# Using Number Talks in a Grade Two French Immersion Classroom to Strengthen Problem Solving Abilities: a Plan for Instruction

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As a teacher with experience teaching mathematics in grades one through eight, it has always been apparent that many students struggle with the problem solving aspects of the math curriculum. In particular, students may have some skills or have memorized some algorithms to produce answers in math class, but when they are presented with similar problems in a phrase or paragraph form, they encounter difficulties. I have observed this phenomena time and time again, throughout the grade levels, and in both the English stream and in French Immersion. "Word problems", as they are infamously known, are often the bane of the curriculum for elementary teachers, as there are many ways to approach instruction and lots of dedicated teachers, and even then students and teachers remain frustrated. Students are not learning to problem solve real life situations when they are presented with these problems. A lot of these issues boil down to an understanding of number sense, which is the ability to think fluidly about numbers (Boaler, 2017).

The development of number sense for students is a high priority for every lower elementary math teacher. So then what it is it that is impeding a child's ability and confidence in problem solving? What are the steps that they are missing in their instruction that impede their understanding of these problems? Is it reading comprehension that is the difficulty? Is it a lack of mathematics vocabulary needed to express themselves in a solution? Perhaps is it a case of confidence and an inability to see themselves as effective problem solvers. Problem solving needs to be a part of mathematics pedagogy from the very beginning, so that students begin

to learn about the language needed to interpret questions and situations, and furthermore they are adept with the language needed to express themselves mathematically. From the very beginning of their journey as learners, students need to see themselves as problem solvers.

Piaget

There have been several researchers who have had an influence on my own practice as an educator, starting with Jean Piaget. Piaget believed that Discovery Learning was the basis for development (McLeod, 2018). Discovery learning is a form of pedagogy based in constructivism through which students interact with their environment by exploring and manipulating objects,considering questions and queries, or performing experiments. The learner draws on his own experience and prior knowledge, as well as access the knowledge of peers. This 'learn by doing' philosophy is important in any classroom.

Piaget's theory of cognitive development explains how a person creates a mental image of the world; he called these mental images schema (1936). Piaget proposed that people make mental models of knowledge, and through various processes, change, adapt and create new understandings of the world. Thus, children move through the stages of cognitive development.

Piaget's (1936) theory of cognitive development is especially important in math classrooms where children progress from hands-on to symbolic to abstract manipulation of concepts. Piaget proposed four stages of cognitive development,

each building on the other and dependant not only on the biological maturity of the brain but also on the influences in the environment of the child. These influences include any instruction or schooling provided by adults as well as interactions with peers. In my current instruction, I am most concerned with the Pre-operational stage, which exists from about age two to about age seven, and the Concrete operational stage, which takes place from about age seven to about age eleven. During the Pre-operational stage children begin to understand symbols, in that a digit represents a collection of objects for example. However, logical thinking has only begun to develop in children at this stage, and they are not yet solid in their understanding of concepts such as conservation. It will be important for me to consider that some students may still be in the Pre-operational stage of their development in Grade Two. These children will benefit from the scaffolding, structures and routine of math class that focuses on learning language and participation.

Piaget considered the next stage of development, the Concrete Operational stage, to be transitional for a child; they are beginning to be able to work things out mentally in their mind, rather than have to always physically manipulate objects. The manipulatives are still important at this stage, since Piaget suggests children learn most effectively through multiple representations and hands-on experiences with concrete materials. The appropriate schemas and pathways are beginning to form in the brain of a child at this point, and even the repetition of the same activity in various ways helps to solidify knowledge and understanding. At the Concrete

Operational stage, children are learning classification of objects, rules of seriation and the development of spatial ability. All of these concepts are a part of the current Grade Two curriculum (Nova Scotia Department of Education and Early Childhood Development, 2013).

