French Immersion High School Science Teachers' Course Development Experiences

by

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Abstract

The first purpose of this case study was to understand the course development experiences of Grade 10 French Immersion (FI) Science teachers in Manitoba. The second purpose was to develop an online instructional resources database model based on an understanding of these teachers' course development experiences that holds promise in supporting Grade 10 FI Science teachers in Manitoba.

Results of this study revealed that teachers' experiences are negatively impacted by equity issues, such as a lack of resources in French designed to address the Manitoba curriculum. These equity issues negatively impact teachers' well-being. In turn, these equity issues for teachers, as well as the impacts of these issues on teachers' well-being, have negative impacts on the quality of FI education in Manitoba.

An online instructional resources database model, entitled the *Living Curriculum* model, was developed. This model is based on the belief that, if teachers are provided with an ample supply of quality instructional resources designed to address the provincial curricular outcomes, the quality of teaching and learning in FI programs can be improved by reducing the time that teachers are spending developing resources and by positively impacting teachers' well-being. In turn, FI teachers are less likely to leave the profession, further improving the quality of FI education in Manitoba.

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Dedication

This thesis is dedicated to all of the past, present, and future French Immersion teachers in Manitoba and across Canada who have or will have devoted so much time, energy, and heart to French Immersion education.

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Chapter 1: Introduction and Overview

In Chapter 1, I introduce the context of my qualitative case study by describing its area of focus. Following this introduction, I present the purposes of my study, the central research question, and the associated research subquestions.

Area of Focus

With enrollment in French Immersion (FI) programs in Canada increasing 27.7% over 20 years since 1991 (Standing Committee on Official Languages, 2013), access to these programs in "many regions" has been limited by enrollment caps and registration challenges (Office of the Commissioner of Official Languages, 2013). One of the reasons for the lack of space in these programs is the shortage of teachers who specialize in "French second-language instruction" (Standing Committee on Official Languages, 2014). According to the Canadian Association of Immersion Teachers (2013), the quality of French-language education is threatened by this shortage of specialists (as cited in Standing Committee on Official Languages, 2014, p. 33).

In my experience as an FI teacher in Manitoba, I have observed the number of qualified French-speaking teachers decrease due to the demands of teaching in French. Specifically, I have met new and experienced FI teachers who admitted that they struggled with high levels of work-related stress and left the profession to pursue other careers as a result of this demanding workload. I have also met teachers who left FI to teach in English programs. Witnessing the stress experienced by my teacher colleagues, as well as observing colleagues leave (or consider leaving) the teaching profession for workload-related reasons, were events that saddened me and inspired me to pursue educational research in hopes of finding ways of supporting FI teachers. These colleagues who have expressed concerns regarding the demanding workload of their teaching position have communicated to me that one factor contributing to this demanding

workload is obtaining and developing instructional resources. With FI enrollment on the rise in Manitoba (Canadian Parents for French, 2014), I believe that investigating teacher support measures, specifically those related to instructional resources, is vital in order to support and retain FI teachers.

Findings reported in the literature echo these situations. First, high levels of teacher stress, not only for FI teachers, are revealed in surveys such as those conducted by the Canadian Teachers' Federation (Froese-Germain & Riel, 2014) and the Manitoba Teachers' Society (Dyck-Hacault & Alarie, 2010). Second, a governmental report entitled *The State of French Second-Language Education Programs in Canada* (2014) noted teachers leaving FI to teach in English programs (p. 32).

Excessive workload and lack of support are often cited by teachers as factors contributing to their departure from the profession (Karsenti & Collin, 2013; Karsenti, Collin, Villeneuve, Dumouchel, & Roy, 2008). While these factors were not specific to one group of teachers, the "lack of instructional materials" was cited as a factor particularly significant for FI teachers (Karsenti et al., 2008, p. 5). Ewart (2009) also identified "lack of resources" as a frequently-reported "challenging factor" in her study of new teachers who recently graduated from the Université de Saint-Boniface's French-language Education program in Manitoba (p. 485). The Canadian Association of Second Language Teachers (CASLT) corroborates the need for instructional resources "especially for FI programs," and reveals, more specifically, the "need for immersion-specific materials" (CASLT, 2013 as cited in Standing Committee on Official Languages, 2014, p. 35). As reported in a 2007 paper published by Lewthwaite, Stoeber, and Renaud, constraining factors to science program delivery in Francophone-minority settings in Manitoba and Saskatchewan included: "[teacher knowledge of] strategies for teaching science to

learners with less-developed French language abilities... [and] physical resource availability and appropriate French language science resource materials" (p. 325). While Lewthwaite et al.'s study focuses on Francophone minority settings, the constraining factor of "[teacher knowledge of] strategies for teaching science to learners with less-developed French language abilities" would be as relevant to FI teachers, since the FI program is designed for students learning French as an additional language. Another related challenge, especially significant for FI teachers, is that texts are frequently written for students studying in their first language and are, therefore, difficult readings for non-native French speakers (Cormier & Turnbull, 2009, p. 824).

In a recent study conducted by Rivard and Gueye (2015), factors that challenged the implementation of language-based activities in Francophone Grade 9 Science courses included: "a heavy workload," "substantial time constraints," and "a lack of resources" (p. 84, translation). Rivard and Gueye (2015) note that "many teachers [who participated in the professional development sessions] mentioned that a collection of varied resources, appropriate and suitable for the Grade 9 Science curriculum, would be extremely useful, and that this collection could even be available online" (p. 84, translation).

In light of the recurring themes of "heavy workload," "lack of instructional resources," and "[teacher knowledge of] strategies for teaching science to learners with less-developed French language abilities," I seek to explore Grade 10 FI Science teachers' practices, challenges, and needs associated with obtaining and developing instructional resources, as well as their experiences with integrating French language-learning into their courses. In order to understand these teachers' experiences at a deep level, a qualitative approach and a case study design were selected. This study aims to address the gaps in the research literature on teaching science in FI programs in Manitoba. Specifically, while the need for French-language instructional resources

has been identified by several scholars, no known research has been conducted that explores Manitoba FI science teachers' practices, challenges, and needs associated with obtaining and developing instructional resources in order to address this reported issue. Furthermore, while the importance of the explicit integration of French language learning in science has been made clear, no known research has been conducted in Manitoba that addresses one of the identified constraints of this integration: a need for instructional resources to support language-based activities. Through an understanding of Grade 10 FI Science teachers' course development experiences, the potential problems of "lack of instructional resources" and "[a lack of teacher knowledge of] strategies for teaching science to learners with less-developed French language abilities" were explored with this group of FI teachers in Manitoba.

