atmosphere to avoid stress and she precise she knows that "from the start when we say we are giving a solving problem task, there is a raise of anxiety in the class". Her first preoccupation she says is to make sure she gives enough explanation to keep the tone relaxed in the class.

As for her, teacher 3 is more concerned for one student in particular. « I have N.. for him, I need to call the psychoeducator. She needs to sit next to him during his work. She must show she is there. Otherwise, he'll go and disturb the others. I have a big problem if the psychoeducator is not around. He doesn't feel concerned if there is no one-to-one adult with him".

Finally, teachers say they usually organize the space in the class as well. Teacher 1 will out a desk in the hallway and teacher 3 creates a dedicated space where she gives all the explanations in small groups in her class.

Weaving (tissage)

Weaving refers to the gestures employed by teachers to connect the knowledge in class with wider knowledge in the society (Bucheton & Soulé, 2009).

In their speeches, we find necessities as well to make links with the prior situations lived in the class. Teacher 4 for example precises that she will take into account the way the situation have been approached in previous grades. So, the situations they are about to present to the students in their class are part of an annual planning. Teacher 1 follows the planification of the copybook she has for her class. Teachers 2 and 4 say they made a change to their usual planning.

Teacher 4 feels the students need to go back to prior knowledge (She chose a situation from October in her copy book) and Teacher 4 says that because of COVID-19 consequences, she needs to spend more time teaching the sense of numbers and the sense of operations. To do so, she chose a situation with mathematical knowledge well mastered for her class to tackle the teaching of demonstration in solving problems. She plans to show the solution step by step. She explains that solving problems hasn't been taught during the pandemic, she wants to go back in knowledge. As for teacher 3, she followed her students from 3 th to 4 th grade, so the question of steering tasks with another teacher didn't apply, and she reported that it's easier for her to choose a situation to fit their needs.

They will weave links as well with the prior knowledge and they will make connections between the grades and the expectations in the grade. Doing so, they planned to be weaving with what's to come in the future years. Teacher 1 evaluates students considering further grades: She gives grades according to the 4th year, but she gives feedback to make them reach the level of the next grades. She considers that if they have reached the level of understanding of their level, they can work on presenting their solution in a mathematical way. In fact, in 4th grade, they just have to present their solution in a personal way.

We took this remark as a sign of the teacher 1's will to maintain high expectations in her class. She reports that if they keep drawing numbers in 4th grade, "they will encounter difficulties in 5th grade, so "they need to write down operations to facilitate their organization".

Furthermore, they mention the requirement of the official exams students have to pass, through the province at the end of 4th grade. It appears to let them believe that they have to teach how to demonstrate. For example, teacher 2 reports that she explains, referring to the exam "they need to present the solution in a certain way".

Steering of Tasks (Pilotage)

Steering refers to the teaching gestures used to organize the lesson step by step (Bucheton & Soulé, 2009).

Initially, our questions focused on the students' intervention plan, which is a mandatory document in Quebec. The team responsible for students with learning difficulties meets throughout the year to set objectives and make daily adaptations as necessary. When asked if students could have extra time to complete tasks, all teachers responded that it's not a priority, as they want to ensure that students complete the tasks within the assigned time to allow for subsequent evaluation.

First and foremost, teachers plan a substantial block of time in their schedules on the day of the problem-solving task. The class schedule can present various constraints. For example, Teacher 4 prefers to schedule the task before the team meeting for the intervention plan but only if a substitute is available on that day. Teacher 3 aims to stay within the confines of the regular math period during the typical week, taking into account recess and disruptions due to interventions by other teachers, such as music or English. In general, all teachers adjust the time according to the students' needs.

In Quebec, there are specialized teachers trained to address adaptation and specific student issues. These adaptive teachers work with students who have intervention plans or who are identified as "at-risk" for learning difficulties. They play a crucial role in supporting the classroom teachers. Therefore, the main constraint mentioned during the interviews is the need to coordinate with these teachers and psychoeducators. As mentioned earlier, Teacher 3 emphasized several times that her student N. cannot work effectively without one-on-one support from an adult. Teacher 1 ensures that the adaptive teacher has time to review tasks with certain students.

Teachers report that steering tasks can be quite complex when teaching problem-solving, primarily due to differences in students' pacing and the level of scaffolding required for some students. "Some students will work independently, which is fine, but others will need my guidance," explains Teacher 4, who enlists certain students and refers to them as "mini-teachers."

Teachers also anticipate organizing materials, including manipulative materials like connectable cubes, number blocks, or visual aids. Teacher 2 regrets not preparing banknotes, as she believes they would aid students' comprehension. She emphasizes the importance of selecting a task closely related to real-life situations.

