Pente or Slope?: Using Student Voices to Explore Program Choice and Experiences in Secondary French Immersion Mathematics

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Abstract: This phenomenological study explores students' decision-making about whether to remain in an optional French immersion (FI) mathematics course in Grade 11, as well as students' subsequent experiences in their mathematics course of choice. Interview data were collected from 10 students who remained in FI mathematics and from six students who did not. The data suggest that for both groups, the decision involves the perceived importance of the FI program, worry and anxiety, and input from parents and others. For students who continued in FI mathematics, reported experiences in the course focused on learning mathematics in the L2, speaking French, use of the L1, and general difficulties. For those who pursued mathematics in English, the reported experiences centred on the transition period and the differences between mathematics in the L1 and the L2.

Keywords: French immersion, mathematics, attrition, student experiences, secondary level

Résumé : La présente étude phénoménologique examine la façon dont les étudiants en viennent à décider s'ils continueront à suivre un cours optionnel de mathématiques en immersion en français (IF) en 11^{e}année, et porte sur leurs expériences subséquentes dans le cours de mathématiques qu'ils ont choisi. Dix élèves qui sont restés en mathématiques IF et six autres qui n'y sont pas restés ont été interviewés. Les données suggèrent que, pour les deux groupes, la décision était basée sur la perception de l'importance du programme d'IF, l'inquiétude et l'anxiété, et l'avis de parents et d'autres personnes. L'expérience acquise par les étudiants qui ont continué à suivre le cours a porté selon eux sur l'apprentissage des mathématiques en L2, le cours dispensé en français, l'utilisation de la L1, et les difficultés en général. Ceux qui ont suivi le cours de mathématiques en anglais ont parlé surtout de la période de transition et des différences entre les mathématiques en L1 et L2.

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Mots clés : immersion en française, mathématiques, attrition, expériences des élèves, niveau secondaire

Through my own experience, first as a French immersion (FI) student and later as a secondary FI mathematics teacher, I have found that many students and their parents feel uncertain whether learning mathematics in a second language (L2) is the best option. As students progress through high school, with the difficulty level of course content increasing and thoughts of post-secondary options looming, this uncertainty seems to intensify. Recent figures show that 300,628 Canadian students are enrolled in FI programs. In New Brunswick, the province in which this study was situated, 21,868 students, or approximately 26%, are enrolled in FI, 6,938 of them at the high school level (Canadian Parents for French, 2006).

In Canada, and particularly in New Brunswick, both numeracy and L2 learning are named as high priorities in education. For example, in 2003, the federal government released *The Next Act: New Momentum for Canada's Linguistic Duality: The Action Plan for Official Languages*, which was followed by the release, in 2009, of the *Roadmap for Canada's Linguistic Duality 2008–2013* (Canada, 2003, 2009). These plans reinforce the government's commitment to the importance of learning Canada's two official languages. *The Action Plan* acknowledges the fundamental role that education, through French second language (FSL) programs, plays in achieving the federal government's goal of doubling the number of bilingual graduates by the year 2013. It also identifies the high dropout rate of FI students at the secondary level as problematic to the achievement of this goal.

New Brunswick's Department of Education (2007) has committed itself in a new education plan 'to work urgently on literacy, numeracy, and science' (p. 11) and 'to promote cultural identity and linguistic growth' (p. 24). This plan emphasizes the importance of strong skills in the areas of numeracy and mathematics, and sets a provincial goal of ensuring that 70% of high school graduates are bilingual in the two official languages.

In July 2007, New Brunswick's Department of Education commissioned a full review of FSL programs in the province, including both Early FI (EFI) and Late FI (LFI). This report, released in February 2008, outlined several recommendations for change. In August 2008, the Education Minister announced that some of these changes would be adopted. The modifications will include an EFI program beginning in

Grade 3 (the program had formerly begun in Grade 1), while the LFI program will continue to be offered with its entry point at Grade 6. All FSL students, including those enrolled in EFI and LFI, will conclude their program at the end of Grade 10, and additional course options, taught in French, will be available to students in Grades 11 and 12 (New Brunswick Department of Education, 2008). In the past, both the EFI and LFI programs had continued through to Grade 12, and students' oral proficiency was assessed at that time using the New Brunswick *Oral Proficiency Interview* (OPI). According to the Department of Education (2008, p. 1), the changes to FSL and FI programs are intended in part, 'to increase French proficiency for a greater number of students' and to 'improve achievement in literacy, *mathematics* [italics added] and science for all students.'

Given the popularity of FI in New Brunswick and nationally, and the popularity of immersion programs around the world, there is a substantial body of national and international literature relating to various aspects of immersion education. A preliminary literature review revealed several studies of content learning in FI; however, only a small number focused on mathematics learning in FI. Furthermore, while a number of studies examine student attrition from FI and program choice, investigations into high school FI students' decision-making experiences, particularly with respect to FI mathematics, are scarce. Students' voices, especially as investigated through qualitative research methods, are largely absent.

These considerations led me to undertake this study. The study aims to contribute to research related to FI students at the secondary level. The research targets students' decision making regarding FI mathematics, and their experiences in these classes. It is particularly timely given federal and provincial educational agendas and the substantial changes recently made to FI programs in New Brunswick.

Learning mathematics in immersion

The phenomenon of learning mathematics through an L2 in an immersion environment has been the focus of several studies, the majority of which have been large scale and quantitative. Researchers have compared immersion students' mathematics results to those of their non-immersion counterparts. For example, in Finland, Jappinen (2005) compared the mathematics results of three groups of immersion and non-immersion students (aged 7–9, 10–12, and 13–15). Immersion students were enrolled in English, French, or Swedish immersion and

had received mathematics instruction in their L2, whereas non-immersion students had received it in their L1. The immersion students' results were comparable to those of the non-immersion students. The youngest immersion students had struggled somewhat compared to their non-immersion peers, but the author argues that this lag was likely to be because these students had had the shortest exposure to the L2. The middle group of immersion students performed better in some instances than their non-immersion counterparts.

