

Math Focus 7 and English Language Learners

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English language learners, or ELLs, are present in every classroom in Alberta. While some schools may offer differentiated reading or English classes to accommodate these students, often they are mainstreamed into other core subjects, including math. Therefore, not only do math teachers teach math and its language to students but also take on the additional task of teaching reading to students who may speak fair to poor English. If teachers are expected to use a textbook as the primary resource in the classroom, they must choose one that cannot only convey mathematical language and concepts but does so in a way that is inclusive of these learners. This paper explores the use of the textbook *Math Focus 7* (2007) in the context of ELL students and why it is an inappropriate choice for many reasons, including lack of diversity, lack of cultural context and poor use of written language. While the book does have some merits, including a bilingual (French and English) glossary, the book does not meet the linguistic needs of ELL students who do not speak French. To successfully meet the needs of ELLs in the math classroom, math teachers cannot rely solely on any textbook and must be prepared to adjust their pedagogy and material.

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“The more things change, the more they stay the same” may be an apt aphorism to describe the use of textbooks in school classrooms. Students and teachers use these books every day, and their use is pushed not only by governments that develop curricula but also by textbook publishers who make considerable amounts of money by creating and developing resources. Despite the evolution of the classroom, such as the increased use of technology, flexible seating arrangements, open-concept spaces and the differences in which material is taught to students (for example, direct instruction versus project-based learning), the textbook and the expectation that students will use one, either a hard copy or online, have not changed (for example, the textbooks currently approved for use in Grade 7 math in Alberta were all copyrighted in 2007). However, have the textbooks themselves changed? One focus for the analysis of textbooks and the ways in which they have changed must be considered in the face of the complexities of our classrooms, especially with regards to English language learner (ELL) students. These students may not only be new to a teacher’s classroom or school but also, perhaps, even to Canada. If teachers are depending on textbooks to facilitate math instruction, they must be sure these books are effective in reaching all learners. With this in mind, I turn my attention to *Math Focus 7* (2007) and its effectiveness for ELLs. I chose this book because it is used in my own school and in many schools across Alberta.

Math Focus 7

The primary author of this textbook is Marian Small, in addition to a committee of other authors and consultants. Small is a professional development math consultant who works with school

districts, mainly helping them to improve K–12 math education and differentiated math instruction. She is the dean and professor emerita at the University of New Brunswick; in the summer of 2012 she was a guest professor at the University of Alberta (Small 2019).

Math Focus is a series of curriculum materials, including student textbooks, workbooks, teacher's guides and other products (such as game packs, poster packs and online material) for Grades 1–9. The language speaks directly to the student (including the use of imperatives, such as calculate or estimate), and the book is full of photographs of children. The book is very colourful and includes photos, drawings and illustrations, and graphs and charts, which may be more attractive to children, as opposed to a textbook with a more factual, minimalist approach. In *Math Focus 7*, there are 11 chapters, and each chapter follows the same pattern: first, there is a Getting Started activity. The chapter is broken down into subtopics (indicated using header numbers such as 1.2 or 9.8), which go more in-depth, followed by questions designed to take students through the solving process step by step. Finally, several questions (usually broken

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down further, such as 1a, 1b, 1c and so on) are included. Each chapter also has a section called Curious Math, which extends the chapter topic with a short game or experiment. There is a mid-chapter review and a self-review in each chapter. Chapters also have a longer math game, which often asks students to use dice or other toys. There is also a chapter task that asks students to apply math to contextual situations, such as planning a party. Finally, there are cumulative reviews every three or four chapters.

An experienced teacher could take a lot of freedom with this book, because they would be aware of which questions would be more relevant to the students and which could be skipped or removed. They would also know how best to organize the chapters or if following the order of the textbook is the best approach. For example, some teachers at our school have seen students struggle with fractions, so teachers introduce the chapter on fractions earlier than can be expected based on the book so they can be revisited throughout the year. Experienced teachers use the book only as a supplemental tool; instead, they may favour using

self-generated materials and regularly reviewing or updating them to meet the needs of new and diverse student populations.

This book is written for a narrower segment of Canadian students. There is a lack of diversity represented in the book (some names demonstrate a bit of diversity; instead of Fiona calculating a problem, it might be Yan or Pavlo). There is very little Indigenous representation and what there is, is rather token (a non-Indigenous student making a dream catcher needs to find the branches necessary; students need to use the divisibility rules to calculate groups of people in a Métis dance; students use the Quilt of Belonging, made up of squares representing Indigenous and immigrant groups to determine common factors). At least half of the children in the photographs in the book appear to be White. These questions in particular would be an excellent place to not only feature Indigenous students, but incorporate the culture behind the activities (for example, What is a dream catcher for? How or why did it originate? Why is the quilt called a Quilt of Belonging?)