Finally, steering the task is facilitated by the use of the electronic whiteboard present in their classrooms. For Teacher 3, this tool allows students to simulate and calculate the paint needed to redecorate their bedroom, reinforcing the link between container size and price.

Scaffolding (étayage)

Scaffolding in the study is heard as the set of gestures employed to make sure the students understand the task at hand (Bucheton & Soulé, 2009).

First, scaffolding in the participants' classes will begin with the teachers questioning all the students at the beginning of the task, which serves as scaffolding for the entire group. However, soon after, participants explain that they will allow most of the students to work independently, focusing their scaffolding specifically on the students they consider might encounter difficulties with the task. Teachers often emphasize that they don't want to over-explain to the entire group unless it is necessary.

The majority of the scaffolding is expected to be provided by the teachers themselves. However, they plan to delegate it within small work groups. Moreover, students requiring specific help in problem-solving are expected to benefit from the scaffolding provided by adaptive teachers or psychoeducators.

In their discussions, the relevance of feedback is also emphasized. Participants explain that they will leave numerous comments on students' sheets and provide frequent oral feedback throughout the process. They mention that they can make specific comments to individual students as they circulate between desks or work with small groups of "at-risk" students. They may also pause the entire group to address an issue relevant to all students. Teacher 3 also mentions that she plans to have one-on-one meetings with certain students, as it is essential for her that they understand the challenges they face. She intends to take the time to analyze their progress in the competency and set objectives for the next task.

In the context of solving problems, scaffolding involves orchestrating back-and-forth between various elements of the task. Teacher 1 also explains her approach to questioning students, making sure not to reveal the path to the solution. She will ask open-ended questions like, "How did you arrive at this number?" and mostly provide comments about the students' written explanations. For instance, she might ask, "What did you calculate here? Is this the number of boxes? Please write it down."

Above all, expert scaffolding is evident when teachers explain their ability to comprehend the errors students make and anticipate how to ask the right questions to help students realize their mistakes. Teacher 2 plans to sit down with students and ask them to explain their thought process, using questions like, "Why did you write this? I don't understand." She considers this aspect a significant challenge in her teaching. Teacher 3 emphasizes that accompanying students on the wrong path is "extremely difficult" because it varies for each student, and sometimes she feels that her intervention comes too late in the process.

Finally, it's noted that all the participants stress the importance of students sharing strategies during the correction phase. "If a student raises their hand to suggest an alternative approach, you can be sure I will hand them the pen and say, “Show us.” " (teacher 4)

Learning Object and Techniques

Many of the participants' explanations revolve around the wording of the situation. They all plan to start with an expressive reading, with Teacher 3 likening it to "reading a literature book." They will engage in a dialogue with the whole group to draw the situation on the board or outline the constraints as bullet points. To ensure that the entire class comprehends the situation, participants will read it aloud and ask questions to confirm that vocabulary is not a hindrance and that the purpose of the situation is clear. Teacher 1 even explains that she has reworded sentences to make the wording clearer.

For some students, the participants plan to reread the situation later on or use vocal synthesis.

Before allowing students to work on finding a solution, Teachers 3 and 4 will encourage students to exchange ideas about the situations and share plans and strategies.

To adapt the learning objects, there is an intention noted in their discourse to provide manipulative objects to some students or calculators for most participants. Teacher 1 added that she had previously given a lesson related to the situation to assess whether her students had mastered the concepts and processes presented.

The primary challenge expressed by all the participants is how to guide students through the problem-solving process. They understand that providing explicit steps is akin to giving away the solution. They plan to ask questions to gauge if students have the necessary cues to complete the task. On the other hand, they are aware that this is not the ideal way to teach problem-solving but anticipate that they may need to guide some students step by step. To address this, they intend to provide sheets that suggest the steps, typically found in all situations, and offer more explanations to a group of "at-risk" students.

During our interviews, we had intended to ask questions about how they accommodate talented students. The participants acknowledge that some students may be able to jump into the situation without much explanation and still succeed, but they only plan to have a range of activities ready for them, such as math games or book-related activities. They stress the importance of ensuring that everyone knows how to start, even the talented students, before working with the "at-risk student group." The way they plan to organize their task steering seems to influence the learning objects. For instance, Teacher 3 critically thought about her lesson after answering questions about her gifted student. She called a few days after finishing the situation in her class to share the content changes she made for him and a group of talented students. She changed the size of numbers and the number of constraints, and she was delighted to see how invested they were in their work.