De Courcy and Burston (2000) tested students enrolled in a partial immersion program in Grades 3–5 in Australia, all of whom had been learning mathematics in their L2, French. The students were separated into two matched groups for each grade; one group was given a standardized mathematics test in French, the L2, while the other wrote the same test in English, the L1. Aside from some difficulty on a small number of word problems, the results of the two groups were comparable, and this was true for students at varying levels of mathematics achievement. The researchers concluded that students instructed in their L2 were able to transfer and apply mathematics concepts on tests administered in their L1.

Marsh, Hau, and Kong (2000) have questioned the strategy of content instruction in students' L2. Their research, situated in a Hong Kong English immersion context at the high school level, found that content instruction in the L2 had a remarkably negative effect on student performance in science, geography, and history. Notably, however, there was only a small negative effect on student performance in mathematics. In addition, the researchers acknowledged that the Hong Kong immersion context differs from the Canadian, Finnish, and Australian due to factors such as point of entry and a lack of teachers who are both fully bilingual in the L1 and L2 and experts in the specific content area.

In Canada, two notable studies have compared FI students' results to those of their English program peers, while another investigated the effects of a switch to mathematics instruction in the L2. Turnbull, Lapkin, and Hart (2001) and Lapkin, Hart, and Turnbull (2003) reported that mathematics results for Grade 3 and Grade 6 FI students in Ontario were comparable to those of students in the English program. Bournot-Trites and Reeder (2001) studied a school in British Columbia that had proposed to increase instruction in French from 50% to 80% for students enrolled in the FI program. This increase would see a switch to mathematics instruction in French from English in Grades 4 through 7. Overall, results of standardized mathematics tests conducted at the Grade 6 level showed that the immersion students instructed in their L2 (the 80% group) matched or outperformed

the previous year's immersion students, who were instructed in their L1 (the 50% group).

Results on standardized tests of achievement in the province of New Brunswick corroborate these positive results. On the *Middle Level Mathematics Assessment*, completed annually by all students in Grade 8, FI students' results have exceeded those of their English program peers for the past six years. In 2005, for example, 78% of EFI students and 80% of LFI students met or exceeded the standard for achievement, compared to 51% of students enrolled in the English program (New Brunswick Department of Education, 2005). These figures suggest that most students in FI are achieving academic success in mathematics.

Mathematics in immersion: Use of the L1

Use of the L1 in the immersion classroom has been investigated in the Canadian FI context (e.g., Swain & Lapkin, 2000; Turnbull, 2001), although not within the specific context of the FI mathematics classroom. On the other hand, extensive research on *code-switching* has been conducted in English immersion mathematics classrooms in South Africa (Setati, 1998; Setati, Adler, Reed, & Bapoo, 2002). Throughout this research, code-switching is broadly defined as when either teacher or learner is, 'switching from one language to another' (Setati et al., p. 134). The immersion context of South Africa differs from the Canadian context in two notable ways: the inferior status of students' L1, and the reduced availability of resources and support (Setati).

Despite these differences, the research is relevant to the present discussion in that it focuses specifically on the mathematics immersion environment. This research has found that, as has traditionally been the Canadian FI viewpoint (e.g., Swain & Lapkin, 2000; Turnbull, 2001), immersion teachers in South Africa feel some combination of internal and external pressure to rely only on the L2 when instructing mathematics, and to encourage or allow only the use of the L2 when students discuss mathematics. At the same time, teachers instinctively feel that the L1 can at times be a valuable resource and may aid students' comprehension of the mathematical concepts. These teachers' instincts are supported by seminal research by Cummins (in Baker, 2006), which has shown that students' use of the L1 can have a positive effect on L2 and content learning in multilingual classrooms. A dilemma appears to exist, and the dual role of being both a language and a mathematics teacher has been recognized as complex (Adler, 1998, 1999; Setati et al., 2002).

Like the research situated in South African immersion classrooms, research within Canadian FI classrooms has acknowledged the complex nature of the FI content teacher's role (e.g., Swain, 1996). According to a Canadian survey of 2,000 FI teachers (Day and Shapson, 1996), teachers appear to be cognizant of the complexity of their role. They ranked the need for professional development (PD) on teaching subject matter in FI second only to the need for PD on teaching language arts in FI and the need for development of curriculum and resources in FI, which tied for the top-ranked need.

Attrition

A large portion of research on the issue of attrition from FI at the high school level was conducted in earlier years of FI (i.e., the 1970s, 1980s, and early 1990s). It had certain limitations including, but not restricted to, lack of student tracking, a focus exclusively on large-scale, quantitative studies, and differing definitions of attrition (Halsall, 1994). Despite these limitations, some of the most recent research on FI attrition has consistently revealed several noteworthy findings. In particular, surveys of parents, teachers, principals, and other educators have revealed that among the main reasons for student attrition are academic difficulty, limited choice of subjects and specialty programs, and post-secondary considerations (Halsall; Obadia & Theriault, 1995). Survey data from FI students revealed that the main reasons for transferring from FI are quality of instruction, a perception of increased ability to get better grades in the English program, and dissatisfaction with course content (Lewis & Shapson, 1989). To a lesser extent, students also cited other factors, including academic difficulty and the desire to enrol in a specialty course as reasons for abandoning the program (Lewis & Shapson).