As the educational leader in the classroom, it is my job to provide students with the experiences to build their schema, as well as to change, adapt and connect the various schema they have already created in their minds. This is cognitive theory: the mind works in a way similar to a computer: inputting, storing and retrieving data (McLeod, 2015). I provide the material that fuels their cognitive development. Discovery learning should be a part of how I shape their experiences in my classroom, but it is not the only answer.

Vygotsky

Les Vygotsky introduced the importance of social interaction to education; the Social Development Theory states that a learner thrives in a community of other learners, as each person's experiences contribute to the learning of other people through social and verbal interaction (1962). This philosophy is extremely important in French Immersion, wherein students learn almost exclusively from each other rather than an intense study of the rules of the language. Teachers manifest experiences for groups of students, whether small groups or whole class discussions, and the students learn from their relationships with each other.

For Vygotsky, cognitive development results from an internalization of language (1962). He felt that an adult influences a child with patterns of language and behaviour, which are then repeated by the child until learned. Vygotsky called this adult a More Knowledgeable Other, and acknowledged that an experienced peer could also serve in this position (McLeod, 2018). Again, this concept of modelling language is very important to the French Immersion classroom and in second language learning. In particular, teaching patterns of language and behaviour can be applied to math instruction in either language, and is of particular interest to me as a researcher.

Vygotsky's Zone of Proximal Development (1962) refers to the difference between what a learner can do without help and what he or she can achieve with guidance and from a More Knowledgeable Other. This guidance is often called scaffolding, and can take on many forms, such as encouragement, specific instructions, modelling and breaking down of the task at hand. My mandate for this project will be to meet my students where they are with respect to problem solving, and to provide them with the supports that they need to grow. An understanding of Social Development Theory will be helpful in creating my own mental schemas of how to support my students.

Krashen

French Immersion programs began in Canada in the latter part of the 1960's and soon spread across Canada (2007). The Official Languages Act in 1969 gave equal

emphasis to both English and French, and the French Immersion movement was born. Thus, more research in to the nature of learning a second language was needed.

Krashen (1981) has had a large impact in all areas of second language research and teaching. The Acquisistion-Learning hypothesis is the most important of Krashen's studies and is often called the Natural Approach. Krashen believed that the acquisition of language is a subconscious process and the learner is unaware of the process taking place. This is similar to the way in which children learn their native language.

"Acquisition requires meaningful interaction in the target language - natural communication - in which speakers are concerned not with the form of their utterances but with the messages they are conveying and understanding" (Krashen, 1981, 1). Information about the language is stored in the brain through the process of communication. This natural approach is the fundamental mode of operation behind the concept of French Immersion in Canada. The learner participates in desired activities in the language, rather than learning about the rules of the language, and thus acquires ways to communicate in the target language. Once again, the teacher is responsible for creating interesting and engaging situations for learning that will give the learner the desire to communicate.

Krashen was not against teaching the rules of the language, rather felt that the study of grammar was a separate task and could be used to strengthen a student's

understanding of a language. He was very clear however, that studying the rules of the language alone did not lead to knowledge of a language. It is more important to use the language to communicate, as it is the use of the language that leads to its acquisition. In the lower elementary French Immersion classroom, traditional grammar lessons are rarely taught in an explicit manner; vocabulary and phrasing is taught as the children learn to listen, understand and communicate.

Netten and Germain

Netten and Germain (2012) follow the research of Krashen with a scientific emphasis. The neurolinguistic approach states that using by following a model in a language, neural pathways are created, and frequent use of the model strengthens the pathway. Further use and the addition of other pathways will lead to a more natural command of the language. The neurolinguistic approach to teaching a second language is grounded in the idea that learning a language begins with knowing how to speak the language, as opposed to the reading and the writing of the language. Oral communication is key to the acquisition of a language. As Krashen also stated, Netten and Germain believe that knowing the rules of a language is quite separate from being able to use a language to communicate. The teacher in the classroom must create authentic and situations for the modelling and practice of language, in which a learner will desire to communicate in the second language.