Discussion

This study employs a didactic model to delineate all the anticipated actions of primary school teachers in Quebec before teaching problem-solving in their classrooms. We chose explicitation interviews (Vermersch, 2006) to gain insight into how teachers in Montreal's primary schools intended to plan a problem-solving situation. Rather than directly asking them how they differentiate instruction, we inquired about how they connected students identified in a class portrait to their anticipated actions. This approach allowed us to understand how everyday resources, such as manipulative objects, the class timetable, and other professional commitments, influenced their planning. We also observed that the importance of success in the final official exam exerts a strong influence on their planning, as they want to ensure students can step-by-step construct the solution before working independently. This may reflect their desire to spend most of their time with "at-risk" students who they believe cannot find solutions on their own, even though they recognize that providing steps to students is akin to giving away the solution.

These attitudes may have negative consequences for both "at-risk" and talented students. These students may miss out on the opportunity to collaborate with their peers in the search for a solution because teachers prioritize their scaffolding. As a result, they may not learn how to independently tackle problems. On the other hand, the group of more advanced students is given cues they do not need from the beginning, and the presented situation does not challenge them. Our participants often cited a lack of time as the reason for not adapting content for these advanced students.

Our results are interesting because they highlight a strong connection between differentiated instruction and didactics. We used a didactic model to describe differentiated gestures, and the main results indicate that, especially in a challenging lesson like problem-solving, teachers must focus on maintaining high expectations for all students. They seem to be aware of the limitations of their planning and could benefit from professional development with experts who can help them build lessons that address the unique needs of each student, without revealing the steps to the solution and providing real challenges to talented students.

Our findings resonate with other studies, such as Demonty & Fagnant (2014) in France, which observed how teachers conducted complex tasks with 11-year-old primary school students. They found that teachers tend to over-guide students when reading the situation and during correction, which ultimately hinders discussions about the difficulties students encountered. This over-guidance is guided by the idea of showing students what is efficient, similar to the teachers in our study who aim to prepare students for the final official exam. Since this exam is very specific about how students must present their solutions to earn good grades, we noted several instances in their discourse highlighting the importance of dedicating time to presenting the wording of the solution.

The TTML project by Sullivan et al. (2009) outlined seven principles for teaching problem-solving from real situations. Three of these principles are particularly relevant to our study: maintaining the challenge of tasks, anticipating what students might do with particular tasks and the strategies they might use (which our Montreal teachers seem to apply well), and understanding novel strategies developed by students as they solve problems. Our results show indeed the complexity of offering the scaffolding in solving math problems without explicitly showing what to do. The intricacies of planning the help to students and maintaining high expectancies appear to be the core complexity of the teaching.

Conclusion

In summary, our study suggests that the four teachers interviewed understood the importance of differentiating problem-solving tasks. However, they appear to have a miscomprehension of what autonomy should mean for students. They spend a considerable amount of time providing instructions before allowing themselves to work with "at-risk" students. This stems from their belief that they are the most qualified to provide expert scaffolding. Further inquiry into their motivations and beliefs would have been beneficial, as our study primarily focused on their plans and the sense of the situation without delving into their beliefs and perceptions.

REFERENCES

Ainscow, M. (2020). Inclusion and equity in education: Making sense of global challenges. *Prospects*, *49*(3), 123-134. https://doi.org/10.1007/s11125-020-09506-w

Bednarz, N., Bacon, L., Lajoie, C., Maheux, J.-F. & Saboya, M. (2017). Mathématisation en contexte d'enseignement: quelques enjeux autour de la résolution d'un problème «réaliste». *Quaderni di Ricerca in Didattica (Mathematics)*, *27*(2), 73-80.

Bergeron, G., Houde, G. B., Barthos, M. & Bergeron, L. (2022). Le soutien à l'autonomie dans la gestion de classe d'enseignants du secondaire: conceptions, pratiques et paradoxes. *Didactique*, *3*(3), 37-64. https://doi.org/10.37571/2022.0303

Bruner, J. S. (1966). *Toward a theory of instruction* (vol. 59). Harvard University Press.

Bucheton, D. & Soulé, Y. (2009). Les gestes professionnels et le jeu des postures de l'enseignant dans la classe : un multi-agenda de préoccupations enchâssées. *Éducation & didactique*, *3*(3), 29-48. https://doi.org/10.4000/educationdidactique.543

Cai, J., Morris, A., Hohensee, C., Hwang, S., Robison, V., Cirillo, M., Kramer, S. L., Hiebert, J. & Bakker, A. (2020). Maximizing the quality of learning opportunities for every student. *Journal for Research in Mathematics Education*, *51*(1), 12-25. https://doi.org/10.5951/jresematheduc.2019.0005