Foster (1998) provides a more recent and qualitative look at the issue of FI attrition, focusing on students who chose to remain in FI rather than on those who chose to leave the program. Foster's research concentrated on six high school students of above-average, average, and below-average general academic achievement and found that all six cited bilingualism, close-knit classes, a sense of pride, and parental support as some of the benefits of remaining in the FI program. Challenges to remaining in FI resembled the previously cited reasons for abandoning the program. While Foster's research examined the FI program in its larger sense, the two below-average students who participated in the study spontaneously spoke about learning mathematics in their L2. Although both students struggled in mathematics,

both stated that they did not believe learning mathematics in English would make it any easier, and both emphasized the role of the teacher as important in FI mathematics.

The role of anticipated post-secondary choices in students' decisions whether to remain in or leave FI has surfaced in several research studies regarding FI attrition at the high school level (Halsall, 1994; Obadia & Theriault, 1995). Other studies (Foster, 1998, April; Goldberg & Noels, 2006; Wesche, Morrison, Ready, & Pawley, 1990) have shown that while a small number of FI graduates opt to pursue university in a francophone, bilingual, or immersion setting, the vast majority, even when reporting having had positive FI experiences, continue their post-secondary studies at an anglophone university.

In sum, review of research indicates that, overall, immersion students' mathematics results parallel or exceed those of their non-immersion counterparts. Furthermore, research has shown that students can transfer mathematical knowledge learned in their L2 and apply it to problems given in the L1. Use of the L1 has been recognized as a dilemma confronted by immersion content teachers and in general, the complex role of the immersion content teacher has been acknowledged in the literature. Research regarding student attrition from FI has been largely quantitative and has been conducted mostly in the earlier years of the FI program. Nonetheless, issues such as academic difficulty, course choice, and post-secondary options have consistently surfaced as challenges to remaining in the program. An explicit exploration into the potential role of FI mathematics in issues of FI attrition is absent. In-depth accounts of students' experiences, as related through their own voices, are also largely absent.

Research questions

The literature review and the research questions that have emerged from it suggest the need for a qualitative study focusing on students' perceptions of and experiences with decision-making regarding course selection, as well as on their perceptions of and experiences with FI mathematics at the high school level. This study approaches its exploration of these issues in a qualitative and small-scale manner in an attempt to further understanding of the areas described above.

The two research questions guiding this study were as follows:

What are the experiences (perceptions, feelings, opinions) of students regarding their decision to either remain in, or transfer out of, French immersion mathematics when entering Grade 11?

What are the experiences of students who decided to stay in French immersion mathematics for Grade 11 and of students who decided to transfer into English mathematics for Grade 11?

In order to address these questions, this study was qualitatively oriented and followed a hermeneutical phenomenological approach.

Methodology

Phenomenology 'describes how one orients to lived experience' (van Manen, 1997, p. 4) and is a means to 'understand the "essence" of the experience *as perceived by the participants*' (McMillan, 2008, p. 291). The research questions clearly focus on participants' perceptions of the decision-making and FI mathematics lived experiences, thus lending themselves to a phenomenological approach.

Phenomenology is sometimes viewed in conjunction with hermeneutics, which 'describes how one interprets the "texts" of life' (van Manen, 1997, p. 4). While some view phenomenology and hermeneutics as separate entities (Giorgi, Silverman, cited in van Manen, 1997), others view the two as linked (Heidegger, cited in van Manen; van Manen). Hermeneutic phenomenology essentially asks, 'What is this or that kind of experience like?' (van Manen, p. 9), a pertinent question for this particular study. The data analysis, described later in more detail, resulted in both a description and an interpretation; thus, the methodological approach can most accurately be described as hermeneutic phenomenology.

Participants

Data for this study was collected at a single site, a large, urban high school in New Brunswick. FI mathematics was a popular option at this secondary school. At the time of the study, 116 students were enrolled in Grade 12 mathematics. Of these, 63 (54%) had been enrolled in FI mathematics up to and including Grade 10. Of the 63 Grade 10 FI mathematics students, 46 (73%) had enrolled in the optional FI mathematics course in Grade 11. Therefore, only 15 students (24%) had chosen to switch to an English mathematics course earlier than necessary, in Grade 11.

Sixteen Grade 12 students participated in the study, all of whom had been enrolled in FI mathematics up to and including Grade 10. Ten of these students had chosen to continue in FI mathematics in Grade 11 by enrolling in the optional FI mathematics course (henceforth identified as the FIM 11 group; see Table 1). Six had chosen to switch to an English mathematics course for Grade 11 (henceforth identified as the EM 11

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TABLE 1
Grade 11 French immersion mathematics student participant demographics

Pseudonym	Gender	Grade 11 mathematics mark (%) range*	FI point of entry (grade)
Grace	F	90–100	6
Megan	F	90–100	1
Melanie	F	90–100	1
Susan	F	90–100	6
Amanda	F	76–89	6
Andrew	M	76–89	1
Mark	M	76–89	1
Rodney	M	76–89	6
Ann	F	60–75	1
Paul	M	60–75	1

* Two-semester average.

group; see Table 2). At the time of the study, all 16 students were enrolled in an English mathematics course, their only option for Grade 12 mathematics. Of the 16 students, 8 came from LFI and 8 from EFI; 7 were female and 9 were male; and 5 had experienced above-average achievement in mathematics (90–100), 8 had experienced average achievement (76–89), and 3 had experienced below average achievement (60–75).