Based on the present study's findings, an online instructional resources database model that holds promise in supporting Grade 10 FI Science teachers was developed. In so doing, I aimed to build on Rivard and Gueye's (2015) study by investigating the relevance of the participants' suggestion ("that a collection of varied resources, appropriate and suitable for the Grade 9 Science curriculum, would be extremely useful, and that this collection could even be available online" [p. 84, translation]) in the present study in the context of Grade 10 FI Science teachers in Manitoba.

In other words, through understanding Grade 10 FI Science teachers' practices, challenges, and needs associated with course development, I developed an online instructional resources database model that: a) supports their current course development practices and b) seeks to address their challenges and needs. This model aims to creatively use technology to increase access to information for FI science teachers. I believe that this online instructional resources database model will be applicable to the creation and sharing of resources in all

teaching areas, not only FI science courses.

The present study was designed as the first phase in a two-phase study. If the online instructional resources database were to be developed and implemented by the provincial government (see page 166), I would hope to evaluate the effectiveness of the database in supporting FI science teachers in the second phase of research (post-thesis). By evaluating the effectiveness of the instructional resources database, I would seek to address Grade 10 FI Science teachers' needs, with the intention of positively impacting teacher well-being, reducing the administrative burden of teacher attrition, and improving the quality of FI science education in the Province of Manitoba.

Reasons for choosing Grade 10 FI Science. I chose to study the experiences of Grade 10 FI Science teachers in Manitoba for several reasons. First, being a FI science teacher in Manitoba, I aspire to determine if and how FI science teachers in this province can be further supported in teaching the Grade 10 Science provincial curriculum. I specifically chose science at the Grade 10 level, as I have experience teaching this course and its content is of personal interest to me. Furthermore, I believe that it is particularly important to engage students in science at the Grade 10 level since Grade 10 Science is the last mandatory science course for high school students in Manitoba.

The final reason for focusing on Grade 10 FI Science teachers is that there are more teachers who have taught Grade 10 Science in Manitoba compared to teachers who have taught chemistry, which is an area in which I also have teaching experience. There is a smaller number of chemistry teachers, because fewer students enroll in Chemistry (an optional course) compared to Grade 10 Science (a mandatory course for graduation). Therefore, by focusing on Grade 10 FI Science teachers in the present study, there were more teachers who I could invite to participate,

which increased the probability of gaining an "*in-depth understanding* of the case," which is a "hallmark of a good qualitative case study" (Creswell, 2013, p. 98).

Definitions of Key Terms.

French Immersion: "French Immersion is a second language program designed for children whose first language is not French and who have little or no knowledge of French prior to entering the program" (Manitoba Education and Training, 1996, p. 3 as cited in Manitoba Education, Training and Youth, 2002, p. 1)

Instructional resources: This term has been defined by the researcher to refer to all teaching resources (print or electronic) used in the context of a science course. They can be used by the teacher or by the students.

Purposes

The first purpose of this case study was to understand the course development experiences of Grade 10 French Immersion (FI) Science teachers in Manitoba. *Course development experiences* is generally defined as a combination of:

- teachers' practices, challenges, and needs associated with obtaining and developing instructional resources for the Grade 10 Science course, and;
- teachers' experiences in integrating French-language learning into their Grade 10 Science course.

The second purpose of this case study was to develop an online instructional resources database model that holds promise in supporting Grade 10 FI Science teachers in Manitoba and is based on an understanding of these teachers' course development experiences.

Research Questions

The central research question of the present study is the following:

How do Grade 10 French Immersion Science teachers in Manitoba describe their course development experiences?

The associated research subquestions are the following:

1. How do FI science teachers describe their practices, challenges, and needs associated with obtaining and developing instructional resources for the Grade 10 Science course?
2. How do FI science teachers describe their role in fostering French-language development among their students?
3. How do FI science teachers describe their practices, challenges, and needs associated with integrating language-learning into their Grade 10 Science course?
4. How do Grade 10 FI Science teachers describe an ideal online instructional resources database that would support them in course development? For example, what online platform would best support teachers' use of this database? What kinds of instructional resources would be most useful to include in this database? What are the characteristics of an ideal online instructional resources database for Manitoba science teachers?
5. How do Grade 10 FI Science teachers describe the impacts that an online instructional resources database would have on their teaching and personal lives?

Summary of Chapter 1 and Subsequent Chapter Overviews

In Chapter 1, I outlined this study's area of focus, providing context and its rationale. Following this introduction, I stated the purposes of the study and its five research questions. In Chapter 2, a review of the literature is provided and gaps in the research literature are suggested. In Chapter 3, *Research Methodology*, I begin by describing this study's theoretical framework, the research approach, and the research design. Following these sections, I present my position and describe this study's ethical considerations, recruitment and sampling procedures, and data

sources. At the end of Chapter 3, I describe the data analysis procedure and address how I ensured the credibility and reliability of this study. In Chapter 4, *Results*, I provide a description of the findings of this study. Finally, in Chapter 5, *Discussion and Conclusions*, I first discuss the three main themes that were revealed after analyzing the results. Second, I present recommendations to various stakeholders. Third, I suggest directions for future research. At the end of Chapter 5, I present concluding remarks.

Chapter 2: Literature Review

The recurring themes of the factors affecting French Immersion (FI) education and the value of gaining insight into FI science teachers' experiences surfaced in Chapter 1. In this review of the literature, these themes will be elaborated as they relate to this study.

The first section of this review, *Factors Constraining and Supporting French Immersion Science Education*, examines the many factors affecting FI education in Canada, generally, and in Manitoba, specifically. First, the factors constraining access to, and the quality of, FI education will be discussed. Second, a more detailed examination of these factors will be provided, namely, an explanation of the factors affecting teacher shortage and science program delivery. Finally, I look to the literature that explores ways in which to improve access to quality FI education.

The second section of this literature review, *Teaching and Learning in French Immersion Science Programs*, provides an overview of some of the current literature on teaching and learning in FI programs. First, views of learning will be described. Second, a summary of the current literature on the importance of, and strategies for, integrating language-learning into FI science courses will be provided.