No provision appears to be in the book for students of varying abilities although some questions, because of the way they are written, are harder than others. Although there are recommendations in the teacher's guide for how to differentiate instruction, but nothing specific to ELLs. There is no section labelled Challenge or similar for students of higher ability. Within the student textbook, there are no questions or exercises specifically tailored to ELL students. (In fact, the word *English* only appears twice in the student book, both times in an exercise.)

Teachers who use Math Focus 7 in their classes not only teach ELLs who were not born in Canada and do not speak English at home but also teach ELLs who may have experienced trauma as a result of displacement.

ELL Students in Alberta

As of April 2006, the year before *Math Focus 7* was published, the majority of ELLs in Alberta schools were foreign-born. Only in K–3 were the majority of ELLs Canadian-born students, and this number steadily decreased with grade level increase (Alberta Education 2006, 4). In 2006, 5 per cent of ELLs were refugees, with the majority in older grade categories. Teachers who use *Math Focus 7* in their classes not only teach ELLs who were not born in

Canada and do not speak English at home but also teach ELLs who may have experienced trauma as a result of displacement.

According to the *Canadian Magazine of Immigration*, between 2000 and 2015, 10 per cent of immigrants to Canada moved to Alberta. The top five source countries for immigrants to Alberta (and therefore for ELLs in Alberta schools) were the Philippines, India, China, the UK and its colonies, and Pakistan (*Canadian Magazine of Immigration* 2016). Of these immigrant students, perhaps the 5 per cent from the UK and its colonies will have a strong command of English. The rest will be ELLs. From 2000

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to 2015, the number of immigrants to Alberta has steadily increased year over year. However, approved math textbooks for Grade 7 in Alberta have not been updated since 2007. Although the curriculum in Alberta was updated in 2016, materials were not, despite new and emergent issues in Alberta classrooms, including increased numbers of ELLs.

According to Ron Schreiber, chair of Christ the Redeemer Catholic Separate School Division in southern Alberta, in 2017 110,000 students were considered ELL in Alberta (CBC/Radio-Canada 2018). These students may have parents who do not speak English well enough themselves to help with homework. As well, according to Alberta Education's 2016/17 *Results Analysis*, 74 per cent of ELLs completed high school within three years, which is 4 per cent lower than the rate overall (78 per cent) of students who completed high school within three years (Alberta Education 2017, 56–57). Likewise, 37 per cent of students enrol in postsecondary studies within four years of their Grade 10 year, but only 34 per cent of ELLs make the same transition (p 59). Math teachers could (and should) be playing a role to narrow this gap, meeting the needs of all students including ELLs, for instance, increased use of visuals, allowing students to annotate notes in a familiar language and having students work together so they can support each other, especially in classes with many students from similar communities.

Challenges for ELL Students in the Mathematics Classroom

Moschkovich (as cited in Kersaint, Thompson and Petkova 2012, 5) notes two principles teachers of ELLs need to consider as they plan their instruction: "Treat students' language as a resource, not a deficit; Address more than vocabulary, and support ELLs' participation in mathematics discussion as they learn English." Kersaint, Thompson and Petkova (2012, 7) themselves go on to say that even native English speakers may not be versed in mathematical language, and so all students should be considered mathematics language learners, while ELLs will be learning English at the same time. Teachers who are math specialists find themselves not only teaching math but also reading and interpreting text by using gestures, drawings, manipulatives and more, so their students can understand tasks.

Several challenges ELLs have in the math classroom are identified by Kersaint, Thompson and Petkova (2012, 46–47). Among them ELLs seldom encounter the passive voice, yet mathematics books often use it to write questions: "In a diagram, perpendicular line segments are indicated by a little square" (Small 2007, 309). In 1984, this was noted by Shuard and Rothery (1984), who, among other things, recommend the present tense only and the avoidance of passive sentences. The use of different determiners makes terms look as though they are different when they are referring to the same thing: "Jake ate $\frac{3}{8}$ of a [emphasis added] pan of lasagna, and his dad ate $\frac{1}{4}$ of the [emphasis added] pan" (Small 2007, 73). These conclusions are substantiated by O'Keeffe and O'Donoghue, who did considerable research in textbook analysis from a linguistic standpoint. Among their ideas, they state that "Consistency is also vital with the introduction of new vocabulary, and the introduction of new words should be planned so only a limited number are introduced at a time" (O'Keeffe and O'Donoghue 2015, 613).