Data collection and analysis

In-depth, individual, semi-structured interviews, described by McMillan (2008, p. 292) as 'the data collection mainstay of a phenomenologist,' were

TABLE 2
Grade 11 English mathematics student participant demographics

Pseudonym	Gender	Grade 11 mathematics mark (%) range*	FI point of entry (grade)
Jack	M	90–100	1
Christopher	M	76–89	1
James	M	76–89	6
Lisa	F	76–89	6
Shane	M	76–89	6
Daniel	M	60–75	6

* Two-semester average.

the main source of data for this study. An 'interview guide' (Seidman, 2006, p. 91), featuring open-ended questions based on the research questions, was developed for FIM 11 and EM 11 student interviews (see Appendix). These questions served as a guide during interviewing, while allowing for prompting and flexibility throughout the process; such flexibility is a key to qualitative interviewing (Warren, 2002). Student interviews lasted between 17 and 34 minutes. All of them were audio recorded and transcribed verbatim.

Following the transcription process, interview data were analyzed following what McMillan (2008) has described as a three-step approach, whereby the data were organized, summarized, and interpreted. Creswell (2003) has expanded on this approach to qualitative data analysis by describing six distinct steps.

The first step consisted of transcription of the recorded interview data and organization of other documents (e.g., notes, files).

Following the transcription and organization of the data, interpretation began with the second step, in which the aim was to 'obtain a *general sense* of the information and to reflect on its overall meaning' (Creswell, 2003, p. 191). All interview transcripts were read in their entirety, passages that were 'interesting' (Seidman, 2006, p. 117) were underlined, and initial notes, reactions, and ideas were written in the margins. This also marked the beginning of the coding process.

The third step, the coding process, involved 'taking text data . . . segmenting sentences . . . into categories, and labeling those categories with a term' (Creswell, 2003, p. 192). After a number of interview transcripts were read again, similar topics were grouped together and these were labelled using a colour-coding system and an abbreviated code. These codes were used to identify corresponding segments of text in the remainder of the interview transcripts. In addition, some new topics, and thus codes, emerged as new transcripts were analyzed. Related topics were grouped and re-grouped into categories and subcategories, and a final coding of the interview data was completed.

The fourth step involved using 'the coding to generate a small number of themes or categories.. . . They [the themes] should display multiple perspectives from individuals and be supported by diverse quotations' (Creswell, 2003, p. 194). These themes were then organized within the framework of the research questions and, consistent with the phenomenological approach, shaped into a 'general description' (p. 194) of the phenomenon of interest.

The description and analysis of the data were extended in the fifth step by a 'detailed discussion of several themes (complete with subthemes, specific illustrations, multiple perspectives from individuals,

and quotations)' (Creswell, p. 194). The results of these steps in the process are presented in the following section.

The sixth and final step in the qualitative data analysis included 'making an *interpretation* or meaning of the data' (Creswell, 2003, p. 194). According to Creswell, during this step the researcher can compare the findings of the study with existing research, suggest new questions, call for action, or make recommendations for change. This step of the data analysis, consistent with hermeneutics or hermeneutical phenomenology, is included in the discussion section below.

Throughout any qualitative research study, and perhaps especially during the data collection, analysis, and interpretation phases of a phenomenological study (due to its emphasis on participant voice), 'the researcher needs to suspend, or "bracket," any preconceived ideas about the phenomenon to elicit and better understand the meanings given by the participants' (McMillan, 2008, p. 292). This need stems from the interpretive nature of qualitative research and the notion that 'the researcher filters the data through a personal lens that is situated in a specific sociopolitical and historical moment' (Creswell, 2003, p. 182). In order to bracket any preconceived ideas, it is important that the researcher 'systematically reflects on who he or she is in the inquiry and is sensitive to his or her personal biography and how it shapes the study' (p. 182). To accomplish this, I kept a journal throughout the study in which I continually reflected on and acknowledged my personal background, feelings, and potential biases in my role as researcher.

Results

The resulting themes are presented in order of pertinence. Within the framework of the research questions, themes that were discussed by greater numbers of participants are presented first. Although participants represented both genders, both FI programs, and different levels of academic achievement in mathematics, these factors did not appear to create any consistent, remarkable differences in their responses in this study.

Students' decision-making experiences

Although two distinct groups of students were interviewed, FIM 11 and EM 11, interview data revealed similar emergent themes with regard to decision-making experiences. However, students from the two groups approached a number of the themes from opposing

viewpoints. Three main themes emerged: the FI program, worry and anxiety, and input from others.

The FI program

Within the first main theme, the FI program, most students discussed course credits and, for the FIM 11 group, remaining in the FI program was very important. To this end, these students found FI mathematics to be a valuable course option. Students identified this course as one that would allow them to simultaneously earn a French credit (five credits were required across Grades 11 and 12 in order for students to remain in FI) and a mathematics credit, in course schedules that did not allow for many electives. As this FIM 11 student explained,

> I wanted to do the French immersion program. I need the five credits, right? I had to find the five credits . . . so math was courses I was going to take *anyway*, and they were offered in French, so that's *part* of the reason. (Susan, FIM 11)

The EM 11 students also spoke extensively about credits; however, all but one did not think that remaining in the FI program was important to them. Because of this, these students were not willing to make the necessary adjustments to their course loads in order to ensure they had the required number of French credits. Only one student who had chosen not to enrol in FI mathematics in Grade 11 had chosen to continue in the FI program by finding alternative French credits.