The third section of this review, entitled *The Grade 10 Science Curriculum in Manitoba*, provides an overview of this curriculum, its underlying philosophy, and the provincial documents available to support its implementation.

The final section of this review, *Gaps in the Research Literature*, will elaborate on what has not yet been studied in Manitoba in the context of FI science education. These gaps in the research literature, as well as my personal experiences, inspired the development of the research questions for this study.

Factors Constraining and Supporting French Immersion Education

Factors affecting access to and the quality of French Immersion education. This section will summarize the literature on how the demand for FI programs, coupled with a shortage of qualified teachers, affect access to, and the quality of, FI education in Canada. Following this summary, a more-detailed examination of literature that outlines concerns for FI program quality will be presented.

Demand for French Immersion programs and shortage of qualified teachers. The enrollment in FI programs in Canada between 1991 and 2011 increased 27.7% (Standing Committee on Official Languages, 2013). In general, there were not enough spaces in French-second language programs to meet the demand across the nation in 2013 (Standing Committee on Industry, Science and Technology, 2013). Access to second-language programs in "many regions" has therefore been limited by enrollment caps and registration challenges, such as "overnight line-ups and lotteries" (Office of the Commissioner of Official Languages, 2013). One of the reasons for the lack of space in these programs is the shortage of teachers who specialize in "French second-language instruction" (Standing Committee on Official Languages, 2014). In the 2014 report entitled "The State of French Second-Language Education Programs in Canada," the Peel District School Board in Ontario is provided as an example of a school board facing a French-speaking teacher shortage (p. 32). In this school board's 2011-2012 review of its FI elementary programs, the challenge of recruiting and retaining "qualified immersion teachers" was identified (p. 32). Furthermore, it was found that some qualified French-speaking teachers left the FI program to teach in English programs (p. 32).

In a 2014 Canadian Parents for French (CPF) report on FI and Core French programs in British Columbia and Yukon, the FI teacher shortage was identified as "serious," with 85% of

responding school districts indicating that it is "challenging" or "very challenging" to find "sufficient qualified FI teachers" (CPF, 2014, p. 10). In response to what hinders school districts' expansion of FI programs, 51% of responding school districts indicated "lack of physical space" and 49% indicated "lack of qualified teaching staff" (p. 10). In the latest available CPF annual report for the Manitoba branch (2012-2013), it was noted that enrollment in FI attained a record high (p. 10). Challenges related to French-second language education access and quality varied by community (especially urban vs. rural). One highlighted challenge was the "need for qualified, linguistically competent" FI teachers (p. 10).

The increase in enrollment in FI programs in Canada has caught the attention of the media. For example, in a 2015 *Vancouver Sun* article, Wendy Carr (director of the UBC teacher education program) notes the high demand for French-speaking graduates (Sherlock, 2015). Carr goes on to explain that her research revealed the same issue experienced by the Peel District School Board: many FI teachers start teaching in French, but then leave to teach in English programs. She found that reasons include "challenges like parent scrutiny and lack of resources" (Sherlock, 2015). In Manitoba, FI enrollment has increased in the Louis Riel School Division ("French immersion surge," 2015). According to the division's assistant superintendent, Christian Michalik, the division is exploring ways to relieve capacity issues at one of its Grade 7 to 12 FI schools. In the same article, it is noted that the Winnipeg School Division, Winnipeg's largest school division, is also addressing capacity issues due to the high demand for FI education.

The Franco-Manitoban School Division (DSFM), which serves Manitoba's Francophone community, reports an enrollment increase of 1.6% from January 2014 to September 2015 (DSFM, 2015, p. 6). Their current September 2015 divisional enrollment includes 295 students

in Grade 12 and 450 students in kindergarten, suggesting the potential for higher enrollments in their middle and high schools in the near future (DSFM, 2015). This increasing enrollment in the DSFM places even more demand for French-speaking teachers in Manitoba.

Factors affecting teacher shortage and program delivery. The literature examining the effects of teacher stress and attrition on programming will be reviewed in this section, followed by a discussion of the factors constraining French-language science program delivery.

Teacher stress. In 2014, the Canadian Teachers' Federation (CTF) conducted the "CTF Survey on the Quest for Teacher Work-Life Balance" that identified factors contributing to teachers' stress levels. Teacher respondents indicated the extent to which specific factors were "contributing to stress [they] may be experiencing" (Froese-Germain & Riel, 2014, pp. 4-12). For example, 82.2% of respondents indicated that "lack of preparation time" was contributing either "significantly" or "somewhat" to their level of stress (p. 4). Furthermore, 82.4% indicated these same responses for "insufficient human and material resources to support the curriculum" (p. 6). This survey does not indicate the percentage of respondents who teach in French, but it is indicated on CTF's website that respondents were teachers from "across the country." Since "lack of instructional materials" has been cited particularly by FI teachers as one of the factors contributing to teacher attrition (Karsenti et al., 2008), it is possible that the shortage of "material resources to support the curriculum" is particularly stress-inducing for FI teachers.

In the "Teacher Workload Survey" conducted in 2010 by the Manitoba Teacher's Society, 70% of respondents indicated that "the teaching job has negatively impacted their health," and 82% indicated that "the stress experienced on the job, especially the time-related aspects of a teacher's job, frequently and adversely spills over into one's personal and/or family life" (Dyck-Hacault & Alarie, 2010, p. 24). Such stress experienced by Manitoba teachers has

consequences on their performance in the classroom: "73 percent [of teachers] stated that on the job stress has negatively impacted their work performance" (p. 24). These studies on teacher stress in Canada and in Manitoba are important to the present study, as they highlight the importance of research in the area of teacher support measures.

Teacher attrition. The research data on teacher attrition in Canada is limited, with the most recent known research published in 2013 by Karsenti and Collin. "Attrition"/"drop-out" among young teachers is "generally understood as voluntary and premature departure from the teaching profession" (Macdonald, 1999 as cited in Karsenti & Collin, 2013). After many discussions with teachers across Canada, however, Karsenti and Collin (2013) believe that the use of the term "voluntary" is problematic, and they define teacher "drop-out" differently (p. 141). These researchers state that "...it is increasingly evident that some teachers are coping with more and more challenges and problems, until the only option is to abandon the profession" (p. 142). As a result, they define teacher "drop-out" in their survey as "a premature departure from the teaching profession, whether voluntary or not" (p. 142).