Celik, S. (2019). Can Differentiated Instruction Create an Inclusive Classroom with Diverse Learners in an Elementary School Setting? *Journal of Education and Practice*, *10*(6). http://eprints.tiu.edu.iq/id/eprint/710

Demonty, I. & Fagnant, A. (2014). Tâches complexes en mathématiques : difficultés des élèves et exploitations collectives en classe. *Éducation et Francophonie*, *42*(2), 173-189. https://doi.org/10.7202/1027912ar

Deunk, M. I., Smale-Jacobse, A. E., de Boer, H., Doolaard, S. & Bosker, R. J. (2018). Effective differentiation practices: A systematic review and meta-analysis of studies on the cognitive effects of differentiation practices in primary education. *Educational Research Review*, *24*, 31-54. https://doi.org/10.1016/j.edurev.2018.02.002

Dossey, J. (2017). Problem solving from a mathematical standpoint. In Csapó, B. and J. Funke (eds.), *The nature of problem solving: Using research to inspire 21st century learning*, OECD Publishing, Paris. https://doi.org/10.1787/9789264273955-6-en.

Dulfer, N., Kriewaldt, J. & McKernan, A. (2021). Using collaborative action research to enhance differentiated instruction. *International Journal of Inclusive Education*, *0*(0), 1-15. https://doi.org/10.1080/13603116.2021.1992678

Faber, J. M., Glas, C. A. & Visscher, A. J. (2018). Differentiated instruction in a data-based decision-making context. *School Effectiveness and School Improvement*, *29*(1), 43-63. https://doi.org/10.1080/09243453.2017.1366342

Finkelstein, S., Sharma, U. & Furlonger, B. (2021). The inclusive practices of classroom teachers: A scoping review and thematic analysis. *International Journal of Inclusive Education*, *25*(6), 735-762. https://doi.org/10.1080/13603116.2019.1572232

Frerejean, J., van Geel, M., Keuning, T., Dolmans, D., van Merriënboer, J. J. & Visscher, A. J. (2021). Ten steps to 4C/ID: training differentiation skills in a professional development program for teachers. *Instructional Science*, *49*(3), 395-418. https://doi.org/10.1007/s11251-021-09540-x

Gaitas, S. & Alves Martins, M. (2017). Teacher perceived difficulty in implementing differentiated instructional strategies in primary school. *International Journal of Inclusive Education*, *21*(5), 544-556. https://doi.org/10.1080/13603116.2016.1223180

Gallagher, F. & Marceau, M. (2020). La recherche descriptive interprétative : Exploration du concept de la validité en tant qu'impératif social dans le contexte de l'évaluation des apprentissages en pédagogie des sciences de la santé. in M. Corbière et N. Larivière (dir.), *Méthodes qualitatives, quantitatives et mixtes*. *Dans la recherche en sciences humaines, sociales et de la santé* (2e édition, p. 5-32). Presses de l'Université du Québec.

Garay, I. S. & Quintana, M. G. B. (2020). Estudio de marcos referenciales de habilidades para el siglo XXI: Un modelo eco-sistémico para orientar procesos de innovación educativa. *Synergies Chili*, (16), 33-128.

Goddard, Y., Goddard, R. & Kim, M. (2015). School instructional climate and student achievement: An examination of group norms for differentiated instruction. *American Journal of Education*, *122*(1), 111-131. https://doi.org/10.1086/683293

Gouvernement du Québec. (2001). Programme de formation de l'école québécoise. *Éducation préscolaire et enseignement primaire. Québec: Ministère de l'éducation*.

Hart, S. A. (2019). Des compétences de bases aux compétences du futur. *Bulletin de l'Observatoire Compétences-emplois*, *9*(3).

Hattie, J. (2012). *Visible learning for teachers: Maximizing impact on learning*. Routledge.

Kingsdorf, S. & Krawec, J. (2016). A broad look at the literature on math word problem-solving interventions for third graders. *Cogent Education*, *3*(1), 1135770. https://doi.org/10.1080/2331186X.2015.1135770

Lajoie, C. & Bednarz, N. (2012). Évolution de la résolution de problèmes en enseignement des mathématiques au Québec: un parcours sur cent ans des programmes et documents pédagogiques. *Canadian Journal of Science, Mathematics and Technology Education*, *12*(2), 178-213. https://doi.org/10.1080/14926156.2012.679992

Lajoie, C. & Bednarz, N. (2014). La résolution de problèmes en mathématiques au Québec: évolution des rôles assignés par les programmes et des conseils donnés aux enseignants. *Éducation et Francophonie*, *42*(2), 7-23. https://doi.org/10.7202/1027903ar

Lajoie, C. & Bednarz, N. (2016). La notion de situation-problème en mathématiques au début du XXIe siècle au Québec: rupture ou continuité? *Canadian Journal of Science, Mathematics and Technology Education*, *16*(1), 1-27. https://doi.org/10.1080/14926156.2014.993443

Lester Jr, F. K. (2013). Thoughts about research on mathematical problem-solving instruction. *The Mathematics Enthusiast*, *10*(1), 245-278.