The importance of completing the FI program was greatly linked with students' desire for the certificate of completion they would receive from the school at graduation. FIM 11 students, who had all remained in the FI program, along with the sole EM 11 student who had remained in the FI program, identified the certificate as important because they viewed it as a valuable credential and as providing a sense of accomplishment. As this student explained,

> [It was] just another option to have, like the French certificate to say that I have French courses, and I have the ability to speak French and stuff. Not only to have the proficiency test [the Oral Proficiency Interview (OPI)] and everything, but just to kind of show that I have taken courses in French, I just thought it might benefit me in the future. (Grace, FIM 11)

Aside from the one EM 11 student who had remained in FI, the remainder of the transfer group stated that the certificate was not a credential they valued. However, they did view the fact that they would not be awarded the certificate as an indication that their time in FI had been a 'waste.' One student explained:

> Like my friends said, I did go this far so it's just kind of like I wasted all that time and got pretty much nothing, I guess. I don't know if I could still take that interview [the OPI] or something. I can't get the certificate, yeah.. . . I kind of feel like it's a waste. (James, EM 11)

Some FIM 11 students also stated that it would be a 'waste' not to complete the program and receive the certificate once they had gotten as far as they had.

Exclusively among FIM 11 students, two additional sub-themes emerged as they spoke about the FI program. For many of these students, the decision to remain in FI mathematics had been an almost automatic choice; they had not seriously considered any other option. One student explained: '[I] actually never considered taking English math. It was, it was just always something I was going to do. I was going to ... I mean that's kind of the only thing I thought about was taking French math' (Andrew, FIM 11).

Finally, a small number of students also acknowledged that taking the FI mathematics course would be an additional opportunity for French learning.

Worry and anxiety

The second main theme that emerged regarding students' decision-making was that of worry and anxiety. Both FIM 11 and EM 11 students spoke about experiencing some worry and anxiety during the decision-making process, but the specific worries and anxieties differed. The FIM 11 group expressed concerns about leaving the 'comfort zone' of learning mathematics in French. Specific concerns cited were having to switch to learning mathematics in English and leaving the customary classroom environment, which included familiar teachers and classmates. As one student explained,

> I was a little more set on staying in French, just because I was used to it for so long, that I couldn't really *picture* trying to learn in the English. That, it was kind of strange.. . . It felt more comforting to have it in French, kind of *safe*, I want to say. (Ann, FIM 11)

For EM 11 students, several worries outweighed the potential comfort of remaining in FI mathematics. For example, Christopher, like others, was concerned about Grade 12:

> In Grade 12, math is only offered in English and the same with university so, kind of figured it'd be more experience in the English, better to switch over then. I thought it would be harder to switch over in Grade 12. (Christopher, EM 11)

Other concerns were preparation for university, perceived increases in comprehension and marks, and the fact that some close friends were leaving FI.

Input from others

The third and final theme that emerged in students' decision-making was input from others. Students from the FIM 11 group more often stated that they felt the decision to remain in FI mathematics was essentially their own, while the EM 11 students appeared to rely more heavily on others for support. In both cases, parents and other relatives (e.g., siblings, aunts, cousins) were the source of most conversations.

As one student explained, 'My parents encouraged me to stay with it but I think it, it was mostly my decision. I wanted to do it but anybody that I asked encouraged me to stay with it' (Susan, FIM 11). Similarly, another student noted,

> Me and my parents talked a lot about it.... My parents had wanted me to take French, and I had wanted to take it too, but then ... when we sat down together at the end of Grade 10, we started picking my courses, we were trying to decide whether or not taking French was a great idea. (Christopher, EM 11)

Only one FIM 11 student explained that parental pressure had contributed to her decision to remain in FI mathematics. Although this same student described the benefits of remaining in FI mathematics, she also had reservations about remaining in the course: 'I found it [FI mathematics] really hard and that's why I was doing really bad in math.... I guess my mom just really wanted me to take it. So I took it, both terms in French' (Amanda, FIM 11).

A smaller number of students in both FIM 11 and EM 11 groups also mentioned having conversations with friends or teachers about their decision.

Students' experiences in Grade 11 FI mathematics

As FIM 11 and EM 11 participants spoke about their experiences in their Grade 11 mathematics course of choice, different themes emerged. For the FIM 11 students, the themes were learning mathematics in the L2, speaking French in FI mathematics, use of the L1 in FI mathematics, and general difficulties.

Learning mathematics in the L2

The majority of FIM 11 students stated that they found learning mathematics in their L2 had little to no effect on their acquisition of the material. As one student explained,

> I find math an easy course to take in French because it's not much different, because you're working a lot with . . . numbers.. . . I didn't find that it was more difficult really at *all*.. . . [T]he knowledge of math, and applying terms and concepts, it's all the same. It doesn't matter what language it is. (Susan, FIM 11)

One student also discussed the positive effects of learning mathematics in French while learning other subjects, in this case physics, in English:

> When I first . . . started taking Physics [in English] . . . that was when, like the *math* part of it, I started learning more of it in English and it almost, it kind of made sense even *more*, having Physics math . . . in English *while* taking the French math because it could, I kind of like, put the two together.. . . [It was] almost like the French helped me remember it more.' (Grace, FIM 11)

Only one student described her L2 mathematics experience as having had a negative impact on her learning:

> They're all [subjects in French] pretty hard, but math would be the–but it's easier to understand like, with the numbers and stuff, but . . . it was harder because it was like a bunch of different stuff.. . . I can't understand math that well, so it was like a lot harder. (Amanda, FIM 11)

This same student had identified benefits of remaining in FI mathematics but had also expressed much more reservation about remaining in the course than the rest of the FIM 11 group.

Despite a majority of students' having stated that learning mathematics in an L2 had neutral effects, most later went on to identify

some difference between L1 and L2 mathematics learning, based on the new perspective they had gained following their eventual switch to English mathematics in Grade 12. These differences were largely similar to those identified by students who had switched to English mathematics in Grade 11, and they will be discussed together in that section.