Karsenti and Collin (2013) go on to explain that the literature reveals that teacher attrition is "associated with the induction phase" of teaching (Borman & Dowling, 2008 as cited in Karsenti & Collin, 2013, p. 142). In other words, "novice teachers (with less than 7 years of experience), not experienced veterans, are the ones who are most often quitting" (Karsenti & Collin, 2013, p. 142).

Karsenti and Collin (2013) note the scarcity and the variability of data on teacher attrition in Canada (p. 143). Ewart indicates that 26% of Manitoba teachers "have stopped contributing to the Teachers' Retirement Allowance Fund after the first five years of teaching" (B. Venuto, personal communication, 2008 as cited in Ewart, 2009, p. 476), which provides a vague

estimation of teacher attrition in Manitoba. In Ewart's study (2009), she examined the attrition rate of graduates from the University of St. Boniface/Université de Saint-Boniface (USB) (formerly Collège universitaire de Saint-Boniface) who completed the Education program between 2001 and 2005 (p. 480). The Université de Saint-Boniface is the only French-language university in Manitoba ("About USB," 2014) and is affiliated with the University of Manitoba ("History of the University of Manitoba," n.d.). Ewart found an attrition rate of 8% for these graduates at the time of the study (p. 484). This percentage only represents the attrition rate for USB graduates, and not for all French-language teachers in Manitoba.

In Karsenti and Collin's 2013 study on teacher attrition, 34 "drop-out teachers" from Halifax, Toronto, Calgary, Vancouver, and Montréal were interviewed (22 of whom were women) (p. 144). At the time these teachers left the profession, 70.3% had five years of teaching experience or less. This data is consistent with previous studies showing that the "induction period" is a time during which teachers are more likely to leave the profession (p. 144). In the 2008 Canada-wide survey conducted by Karsenti et al., they also noted that a "large proportion of the departures reported in the survey occurred within the first five years of service" (p. 5). Karsenti and Collin (2013) and Karsenti et al. (2008) reported that 50% of the teachers in their study left the profession within the first two years.

The studies conducted by Karsenti and Collin (2013) and Karsenti et al. (2008) reveal that excessive workload, classroom management issues, and lack of support are often cited by teachers as factors contributing to their departure from the profession. The "lack of instructional materials" has been cited as a factor particularly significant for FI teachers (Karsenti et al., 2008, p. 5). Another reported factor specific to FI teachers is "difficult work conditions inherent in French immersion" (Karsenti et al., 2008, p. 5). The authors do not describe these inherent

conditions any further. The present study was designed to build on Karsenti and Collin's (2013) and Karsenti et al.'s (2008) studies by exploring FI teachers' experiences at a deeper level. Specifically, FI science teachers' course development experiences were explored.

Factors constraining science program delivery. In 2007, Lewthwaite, Stoeber, and Renaud conducted the first phase of a multi-phase action research study that aimed to "[improve] science education delivery in francophone-minority settings" in Manitoba and Saskatchewan (p. 317). The authors explain that science program delivery in these settings is complex for various reasons, including that the language of instruction (French) is different from the language of the majority in the community (English) (pp. 318-9). Various data collection methods were used to identify the "factors perceived to be constraining or contributing to the delivery of science programs in francophone-minority schools" (in kindergarten to Grade 9) (p. 325). Some of the constraining factors included: "[teacher] content knowledge... [teacher knowledge of] strategies for teaching science to learners with less-developed French language abilities... physical resource availability and appropriate French language science resource materials" (p. 325). The authors did not report the frequency with which each factor was reported as contributing or constraining. While this study focuses on Francophone minority settings, the constraining factor of availability of "appropriate French language science resource materials" is undoubtedly a factor for FI teachers, as the Manitoba science curriculum in French is the same for FI and Francophone programs ("Éducation Manitoba," n.d.). As discussed above, the "lack of instructional materials" for FI teachers is corroborated by Karsenti et al. (2008, p. 5). The Canadian Association of Immersion Teachers (CAIT) also supports the need for materials "especially for FI programs," and reveals, more specifically, the "need for immersion-specific materials" (CAIT, 2013 as cited in Standing Committee on Official Languages, 2014, p. 35).

The reported constraining factors affecting Francophone science programs in Manitoba and Saskatchewan in Lewthwaite et al. (2007) inform the present study. Specifically, the present study sought to examine, at a deep level, the reported constraining factors of a lack of instructional resources and "[teacher knowledge of] strategies for teaching science to learners with less-developed French language abilities" in the context of FI science education in Manitoba.

In order to address several of the challenges with science program delivery in Francophone-minority schools identified in Lewthwaite et al. (2007), Stoeber (2012) conducted a follow-up study with the objective of determining the effectiveness of an online virtual collaborative learning community in supporting four teachers in four rural Francophone schools in Manitoba. This study revealed that problems associated with technology can be another factor hindering science program delivery in these settings; for example, slow Internet connections caused frustration for teachers when trying to collaborate for their online virtual science lesson (Stoeber, 2012, p. 117). Since Stoeber's study was published approximately five years ago, it was important in the present study to identify if "slow Internet connections" is still a reality in rural schools, or if there are other challenges to using the Internet, in order to understand the course development experiences of FI science teachers in Manitoba.

Ways to improve access to quality French Immersion education. Reducing teacher stress and attrition, improving science program delivery, and investing in research will be examined in this section.

Reducing teacher stress and attrition. Recommendations suggested to improve retention of teachers in the profession in Canada include increased support, working conditions specific to new teachers, and the implementation of mentoring programs (Karsenti & Collin, 2013; Karsenti

et al., 2008). While Ewart (2009) chose not to include the responses of the participants in her study who left the teaching profession because "attrition [was] not substantial for this group of graduates" (p. 484), she did report on the factors that challenged and supported the Université de Saint-Boniface graduates in their first years of teaching. "Classroom management, student evaluation, and lack of resources" were most frequently reported as "challenging factors" (p. 485). The most frequently-reported factors that "facilitated integration" included "support from my colleagues" (82%) and "my pre-service training" (79%) (p. 487). Mentorship was the most frequent response to "what could have further helped your integration into the profession?" (p. 488). The role of colleagues was examined in the present study in the context of FI science teachers' course development experiences in Manitoba.