Miles, M. B. & Huberman, A. M. (2003). *Analyse des données qualitatives*. De Boeck Supérieur.

Ministère de l'Éducation et de l'Enseignement supérieur. (2017). *Politique de la réussite éducative. Le plaisir d'apprendre, la chance de réussir*. Gouvernement du Québec. http://www.education.gouv.qc.ca/fileadmin/site_web/documents/PSG/politiques_orientations/politique_reussite_educative_10juillet_F_1.pdf

Moldoveanu, M., Grenier, N. & Steichen, C. (2016). La différenciation pédagogique: représentations et pratiques rapportées d'enseignantes du primaire. *McGill Journal of Education/Revue des Sciences de l'éducation de McGill*, *51*(2), 745-76. https://doi.org/10.7202/1038601ar

Moldoveanu. M & Grenier. N (2020). Profil professionnel d'enseignants qui utilisent des pratiques de différenciation. *Formation et Profession*, *28*(1), 20-36. https://doi.org/10.18162/fp.2020.522

National Council of Teachers of Mathematics (NCTM) (2019a). Executive Summary, Principles and Standards for School Mathematics. https://www.nctm.org/uploadedFiles/Standards_and_Positions/PSSM_ExecutiveSummary.pdf

Nilholm, C. (2021). Research about inclusive education in 2020–How can we improve our theories in order to change practice? *European Journal of Special Needs Education*, *36*(3), 358-370. https://doi.org/10.1080/08856257.2020.1754547

OECD (2016). *PISA 2015 results in focus* (PISA in Focus, No. 67). OECD Publishing. https://doi.org/10.1787/aa9237e6-en

Prast, E. J., Weijer-Bergsma, E. V. de, Kroesbergen, E. H. & Luit, J. E. H. V. (2015). Readiness-based differentiation in primary school mathematics: expert recommendations and teacher self-assessment. *Frontline Learning Research*, *3*(2), 90-116. https://doi.org/10.14786/flr.v3i2.163

Prud'Homme, L., Duchesne, H., Bonvin, P. & Vienneau, R. (2016). *L'inclusion scolaire: ses fondements, ses acteurs et ses pratiques*. De Boeck Supérieur.

Roditi, E. (2003). Régularité et variabilité des pratiques ordinaires d'enseignement. *Recherches en Didactique des Mathematiques*, *23*(2), 183. https://halshs.archives-ouvertes.fr/halshs-00349723

Rubel, L. H. (2017). Equity-directed instructional practices: Beyond the dominant perspective. *Journal of Urban Mathematics Education*, *10*(2). https://doi.org/10.21423/jume-v10i2a324

Selling, S. K. (2016). Making mathematical practices explicit in urban middle and high school mathematics classrooms. *Journal for Research in Mathematics Education*, *47*(5), 505-551. https://doi.org/10.5951/jresematheduc.47.5.0505

Shumm, J. S. (1999). *Adapting Reading and Math Materials for the Inclusive Classroom. Volume 2: Kindergarten through Grade Five.* ERIC Clearinghouse on Disabilities and Gifted Education. https://eric.ed.gov/?id=ED429382

Sullivan, P., Clarke, D. & Clarke, B. (2009). Converting mathematics tasks to learning opportunities: An important aspect of knowledge for mathematics teaching. *Mathematics Education Research Journal*, *21*(1), 85-105. https://doi.org/10.1007/BF03217539

Tomlinson, C. A. (2018). Complex Instruction: A Model for Reaching Up—and Out. *Gifted Child Today, 41*(1), 7-12. https://doi.org/10.1177/1076217517735355

van Geel, M., Keuning, T., Frèrejean, J., Dolmans, D., van Merriënboer, J. & Visscher, A. J. (2019). Capturing the complexity of differentiated instruction. *School Effectiveness and School Improvement*, *30*(1), 51-67. https://doi.org/10.1080/09243453.2018.1539013

Vermersch, P. (2006). *L'entretien d'explicitation* (5e éd.). ESF.

Wright, H. D. (2018). *Teachers' perceptions of the use of individualized differentiated instruction in planning, teaching, and professional responsibilities* [doctoral thesis, Walden University]. ScholarWorks. https://scholarworks.waldenu.edu/dissertations/4826/

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