## Second language learning in mathematics

Karla Culligan (2017) is a researcher at the Second Language Research Institute of Canada at the University of New Brunswick. She is interested in the role of second language learning in mathematics. Her research shows the importance of a strong basis in the second language to being able to communicate for the purpose of problem solving. Students need a good command of structures such as *parce que* and *je pense que* in order to explain and justify their thinking. The repetition of certain linguistic structures in the discussion of mathematics emphasises the need for teachers to think about the teaching of the French language phrases as well as the traditional math vocabulary. Culligan's research, along with that of Piaget, Vygotsky, Krasen, Netten and Germain, further strengthens the case for implementing Number Talks in the French Immersion classroom.

## Number Talks

Number talks are short discussions within a classroom community, wherein a problem is proposed and students are given time to solve mentally (Parrish, 2011). Students are then asked to share, explain and justify their answers orally, and may choose to use symbols to help support their communication. Number talks are short but powerful learning activities that shows students "creativity in maths, the many different ways people see maths and flexibility in numbers" (Boaler, 2018, 1). All students are encouraged to contribute, and all of the answers are valued and

considered. Students are considered as principal contributors in this pedagogy, and are not simply receiving instruction.

During Number Talks there are many opportunities for learning computational concepts as well as mathematical language. These exchanges of language lead to the development of more accurate, efficient, and flexible strategies for problem solving (Parrish, 2017). Number Talks also contribute to the development of number sense for students (Sun et al, 2018). During Number Talks, students are busy creating their own knowledge and learning from the teacher and from each other. Rather than learning about mathematics as a set of rules, students are experiencing mathematical reasoning.

Furthermore, Boaler (2016 and 2018) believes that routinely considering open ended questions with multiple solutions allows students to develop the confidence to propose answers without fear of being shamed for being wrong. In a group such as a classroom, all students are expected to attempt to answer questions and to learn from each other. Number talks are one way to accomplish this approach. There is an increase in participation which helps communicate the message that all students are capable of understanding and engaging in math class. Making mistakes leads students to further create neural networks in their brains, and therefore facilitates learning. A positive attitude, or rather a growth mindset, allows people to learn (Boaler, 2016).

Using Number Talks in a Grade Two French Immersion Classroom to Strengthen Problem Solving Abilities - My classroom in September

When I first heard about Number Talks, my first thought was that the practice would never work in a lower elementary French Immersion classroom; the students simply do not have the language to express themselves in French. However, as I began to think about teaching problem solving and researching for this project, I realised that it was up to me as the educational leader to provide students with that language. It is my duty and job to create the experiences in which students will learn to express themselves mathematically, so that they can engage in meaningful mathematical discussions and problem solving. Culligan's (2018) research reinforced the idea that it was not just mathematical lexicon I needed to be teaching, but that I needed to be sure that they students had a good command of the words and linguistic structures needed to communicate and justify in French. Moschkovich (2013), a researcher who studies the reality of English as a Second Language Learners in the mathematics classroom, reinforces the idea that there should be a focus on language as a resource for reasoning, sense making, and communicating. Moschkovich (2013) supports Krashen's (1981) theories of language acquisition, and states that "activities calling students' attention to features of language (e.g., grammatical structures, vocabulary, and conventions of written and oral language) should only occur in conjunction with, and in the service of, engagement with the mathematical ideas, mathematical practices, and multiple representations at the heart of high cognitive demand mathematical tasks (53)." In

other words, the rules of the language should be taught right along with the activities that require the usage of the structures. Without a doubt, when planning to teach my students about problem solving, I need to start with teaching the language.

There are many things to consider when planning to implement Number Talks in a Grade Two French Immersion classroom. Piaget's (1936) work supports Number Talks at the Grade Two level, as he believes that children at this age are ready to consider more complicated problems mentally. Children are ready at this stage to create more complicated schemas in their minds, and to further connect those mathematical schemas. The connecting of these mental schemas is essentially the basis of number sense, and instrumental to learning to problem solve. Piaget also supports the idea of letting children form their own conclusions and solutions, a process that would have fit in nicely with his theory of Discovery Learning.