Improving science program delivery. Stoeber (2012) found that her online virtual collaborative learning community project attended to some of the risk factors associated with teaching in Francophone minority settings by "reducing isolation by collaboration" and by "supplying fast access to resources in French" (translation, p. 118). Stoeber provided some specific examples of online tools and demonstrated the effectiveness of these online tools in supporting and fostering collaboration among teachers. These online tools included "Elluminate" (online video conferencing) and "Moodle" (course management system for the creation of online learning communities) (pp. 108-9). Moodle was used by teachers and students.

In this same study conducted by Stoeber's (2012), Grade 9 Science lessons (on electricity) were created by the researcher and consultants. Each teacher was then given training on one section of the unit and presented a lesson plan to the other three teachers. Collectively, the teachers finalized the lesson plans and then returned to their schools to teach the lesson to their own students, as well as the students in the other three schools (by means of the online

community) (Stoeber, 2012, p. 107). While this collaborative project "[reduced] isolation" and "[supplied] fast access to resources in French" for teachers in these communities, the time-consuming nature of the process used to collaborate could present a challenge. Since Stoeber's study was specific to teachers in Francophone schools, the present study built on the literature in the area of French-language science education in Manitoba by determining if FI high school science teachers are also in need of "fast access to resources in French" and, if yes, the types of resources that are most needed. The present study was also designed to determine the best ways of increasing access to these resources by identifying potentially useful resource-sharing online tools (e.g., if "Moodle" is still a relevant resource-sharing tool in 2016).

Investing in research. In The State of French-Language Education programs in Canada, "several witnesses" noted the role that the Government of Canada could play in improving "French second-language education programs by investing in research" (Standing Committee on Official Languages, 2014, p. 36). For example, the Canadian Association of Second Language Teachers (CASLT) states that "comparative studies are needed on second-language instruction materials," as the "results of this research would allow decision-makers and the various levels of government to identify and implement best practices for French second-language programs" (Standing Committee on Official Languages, 2014, p. 36). CASLT has suggested that the Government of Canada "mandate the Social Sciences and Humanities Research Council to encourage research and the dissemination of research findings on the acquisition, teaching and evaluation of second languages and on teacher training by offering research grants in those fields" (CASLT, 2013 as cited in Standing Committee on Official Languages, 2014, p. 37).

The statement by CASLT that "comparative studies are needed on second-language instruction materials" is relevant to the present study, which has been designed as a potential

two-phase study. Specifically, in the second, post-thesis phase of the present study, I would seek to evaluate the effectiveness of a provincially-managed online instructional resources database that is informed by the results of the present study, should one be developed by the government (see page 166). This second phase would potentially address the need for "comparative studies on second-language instructional materials" identified by CASLT. This follow-up study could also contribute to research that "would allow decision-makers and the various levels of government to identify and implement best practices for French second-language programs."

Teaching and Learning in French Immersion Science Programs

View of learning. Schunk (2000) reminds us of the importance of drawing on a variety of learning theories to understand the various strategies that can help individuals learn: "effective teaching requires that we determine the best theoretical perspectives for the types of learning we deal with and draw on those perspectives for teaching suggestions" (p. 15). The main theory upon which I draw to understand learning is social constructivism, which is commonly associated with Vygotsky (Woolfolk, Winne, & Perry, 2012, p. 310). The social constructivist theory is used in the present study to understand learning in three areas: learning in high school science courses, language acquisition, and in-service teachers' experiences in course development.

While there are various "dimensions of constructivism," there are two main ideas consistent among the majority of constructivist theories: "Learners are active in constructing their own knowledge" and "social interactions are important to knowledge construction" (Bruning, Schraw, Norby, & Ronning, 2004, p. 195). These two main ideas of constructivist learning have specific implications for teaching such as the importance of differentiating instruction, fostering the use and development of metacognitive strategies, and providing

opportunities for discussion (Driscoll, 2005). Building on prior knowledge is also important to constructivist theory (Slavin, 2015).

Important to social constructivist theory is the "zone of proximal development," which Vygotsky (1934/1962) introduced and defined as "the discrepancy between a child's actual mental age and the level he reaches in solving problems with assistance" (p. 103). This notion emphasizes the use of "scaffolding," which can be defined as "support for learning and problem solving" (Woolfolk et al., 2012, p. 50).

Integrating French language-learning into science courses. This section will first provide an overview of literature on the importance of, and strategies for, integrating French language-learning explicitly into science courses in FI and Francophone programs. Second, recent literature on professional development related to language integration in Francophone science courses will be examined. Finally, reported challenges of integrating language learning in French-language science courses and suggestions for further support measures will be outlined.

Importance of, and strategies for, integrating French language-learning in science. Researchers (Cormier, Pruneau, Rivard, & Blain, 2004a; Cormier, Pruneau, & Rivard, 2010; Rivard & Cormier, 2008; Rivard, Cormier, & Turnbull, 2012; Rivard & Gueye, 2015) highlight the importance of linguistic activities (reading, writing, speaking) in promoting language development among students learning science in FI and Francophone-minority schools, as well as in fostering students' understanding of science concepts.

Reading. Researchers recommend incorporating a variety of texts in French-language science courses (Cormier et al., 2004a, p. 30; Rivard et al., 2012, p. 93). Reading "authentic scientific texts" (or "real-world texts") such as "articles published in journals, magazines, and

newspapers, as well as brochures, government pamplets, and Websites" (Karchmer, 2001 as cited in Rivard et al., 2012, p. 93) in FI science courses "provides a rich language experience for L2 [FI] learners" (Rivard et al., 2012, p. 93). Cormier et al. (2004a) support the use of "informative" readings in their model for teaching science in Francophone-minority contexts, and additionally suggest the use of "expressive" readings (p. 30).

Rivard and colleagues (2012) recommend explicitly teaching reading comprehension strategies in FI science courses, as "strategic teaching of reading strategies scaffolds FI students' text comprehension, thereby making them more effective science learners" (p. 94). Fostering vocabulary development is also especially important for FI (August & Shanahan, 2006 as cited in Rivard et al., 2012, p. 94) and minority-language students (Cormier, Pruneau, & Rivard, 2004b, p. 190). For example, Cormier et al. (2004b), observed that Grade 5 students in a Francophone program in a Francophone-minority setting in New Brunswick sometimes used English words when communicating information about salt marshes in science class (p. 190).