Speaking French in FI mathematics

Many FIM 11 students described their experiences regarding speaking French in the FI mathematics classroom as they spoke about their general experiences in the course. For some students, speaking French in FI mathematics felt 'natural,' and these students thought that French was spoken a majority of the time:

> You were supposed to talk French in the class.. . . [I]t was just, kind of natural to talk French in a French class.. . . [W]e're used to having math in French so when we go in the class it's just automatic to speak in French. (Melanie, FIM 11)

Other students considered that French was not spoken as much as it should have been and expressed regret at not having spoken more French:

> Oh yeah, when you're speaking to your teacher and everything like that, it's all in French, but a lot of the students speak English to each other in class.. . . [I]n French math, not everybody always spoke French all the time, which is probably like a problem. If they did speak French all the time, I'm 100% sure they would do a lot better and I know I would do a lot better. (Paul, FIM 11)

On the other hand, students mentioned that they found that some use of English by the FI mathematics teacher aided their comprehension. This notion is developed in the next theme.

Use of the L1 in FI mathematics

As the following example illustrates, students found that the use of some English vocabulary provided them with links to prior knowledge and to English-program peers:

> I know that sometimes they [the teachers]'re trying to encourage just like, pure French in the class and everything, but I think it's kind of helpful if

> like, once in a while, they'd kind of give you the English term just so that, if you knew it before . . . and heard about it in English, then you'd kind of associate it with what you're doing.. . . And it makes it easier to . . . help out other people who are in the English program or like, talk with them. (Grace, FIM 11)

In addition, students noted that they sometimes found themselves using the L1 during the FI mathematics class: 'It's so frustrating sometimes because when you're trying to convey sarcasm or something, but you can't, really, because your French isn't good enough' (Grace, FIM 11).

Students stated that they used the L1 most often when trying to formulate a question related to mathematics, or during social interactions with each other that were not related to mathematics.

General difficulties

On a final note, a number of FIM 11 students discussed what they perceived as a general increase in difficulty in Grade 11 mathematics and/or in Grade 11 in general:

> Well Grade 11 math, it seemed really hard to everybody because I talked to people about it, French and English class, I'd say, 'Do you know what's going on?' and they'd say, 'Nah.' . . . So, I mean, it was hard, there was no getting around that, it was tough for everybody. (Andrew, FIM 11)

As this student suggests, this difficulty was perceived to exist in both FI and non-FI courses.

Students' experiences in Grade 11 English mathematics

Other themes emerged during analysis of the interview data collected from students who had made the switch from FI to English mathematics in Grade 11. For these EM 11 students, the themes included the transition into mathematics in the L1 and the experience of mathematics in the L1 versus the L2.

The transition into mathematics in the L1

EM 11 students experienced a transition in their Grade 11 year, and this transition was the focus of most students' experiences in Grade 11 mathematics. They described the initial transition period as brief and

causing little difficulty: 'I thought it would be a lot harder but it only took me like, a week or two to get used to the terms' (Shane, EM 11).

FIM 11 students described their transition to English mathematics in a similar fashion even though it occurred in Grade 12 rather than Grade 11. Some students from the FIM 11 group qualified their description of initial transition as 'weird,' and a smaller number of students from both groups described the adjustment as somewhat difficult, although brief.

Mathematics in the L1 versus the L2

Both EM 11 and FIM 11 students described differences they perceived once having switched to English mathematics, even though the switch had happened at different grade levels. Many FIM 11 students identified the new vocabulary as the sole difference, and they considered it a minor difference at that. Interestingly, almost all those who mentioned this change in vocabulary identified the term *pente*, or slope, to have been the most problematic:

> I found I was always using 'pente' instead of slope. I was like, 'And then you find the "pente" of the line, I mean, the *slope* of the line' [laughs], but other than that I didn't find it was a big deal. (Megan, FIM 11)

Other students, from both the EM 11 and FIM 11 groups, identified more substantial differences, such as an increased working vocabulary, a small increase in marks (in some cases, students noted there was no increase), an increase in ease of comprehension, an increase in the ability to focus on instruction, and an increase in ease of expression and overall general comfort level. For example, one student explained: '[I found] alternative ways of expressing a certain problem.. . . I have a larger vocabulary and a more broad understanding of things in English, just from living my life in it' (Jack, EM 11). Another student noted,

> Like at least in English, if you're just kind of drifting off, you still hear the words and you don't have to, in your mind, translate . . . but in French, if you're just kind of head in the clouds, your brain isn't paying attention at all. Like, you're just not, you don't pick up on anything. (Paul, FIM 11)

Despite these positive differences identified by some EM 11 students following their transfer to English mathematics, these same students stated that the changes were not as substantial as they had originally

expected: 'It probably made a difference but not as *big* a difference as I thought it would've made.... So it did prepare me but not as much as I thought it would' (Christopher, EM 11).

One EM 11 student thought that, in fact, he could have performed equally well in FI mathematics in Grade 11 had he chosen to remain in the course.

Discussion

In qualitative research, 'the emphasis is on how well the data, categories, analyses, and patterns are described and how well other researchers can understand the findings so that they can be used in other settings' (McMillan, 2008, p. 298). The data in this study, while not generalizable, are thus intended to contribute to a better understanding of secondary students' decision-making regarding, and experiences in, FI mathematics. A majority of FI high school students in this study, when given the choice, continued studying mathematics in French. These students based their decision on a variety of factors, including the importance they placed on the FI program (and especially the certificate), considerations regarding necessary credits and available FI courses, the comfort level they had attained learning mathematics in their L2, and the support they had received from others (especially their parents). At the same time, some students described staying in FI mathematics as something that had occurred almost automatically.