Given that students and classrooms are more diverse than ever before, a modern math teacher can expect to teach mathematical and instructional language to a class of students with Tagalog, Punjabi, Hindi, Spanish, Mandarin and more as first languages. The common language they share in the classroom is English. In his 2007 article, Winsor details his own challenges as a math teacher who happened to speak a second language shared by many of his students (Spanish). Because of the shared languages, he was able to come up with a way to reach his students, which he called MSL or

mathematics as a second language (Winsor 2007, 373). For a teacher in a diverse classroom, this may be one feasible approach.

In addition to the lack of English language skills ELL students bring to a classroom, another challenge teachers face is that math textbooks tend to be either quite Eurocentric, or even very Canadian-centred. Newcomers to Canada may lack a cultural context to help make sense of problems presented in a textbook. For example, in many countries (such as in eastern and central Europe or South America), commas are used instead of periods to represent decimals. Students who are unfamiliar with Canadian money may find such questions challenging since there is very little correlation between value and the size of coins or the colour of bills as in other cultures. Some countries represent algorithms differently; Kersaint, Thompson and Petkova (2012, 61) provide an excellent example of the structure of long division in different cultures.

Math Focus 7 and the ELL Student

The language in *Math Focus 7* tends to follow a pattern: first, there is a little story or sentence (often accompanied by a photo or illustration) about a person and what they are doing. Next, numbers are provided in context. Finally, either a question or imperative verb (or both) is used to signal what the student is to do.

The first concern for the ELL student using *Math Focus 7* is the wording of some of the questions. For example:

Kyle is filling his little brother's wading pool. The pool holds 180L of water, and the hose supplies water at 22.5L for each minute. How long will it take to fill the pool? Answer to the nearest minute. (Small 2007, 127)

For many ELLs, especially recent newcomers, a problem like this may be too wordy. Is it relevant to know what Kyle is doing, and why? Or is the problem written this way simply to make it more interesting and engaging (which are subjective terms) to the student? An ELL student who cannot read a lot of English is likely to get frustrated with the amount of text. The background information about Kyle, his brother and pool is unnecessary, when the actual task is "If 1 minute = 22.5L, x minutes = 180L. Solve for x ."

A common grammatical error with ELLs is the confusion of prepositions. Problems that rely on specific prepositions to dictate a desired result might produce something else. For example: "Fiona is doing

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a project for the science fair. She is recording the rise and fall of the water level in a pond. One day, she had this result" (Small 2007, 248). The illustration beneath this text shows a rod in a pond, with an arrow indicating the normal level of the water, and the water itself at 35 cm below the normal level. The text continues: "The next time Fiona measured the water level, it had risen by 40 cm. What was the new reading on the rod?" (Small 2007, 248). Grammatically speaking, the most important word in this problem is *by*, which implies the requirement of addition. However, nowhere in the question does it explicitly tell the student to add. A weaker ELL student may miss the preposition entirely; for such a student, a logical answer might be 40 cm (the number is, after all, in the question). The use of the word *risen* should tell the student the water increased (assuming they know that *risen* is the past participle of *rise*, which means to increase; considering this is an irregular past participle, many ELL students may be unfamiliar with its use). In addition to the grammatical issues, the problem is, again, wordy and filled with unnecessary information. Does the student need to know why Fiona is measuring pond water? This problem is about adding integers far from zero. Essentially, the problem is: $-35 + 40 = \underline{\quad}$.

Another problem uses words that are short and fairly easy to understand. Unfortunately, there are so many of them:

Sarah cares for 24 cats at the local animal refuge. Six of these cats have short tails, 12 are black, and 15 have long hair. All the cats in the refuge have at least one of these features. One cat is black and has a short tail and long hair. Two cats are black and have short tails, but do not have long hair. Two cats have short tails and long hair, but are not black. How many cats are black and have long hair, but do not have short tails? (Short 2007, 229)

This is a logic problem, and it is designed to be circular in its wording. However, in addition to being long and wordy, this problem uses both words and digits to express numbers (six versus 12 and 15). The expression *at least* indicates a minimum of one feature, but the possibility of more. The use of the conjunction *but* means that the feature following it is not present, whereas the conjunction *and* indicates that both features are present. Finally, the question in the last sentence asks students to sort between three

features, identify which are present and which are not, and identify the number of cats indicated.

For an ELL, this is a lot of information to sift through. It requires knowledge that words are used in a grammatical sense (what conjunctions do and how they are used; the use of limiting expressions such as *at least*) and also a mathematical sense, as such words are used as logical connectors, which indicate a relationship. It requires students to be able to understand that words and numbers can be used to express the same idea, such as $six = 6$, which some ELLs may not have connected. In short, this question seems designed to trip up an ELL at multiple points. On further analysis, this question can be solved by using a Venn diagram, which would be a useful strategy for the teacher. Not only are Venn diagrams a strong visual tool for making connections, which means students without a strong grasp of English can use them, but they are also common in other core subjects, such as comparing and contrasting characters in language arts, or organizing data in science.