Vygotsky (1962) too would have appreciated the fundamental nature of a Number Talk; the teacher (otherwise known as the "More Knowledgeable Other") creates the scenario and provides the scaffolding between what the students already know and the Zone of Proximal Development. In the collaborative nature of a Number Talk, the other students can also serve as the More Knowledgeable Other, thus further strengthening neural pathways and creating confidence within the learner. This confidence contributes to growth mindset; Boaler (2016) would approve.

Netten and Germain's (2012) neurolinguisic pedagogy reinforces the idea that children must learn to speak the language before they can read it and write it. The neurolinguistic approach states that using by following a model in a language, neural pathways are created, and frequent use of the model strengthens the pathway. In my personal experience with neurolinguisic pedagogy, the phrasing targeted in the classroom is chosen by the teacher based on a topic that is interesting and desirable to the students. I have an opportunity to create problems and discussions for my students that will be interesting to them and meet the curriculum outcomes. It is an easy leap to suppose that the repetitive nature of the methods proposed by Netten and Germain will assist students in their learning of the vocabulary and language structures needed for problem solving.

For example, the Grade Two performance indicator N02: *Students will be expected to demonstrate if a number (up to 100) is even or odd*, provides students with the opportunity to consider, discuss, and contribute towards a solution to the problem. Consider the following scenario: the teacher gathers the students to the predetermined spot in the classroom where mathematical discussions typically take place. This may be on a carpet or in front of a tablet of chart paper, anywhere that signals to the students that it is time to think and to collaborate. It is quite possible that appropriate anchor charts surround this area, encouraging students to access what they already know. The teacher writes the number 53 and then says it orally. She then invites the students to think about whether they think that the number is even or odd. The methodology of a Number Talk requests that the

teacher then ask for students to volunteer their answers and explain why they are of that opinion. Neurolinguistic pedagogy states that the teacher will support the student by modelling the language used in the utterance. The teacher accepts multiple answers and makes note of them all. For example, the following scenario might occur in my classroom:

> Teacher: Bonjour ma communauté des mathématicians! Pensez-vous ce que nombre est pair ou impair?
>
> Linnea: Pair.
>
> Teacher: Merci, Linnea. Répète apres moi - Je pense que c'est un nombre pair.
>
> Linnea: Je pense que c'est un nombre pair.
>
> Teacher: Très bien. Pourquoi penses-tu que c'est un nombre pair? Répète apres moi - Je pense que c'est un nombre pair parce que...

The teacher invites the student to demonstrate their thinking orally, providing opportunities for repetition and modelling of language, as well as pictorially, to give the student plenty of ways to express themselves and create further reasons to support the student with the appropriate French and mathematical language. To emphasise engagement, the teacher can also call upon students to consider and

explain the thinking of other students. The process is repeated several times with different students, finally coming to a consensus on the correct answer. Thus, I would I propose that I meld the concepts of Number Talks with the neurolinguisitc approach to language learning as a way of strengthening problem solving abilities in my Grade Two classroom.

Obviously, this project is in its infancy. Both Parrish and Boaler offer websites and books with incredible resources for the educator who wishes to implement Number Talks in their classroom. In my own practice, there still remains the question of how to support and engage all learners, as well as specific ways to present questions. Further plans include action research within my classroom in which I will begin creating problem solving opportunities for students complete with appropriate language scaffolding. Indubitably, as I continue to consider my own teaching practice, I will continue to find ways to apply the work of Netten and Germain to the learning about the language of mathematical problem solving in my classroom. Ultimately, I believe that I have found a strong methodology of strengthening problem solving abilities in my grade Two French Immersion classroom.

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