Writing. Rivard (2009) emphasizes the importance of writing in science and identifies two "functions" of writing in this regard: "instrumental function" (writing to "communicate information to others") and "epistemic function" (writing to support learning) (p. 190).

Rivard (2001) studied summary writing by comparing the quality of Francophone (FL1) and FI students' summaries across Grades 9 through 12, as measured by their scores on 10 variables such as "fidelity to the text" (accuracy of summary), "style," and "language usage" (p. 174). In Grades 9 and 10, FI students "tended to include more inaccuracies in their summaries... compared to FL1 students" (p. 178). However, the accuracy of the FI students' summaries was higher in the higher grade levels and "the differences between both groups of students were negligeable in the latter half of the secondary programme" (p. 178). In fact, by the end of Grade

12, Rivard (2001) notes that "style seems to be the only aspect differentiating the written summaries of these two groups" (p. 180). In this publication, a description of the instructional practices of the participating teachers was not provided. Therefore, it was not explained whether the groups differed in the amount or type of summary writing instruction prior to the study. Furthermore, since this study was a comparative study that involved different individuals at each grade level (not a longitudinal study measuring the achievement of the same group of students over time), the effect of engaging in summary writing throughout high school on students' writing abilities was not this study's focus. Nonetheless, this study highlights the potential for FI students to improve their summary-writing skills over time to reach levels similar to FL1 students.

Speaking. Swain (2005) notes the importance of discussion in learning, as she "provided evidence to show that collaboration and discussion among learners help solidify language acquisition and support cognition around complex content such as science" (as cited in Rivard et al., 2012, p. 92). Other researchers emphasize the importance of discussion in French-language science courses (Cormier et al., 2004a; Cormier et al., 2010; Rivard & Cormier, 2008; Rivard et al., 2012; Rivard & Gueye, 2015). In a study conducted by Rivard and Straw (2000) to determine the effects of speaking and writing in science, random selection was used to divide 48 Grade 8 students into four groups: control, "talk-only," "writing-only," and "talk-and-writing" (pp. 570-1). While the researchers were unable to place confidence in their quantitative data due to the small sample size, they note that "trends were evident" and propose "tentative conclusions" (p. 585). For example, their data revealed that "talk combined with writing appears to enhance the retention of science learning over time" (p. 566).

Models designed for integrating language learning into science courses. Cormier et al. (2004a) developed a seven-step model that integrates reading, writing, and speaking activities in science courses in Francophone programs (p. 29). An understanding of integrating reading, writing, and speaking activities in French-language science courses is important to the present study, as one of my objectives was to understand Manitoba teachers' experiences with integrating French language-learning in science.

Cormier and colleagues' (2004a) model emphasizes the importance of students initially communicating science concepts by means of informal written and spoken language, and then progressively communicating with more formal terminology (p. 30). As Cormier et al. (2004a) point out, "this role of language is particularly beneficial in linguistic-minority settings where we note the presence of linguistic insecurity and negative attitudes toward the vernacular language" (p. 31, translation). Like Francophone students in linguistic-minority settings, many FI students are likely to have "linguistic insecurity" in French, especially since FI students are learning French as an additional language.

Examples of activities incorporating the use of informal language in Cormier et al.'s (2004a) model include the activation of prior knowledge by writing ideas about the science subject matter in a journal or by discussing ideas in groups prior to being introduced to the topics of study (p. 30). The students then "experience the phenomenon concretely (if possible)" and, during this experience, they discuss their observations, record their reflections and observations, and read about the phenomenon" (p. 30, translation). After this experience, the students review and compare what they observed during the experience (p. 30). At this point in the process, students begin to be introduced to more formal terminology through readings that employ more scientific vocabulary (p. 30). Finally, students communicate what they learned using formal

language in writing (for example, through laboratory reports) and orally (for example, through presentations) (p. 30). Cormier et al. (2004a) emphasize the possibility of students communicating their learning publicly, for example, through creating and hanging posters in the hallways or by presenting to an outside audience (such as other classes or parents) (p. 30).

Cormier et al.'s (2004a) model was implemented with Grade 5 students in a Francophone-minority context in New Brunswick, and the results were published by Cormier et al. (2010). The Grade 5 teacher (also one of the researchers) implemented the model to teach a science unit on salt marshes over a two-month period (Cormier et al., 2010, p. 343). According to the authors, "this study demonstrated that students in a linguistic-minority setting can evolve conceptually and appropriate a scientific vocabulary" (p. 358, translation). Cormier et al. (2004a) and Cormier et al. (2010) do not discuss the challenges associated with implementing the model in these two publications. As previously-mentioned, finding appropriate resources is particularly challenging for educators who teach in French (Ewart, 2009; Karsenti et al., 2008; Lewthwaite et al., 2007). Therefore, finding appropriate resources could be a challenge of implementing Cormier et al.'s (2004a) model. Another potential challenge of implementing this model is ensuring that the conversations occur in French in Francophone-minority settings and not in English, the majority language. In terms of the effectiveness of this model for teaching other topics or at other grade levels, Cormier et al. (2004a) note that other researchers could "try out the model, modify it, and personnalize it in order to appropriate it and increase its effectiveness" (p. 31, translation). No known research has been conducted in Canada to assess the effectiveness of this model, or a similar model, in French-language high school science classes.

Professional development and language integration in science. Rivard and Gueye (2015) conducted research at the high school level in Canada to "determine how the beliefs and

practices of francophone-minority teachers changed [regarding integrating language in science] after a continuous small-scale professional development program" (pp. 67-8, translation). The researchers invited Grade 9 Science teachers in Francophone programs to participate in 10 full-day professional development sessions over three years that "demonstrated how the teachers could integrate content and language-learning concurrently while the students engaged in speaking, listening, and writing activities in science class" (Rivard & Gueye, 2015, p. 65, translation). The total number of participants was 16. However, all of these teachers did not participate in all of the sessions (the average was four sessions per participant) (p. 69). Support for the professional development sessions was provided by the provincial French-language science consultant and, during the second year of the program, by a mentor who worked with the teachers in planning language-based lessons (Rivard & Gueye, 2015, pp. 65-6). An online collaboration and resource-sharing website ("Wikispace") was also created (p. 67). One finding of this study was that "the teachers are now [after participating in the program] aware of the importance of language when they teach science and for helping students" (Rivard & Gueye, 2015, p. 73, translation). However, the initial beliefs of these teachers regarding the importance of integrating language learning in science (prior to the professional development) was not discussed in this particular publication of this study.