The cultural context in the book skews heavily Canadian, and western in general, which potentially alienates students who are unfamiliar with ideas their classmates can easily reference. Several questions deal with hockey: the area of a hockey rink, the plus and minuses (and other statistics) of a hockey player. There are pictures of children wearing hockey jerseys in the books. Some questions use French words: “Louise wants to integrate the Franco-Albertan flag into the flag for La Conférence de la Francophonie” (Small 2007, 113). Using words like this in isolation adds another layer of confusion for ELLs, who would have to wade through extraneous information in two languages to identify the task at hand.

What Works? What Needs to Be Changed?

The book does employ some strategies that make it more user friendly, not just for students in general, but for ELLs in particular. One interesting inclusion is the glossary, which not only defines instructional and mathematical terms (and distinguishes them) but also includes the word in French. For example, the first entry under Instructional Words is “calculate [calculer]: figure out the number that answers a question; compute” (Small 2007, 494). As a student who took math in French from kindergarten to Grade 10, and then struggled in Grade 11, I appreciate this inclusion. The majority of the instructional words, which are verbs, may be inferred from their English

counterparts, such as determine (*déterminer*) or validate (*valider*). However, a few of the verbs and many of the mathematical words are very different in English and in French; it may be difficult for a native French speaker to get “sketch” from “*esquisser*” or “sample” from “*échantillon*.” While I might not understand what my teacher means if they tell me to sketch a geometric shape, a quick glance in the glossary would tell me what I need to do. This glossary, however, is only of use to French speakers.

The book also uses strategies to draw students’ attention to particular words, to help them understand the action they need to undertake to solve the task or problem. In some questions, words are bolded: “Write an **equivalent** decimal” (Small 2007, 152), although this is only useful if a student knows the meaning of the bolded word. In other questions, words are highlighted to draw attention to the definition in the margin. In a question about calculating the area of wallpaper required, the term *order of operations* is highlighted and defined in a box in the margin.

The *Mathematics Kindergarten to Grade 9 Program of Studies* says both that “Students learn by attaching meaning to what they do” (Alberta Education 2016, 1) and “Contextualization and making connections to the experiences of learners are powerful processes in developing mathematical understanding” (2016, 5). Both can (attempt to) explain why math textbooks write questions with so much background information in them. As well, being able to sort important information while setting the rest aside is an important skill for all students. But the use of language in *Math Focus 7* could be clarified and standardized. While many students (including but not limited to ELLs) may appear to have good second language skills in a social setting, their academic language is not as strong, and an improvement in textbook language should strike a better balance between the two.

While math is a language, it is not an international language.

As well, the inclusion of more “international” names is pseudo-contextual at best. While some students may appreciate seeing themselves reflected in the text, unfortunately the children in the textbooks (both math and in other subjects) continue to engage in activities that are very Canadian or western-centred. If the example activities are more culturally realistic, they are often presented without any context as to their importance, which can be more harmful than excluding them altogether. This does not meet

the outcome on contextualization in the program of studies, and in fact is ridiculous from a mathematics instruction perspective. While math is a language, it is not an international language, and the attempt to culturally contextualize math without appropriate support and background knowledge is useless at best and offensive at worst.

Finally, questions that seem deliberately obfuscating or unrealistic, even to the native speaker, should be eliminated. One example would be the question cited previously about Sarah and the cats. Another would be the following, from the chapter on fractions, which is unrealistic mainly because of the inclusion of $\frac{1}{7}$, which is a fraction not common in everyday use:

Leanne put some of her allowance into her bank account to save for a bicycle. After making the deposit, she had $\frac{2}{5}$ of her allowance left. At the end of the week, she still had $\frac{1}{7}$ of her allowance left. What fraction of her allowance did she spend during the week? (Small 2007, 73)

There are opportunities for a cross-curricular approach to some of these questions. For instance, calculating fractions of land covered by forests or prairies can tie in with geography in social studies and include the encounters all students have with new or unfamiliar words in a variety of contexts.

Conclusion

The book makes some strides toward accommodating different learners, but with regards to ELL students, it rather misses the mark. A teacher who chooses this textbook for their Grade 7 classes would do well to use a variety of teaching methods to convey information, give students strategies to help them sort out essential information in longer word problems, focus on questions that clarify what the student is actually expected to do and supplement with additional realistic tasks to allow students to demonstrate they are meeting the outcomes and can complete the skills required. This is also an excellent opportunity to collaborate with other professionals within a school, including other teachers, reading specialists, and other interventionists who can support ELLs and mathematics teachers.

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