Nonetheless, almost one-quarter of students in this study had opted out of FI mathematics when given the option, and all but one of these students also opted out of the FI program at this time. For these students, concerns regarding post-secondary preparation and expected increases in ease of comprehension and in marks were at the heart of the decision-making. Having the support of others (especially parents) also played a role in the decision-making of the transfer students.

Some results of this study corroborate previous research regarding FI attrition (Foster, 1998; Halsall, 1994; Lewis & Shapson, 1989; Obadia & Theriault, 1995). For example, students who chose to leave FI mathematics in this study cited reasons such as post-secondary preparation and a perceived ability to achieve better grades in the English program. Those who chose to stay based the decision on the perceived importance of the FI program, the comfort factor, and parental support.

Other results from this study provide new insight into the decision-making experiences of high school FI students. The sentiment

expressed by both FIM 11 and EM 11 students that, should they not receive their FI certificate, their study of French would be a 'waste' is perhaps the most poignant insight. This saddens me as an immersion educator and is likely to sadden many others. Students placed more emphasis on the FI certificate awarded by the school than they did on the OPI, which is the official assessment tool used in the province of New Brunswick to measure the proficiency level of its FI graduates (New Brunswick, n.d.). These differing emphases of FI students and the province need to be addressed. To remedy feelings of wasted study, students may benefit from a more on-going, autonomous documentation of their language learning. A tool such as the *European Language Portfolio* (ELP) could address such concerns (Council of Europe, n.d.).

Regarding the effect of learning mathematics in an L2, most FIM 11 students maintained that the effect was neutral. Upon switching to an English mathematics course, whether in Grade 11 or Grade 12, most students acknowledged little to no difference in mathematics performance as measured by marks. Such observations corroborate previous research, which has found that immersion students' results match or exceed those of non-immersion students and that students instructed in their L2 can transfer mathematics concepts and apply them in the L1 (Bournot-Trites & Reeder, 2001; de Courcy & Burston, 2000; Jappinen, 2005; Lapkin, Hart, & Turnbull, 2003; Marsh, Hau, & Kong, 2000; New Brunswick Department of Education, 2005; Turnbull, Lapkin, & Hart, 2001). Nonetheless, both FIM 11 and EM 11 students perceived an increased ease in some area of learning on switching to learning mathematics in their L1. It is important to note however that, for students who had chosen to switch to English mathematics in Grade 11, the change, although described as positive, had not produced the dramatic results (i.e., increase in comprehension or marks) they expected. Such observations imply that, while transferring from FI to English mathematics may be the best option for some students, it should not be viewed as a 'magic bullet' solution to all difficulties regarding academic achievement in mathematics. Furthermore, most students who remained in FI mathematics saw the course as a viable and useful option that helped them to remain in the FI program. Enabling more students to remain in FI mathematics, and thus the FI program, especially throughout their secondary years, may further the national and provincial goals for bilingualism outlined in this article's introduction.

Students spoke extensively about using the L1 in the L2 mathematics class when discussing their experiences with FI mathematics. Students saw English as a resource that helped them connect to prior

knowledge and that provided a quick clarification when one was needed. Students also found that while they had an easier time discussing mathematics vocabulary in French, expressing themselves when talking about non-mathematical topics sometimes proved more difficult. Previous research regarding use of the L1 in the L2 content classroom (Adler, 1998, 1999; Setati, 1998; Setati et al., 2002; Swain & Lapkin, 2000; Turnbull, 2001) has identified this issue as a dilemma for teachers. Students in this study recognized the need for, and importance of, the L2, French, as the primary language in the classroom; however, they stated that L1 use does occur. These results suggest that rather than viewing the L1 as strictly damaging to the L2 classroom, we should, perhaps especially in the FI content classroom, recognize that students' occasional use of the L1 may be likened, as one FI mathematics teacher at the site described, to calling upon another 'tool,' an additional resource, similar to the computer or graphing calculator (personal communication, January, 2008).

Although the results discussed here provided answers to the research questions, they also raised additional questions about what constitutes a 'good' FI mathematics class. Further analysis of the interview data from this study could provide some insight into this question. Another question relates to the use of the L1 in high school FI mathematics. Although participants in this study were not asked any questions that specifically addressed the role of the L1 in their FI mathematics class, they discussed this notion at considerable length. Additional research, based in the Canadian FI mathematics context, could build on research from existing studies (e.g., Swain & Lapkin, 2000; Turnbull, 2001) regarding the effect and role of teacher and student use of the L1 in FI content classrooms.

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References

Adler, J. (1998). A language of teaching dilemmas: Unlocking the complex multilingual secondary mathematics classroom. *For the Learning of Mathematics*, *18*(1), 24–33.

Adler, J. (1999). The dilemma of transparency: Seeing and seeing through talk in the mathematics classroom. *Journal for Research in Mathematics Education*, *30*(1), 47–64.

Baker, C. (2006). *Foundations of bilingual education and bilingualism* (4th ed.). Clevedon, UK: Multilingual Matters.

Bournot-Trites, M., & Reeder, K. (2001). Interdependence revisited: Mathematics achievement in an intensified French immersion program. *The Canadian Modern Language Review, 58*(1), 27–43.

Canada. (2003). *The next act: New momentum for Canada's linguistic duality: The action plan for official languages*. (Cat. CP22–68/2003E). Ottawa: Privy Council Office.