Another important finding of Rivard and Gueye's (2015) study was that participation in the professional development sessions was positively correlated with implementation of the language-based activities (p. 88). Some of the factors reported by the teachers that supported implementation of the language-based activities in their classrooms included "discussing, collaborating, and talking about their experiences with other colleagues" and mentoring (p. 85, translation).

Challenges of language integration in science and suggestions for further teacher support measures. A challenge of integrating texts in FI science classes is that the available texts are frequently written for students studying in their first language and are, therefore, difficult readings for non-native French speakers (Cormier & Turnbull, 2009, p. 824). This finding is important to the present study, as I aimed to determine if obtaining suitable texts is a challenge for FI science teachers in Manitoba.

In Rivard and Gueye's (2015) study, factors that challenged the implementation of language-based activities in Francophone Grade 9 Science courses included: "a heavy workload," "substantial time constraints," and "a lack of resources" (p. 84, translation). These factors are particularly significant for the present study, as one of my objectives was to understand if, and how, these factors affect Grade 10 FI Science teachers in Manitoba and how these challenges could be addressed if they are having an effect.

Suggestions by participants in Rivard and Gueye's (2015) study are also important to the present study. Specifically, Rivard and Gueye (2015) note that "many teachers [who participated in the professional development sessions] mentioned that a collection of varied resources, appropriate and suitable for the Grade 9 Science curriculum, would be extremely useful, and that this collection could even be available online" (p. 84, translation). This suggestion is highly relevant to the present study in that I sought to develop an online instructional resources database model that holds promise in supporting FI teachers by understanding these teachers' course development experiences. In so doing, I aim to build on Rivard and Gueye's (2015) study by investigating the relevance of the participants' suggestions in this study in the context of FI science teachers in Manitoba.

The Grade 10 Science Curriculum in Manitoba

Overview of the Manitoba Grade 10 Science curriculum. This subsection of *The Grade 10 Science Curriculum in Manitoba* provides an overview of this curriculum by introducing the curriculum and by describing the units or "clusters" of this curriculum. The Grade 10 Science curricula are the same for the English, French Immersion (FI), and Francophone programs.

Description of Manitoba Grade 10 Science curriculum. The Grade 10 Science outcomes were published in 2001 by Manitoba Education, Training and Youth in a document entitled *Senior 2 Science: Manitoba Curriculum Framework of Outcomes* (henceforth *Science Framework*). It should be noted that "Senior 2" and "Grade 10" are synonymous in Manitoba, but "Grade 10" is used in this review, as it is the terminology presently used by Manitoba Education (http://www.edu.gov.mb.ca/k12/index.html).

The *Science Framework* "presents student learning outcomes for Senior 2 science" (Manitoba Education, Training and Youth, 2001, p. 1.1). As described by the curriculum writers, "Manitoba's science student learning outcomes are based on those found within the *Common Framework of Science Learning Outcomes K to 12*" published by the Council of Ministers of Education, Canada (1997) (Manitoba Education, Training and Youth, 2001, p. 1.1).

To accompany the *Science Framework*, the *Senior 2 Science: A Foundation for Implementation* document was published in 2003 by Manitoba Education and Youth. Henceforth, the *Science Framework* and the *Senior 2 Science: A Foundation for Implementation* documents will collectively be referred to as the *Grade 10 Science curriculum*. In the words of the curriculum writers, the *Foundation for Implementation* document "complements the *Science Framework*, providing support for its implementation, including suggestions for instruction and assessment" (2003, p. 1).

Clusters in the Grade 10 Science curriculum. The Grade 10 Science curriculum is divided into five clusters (units): Cluster 0 (*Overall Skills and Attitudes*), Cluster 1 (*Dynamics of Ecosystems*), Cluster 2 (*Chemistry in Action*), Cluster 3 (*In Motion*), and Cluster 4 (*Weather Dynamics*) (Manitoba Education, Training and Youth, 2001, p. 3.5). The total number of specific learning outcomes across all clusters is 91. A brief explanation of the contents of these clusters is provided in the Science Framework, a portion of which is provided below:

> Cluster 0 comprises nine categories of specific learning outcomes that describe the skills and attitudes involved in scientific inquiry and the decision-making process for STSE [(Science, Technology, Society, Environment)] issues.
>
> In [Cluster 1], students examine the complex relationships present in ecosystems in order to further investigate issues of sustainability.
>
> [Cluster 2] provides students with the opportunity to examine the interactions among elements as they form compounds through chemical reactions.
>
> In order to develop an understanding of the physics of motion, the outcomes of [Cluster 3] are examined within the context of the automobile.
>
> [Cluster 4] develops an understanding of the relationships that control weather and climate. (Manitoba Education, Training and Youth, 2001, pp. 3.10-3.22)

Provincial documents available for Grade 10 Science. This subsection of *The Grade 10 Science Curriculum in Manitoba* outlines the provincial documents available for teaching Grade 10 Science in Manitoba. The following table outlines the documents available from the Province of Manitoba (Manitoba Education) to support the Grade 10 Science curriculum.

Table 1: Grade 10 Science curriculum documents and curriculum support documents available from Manitoba Education

English Title	French Title
Senior 2 Science: Manitoba Curriculum Framework of Outcomes (2001)	n/a
Senior 2 Science: A Foundation for Implementation (2003)	*Sciences de la nature Secondaire 2, Programme d'études : document de mise en oeuvre* (2005)
In Motion: A Learning Resource for Students (2003) (also included as an appendix in the *Foundation for Implementation* document)	*En Mouvement: guide d'apprentissage de l'élève* (2003)
Science and Safety: A Kindergarten to Grade 12 Resource Manual for Teachers, Schools, and School Divisions (2014)	*La sécurité en sciences de la nature: Un manuel ressource à l'intention des enseignants, des écoles et des divisions scolaires (de la maternelle à la 12^{e} année)* (2015)
Science 20F Independent Study Option (Grade 10 Science distance education course)	n/a
Science 20F Web-Based Course Option (Grade 10 Science web-based course)	n/a
A Teacher's Guide for the Video Sila Alangotok – Inuit Observations on Climate Change : A Resource for Senior 2 Science (2003)	n/a

As identified in Table #1, there are more English instructional resources available from Manitoba to support the Grade 10 Science course compared to French instructional resources. This information is important to the present study, as one of my objectives was to learn if and how Grade 10 FI Science teachers use these documents.