Canada. (2009). *Roadmap for Canada's linguistic duality 2008–2013*. Retrieved June 9, 2009, from www.pch.gc.ca/pgm/slo-ols/strat-eng.cfm

Canadian Parents for French. (2006). *The state of French-second-language education in Canada 2006*. Retrieved September 17, 2007, from http://www.cpf.ca/eng/resources-reports-fsl-2006.html

Council of Europe (n.d.). *European language portfolio*. Retrieved July 7, 2008, from http://www.coe.int/t/dg4/portfolio/default.asp?l=e&m=/main_pages/welcome.html

Creswell, J. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Day, E.M., & Shapson, S.M. (1996). *Studies in immersion education*. Clevedon, UK: Multilingual Matters.

de Courcy, M., & Burston, M. (2000). Learning mathematics through French in Australia. *Language and Education*, *14*(2), 75–95.

Foster, R. (1998, April). *Graduates of a French immersion program*. *Paper presented at the annual meeting of the American Educational Research Association*, San Diego, CA. Retrieved September 28, 2007, from from ERIC. (doi ED420196).

Foster, R. (1998). Profile of a group of 'successful' bilingual senior high school students. *Bilingual Research Journal*, *22*(2–4), 201–214.

Goldberg, E., & Noels, K.A. (2006). Motivation, ethnic identity, and post-secondary education language choices of graduates of intensive French language programs. *The Canadian Modern Language Review, 62*(3), 423–447.

Halsall, N.D. (1994). Attrition/retention of students in French immersion with particular emphasis on secondary school. *The Canadian Modern Language Review, 50*(2), 312–333.

Jappinen, A.-K. (2005). Thinking and content learning of mathematics and science as cognitional development in content and language integrated learning (CLIL): Teaching through a foreign language in Finland. *Language and Education*, *19*(2), 148–169.

Lapkin, S., Hart, D., & Turnbull, M. (2003). Grade 6 French immersion students' performance on large-scale reading, writing, and mathematics tests: Building explanations. *Alberta Journal of Educational Research*, *49*(1), 1–21. Retrieved September 5, 2007, from ProQuest http://proquest.umi.com/pqdlink?Ver=1&Exp=08–21–2013&FMT=7&DID=579671291&RQT=309

Lewis, C., & Shapson, S.M. (1989). Secondary French immersion: A study of students who leave the program. *The Canadian Modern Language Review, 45*(3), 264–275.

Marsh, H.W., Hau, K.-T., & Kong, C.-K. (2000). Late immersion and language instruction in Hong Kong high schools: Achievement growth in language and nonlanguage subjects. *Harvard Educational Review Online*, *70*(3), 1–46. Retrieved September 17, 2007, from www.edreview.org

McMillan, J.H. (2008). *Educational research: Fundamentals for the consumer* (5th ed.). Boston: Pearson Education.

New Brunswick (n.d.). *The oral proficiency evaluation*. Retrieved September 17, 2007, from www.gnb.ca/0381/002%2De.asp

New Brunswick Department of Education. (2005). *Report card 2005: Anglophone school districts*. Fredericton, NB: Department of Education Assessment and Evaluation Branch.

New Brunswick Department of Education. (2007). *When kids come first*. Fredericton, NB: Department of Education.

New Brunswick Department of Education. (2008). *Background paper: Revised FSL model*. Retrieved August 5, 2008, from www.gnb.ca/cnb/Promos/EFI/PDF/FSLReport-e.pdf

Obadia, A.A., & Theriault, C.M.L. (1995). *Attrition in French immersion programs: Possible solutions*. Burnaby, BC: Simon Fraser University.

Seidman, I. (2006). *Interviewing as qualitative research: A guide for researchers in education and the social sciences* (3rd ed.). New York: Teachers College Press.

Setati, M. (1998). Code-switching in a senior primary class of second-language mathematical learners. *For the Learning of Mathematics*, *18*(1), 34–40.

Setati, M., Adler, J., Reed, Y., & Bapoo, A. (2002). Incomplete journeys: Code-switching and other language practices in mathematics, science, and English language classrooms in South Africa. *Language and Education*, *16*(2), 128–169.

Swain, M. (1996). Integrating language and content in immersion classrooms: Research perspectives. *The Canadian Modern Language Review, 52*(4), 529–548.

Swain, M., & Lapkin, S. (2000). Task-based second language learning: The uses of the first language. *Language Teaching Research*, *4*(3), 251–274.

Turnbull, M. (2001). There is a role for the L1 in second and foreign language teaching, but... *The Canadian Modern Language Review, 57*(4), 531–540.

Turnbull, M., Lapkin, S., & Hart, D. (2001). Grade 3 immersion students' performance in literacy and mathematics: Province-wide results from Ontario (1998–99). *The Canadian Modern Language Review, 58*(1), 9–26.

van Manen, M. (1997). *Researching lived experience: Human science for an action sensitive pedagogy.* London, ON: Althouse Press.

Warren, C.A.B. (2002). Qualitative interviewing. In J.F. Gubrium & J.A. Holstein (Eds.), *Handbook of interview research: Context & method* (pp. 83–102). Thousand Oaks, CA: Sage Publications.

Wesche, M.B., Morrison, F., Ready, D., & Pawley, C. (1990). French immersion: Postsecondary consequences for individuals and universities. *The Canadian Modern Language Review, 46*(3), 331–352.

Appendix: Interview questions

1. What was it like for you when you were deciding whether or not to choose FI mathematics when entering Grade 11? Tell me about what you were thinking and give me details about what happened.
2. Was anyone involved in helping you make your decision? If so, tell me about this.
3. Think about the reasons you stayed in/left FI mathematics in Grade 11 and talk about your experiences in the course. Tell me about your thinking and give details about your experiences.
4. Did you ever consider taking mathematics in English/French in Grade 11? If so, tell me about this.