Gaps in the Research Literature

In light of the recurring themes of "heavy workload," "lack of instructional resources," and "[teacher knowledge of] strategies for teaching science to learners with less-developed French language abilities" in recent literature, I sought to explore Grade 10 FI Science teachers' practices, challenges, and needs associated with obtaining and developing instructional

resources, as well as their experiences with integrating French language-learning into their courses, in the present study. This study aimed to address the gaps in the research literature on teaching science in FI programs in Manitoba. Specifically, while the need for French language instructional resources has been identified by several scholars reported above, no known research has been conducted that explores Manitoba FI science teachers' practices, challenges, and needs associated with obtaining and developing instructional resources in order to address this reported issue. Furthermore, while the importance of the explicit integration of French language learning in science has been made clear, no known research has been conducted in Manitoba that addresses one of the identified constraints of this integration: a need for instructional resources to support language-based activities. Through an understanding of Grade 10 FI Science teachers' course development experiences, the potential problems of "lack of instructional resources" and "[a lack of teacher knowledge of] strategies for teaching science to learners with less-developed French language abilities" were explored with this group of FI teachers in Manitoba.

Based on the present study's findings, I developed an online instructional resources database model that holds promise in supporting Grade 10 FI Science teachers. In so doing, I aimed to build on Rivard and Gueye's (2015) study by investigating the relevance of the participants' suggestion ("that a collection of varied resources, appropriate and suitable for the Grade 9 Science curriculum, would be extremely useful, and that this collection could even be available online" [p. 84, translation]) in the context of Grade 10 FI Science teachers in Manitoba.

In other words, through understanding Grade 10 FI Science teachers' practices, challenges, and needs associated with course development, I developed an online instructional resources database model that: a) supports their current course development practices and b) seeks to address their challenges and needs. This model aims to creatively use technology to

increase access to information for FI science teachers. I believe that this online instructional resources database model will be applicable to the creation and sharing of resources in all teaching areas, not only FI science courses.

The present study was designed as the first phase in a potential two-phase study. If the online instructional resources database were to be developed and implemented by the provincial government, I would hope to evaluate the effectiveness of the database in supporting FI Science teachers in the second (post-thesis) phase of research. By evaluating the effectiveness of the instructional resources database, I would seek to address Grade 10 FI Science teachers' needs, with the intention of positively impacting teacher well-being, reducing the administrative burden of teacher attrition, and improving the quality of FI science education in the Province of Manitoba.

Chapter 3: Research Methodology

In this chapter, I describe this study's theoretical framework, the research approach, and the research design. I also present my position; as I am a French Immersion (FI) science teacher in Manitoba, it is essential that I be as transparent as possible throughout my study. The recruitment and sampling procedures are then described, followed by the *Data Collection* and *Data Analysis* sections. I will conclude Chapter 3 with an explanation of how I ensured the credibility and reliability of my study.

Philosophical Worldview (Theoretical Framework)

The beliefs of the social constructivist worldview guide this study. Creswell (2014) describes social constructivism as an example of a "worldview," but notes that terms other than "worldview" are used (p. 6). For example, "paradigms" (Lincoln, Lynham & Guba, 2011, p. 98), "epistemologies and ontologies" (Crotty, 1998 as cited in Creswell, 2014, p. 6) and "broadly conceived research methodologies" (Neuman, 2009 as cited in Creswell, 2014, p. 6). Guba states that the term "worldview" can describe "a basic set of beliefs that guide action" (Guba, 1990, p. 17 as cited in Creswell, 2014, p. 6). Therefore, the beliefs that define social constructivism will guide decision-making throughout my research.

As described by Creswell (2014), "social constructivists believe that individuals seek understanding of the world in which they live and work" and "develop subjective meanings of their experiences" (p. 8). Acknowledging that "these meanings are varied and multiple," the researcher "[looks] for the complexity of views rather than narrowing meanings into a few categories or ideas" (p. 8). As such, "the goal of the research is to rely as much as possible on the participants' views of the situation being studied" (p. 8).

The present study research is guided by these beliefs, as I aimed to understand the experiences of Grade 10 FI Science teachers in Manitoba by engaging in conversation with them. While I recognized that these teachers would share some similar experiences, I understood that their situations are unique and that each individual interprets and comprehends his or her situation differently. The situation and the experiences of the FI science teachers would depend on several factors such as their first language, their education, their teaching experience, and the context of the school(s) in which they work or have worked (for example, FI schools or Francophone schools).

Another assumption of social constructivism is that "the basic generation of meaning is always social, arising in and out of interaction with a human community" (Crotty, 1998 as cited in Creswell, 2014, p. 9). This assumption is important for my study for three reasons. First, I believe that teachers' experiences are significantly affected by their interactions with their colleagues, administrators, and students. Second, the community in which the school is located is also a significant influence on the teachers' in-school experiences. The culture of the outside community, especially community members' use of the French language is particularly significant in this study, since Manitoba is a Francophone-minority province. In other words, the language of instruction in FI is different than the dominant language in the community (English) (Lewthwaite et al., 2007, pp. 318-9). Finally, the assumption of the social construction of meaning is important to this study because I believe that these teachers have a wealth of experience and, through dialogue, I hoped to gain insight into their experiences in order to develop a "pattern of meaning" (Creswell, 2014, p. 8).

Research Approach

A qualitative research approach was selected in order to "[explore] and [understand] the meaning individuals or groups ascribe to a social or human problem" (Creswell, 2014, p. 4). Similarly, in the words of Merriam and Tisdell (2016), "qualitative researchers are interested in understanding how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences" (p. 6). As a result of the gaps in the research literature identified in Chapter 2, a qualitative approach was chosen in order to explore and understand the course development experiences of these teachers.

Merriam and Tisdell (2016) explain "four characteristics [that] are identified by most as key to understanding the nature of qualitative research: the focus is on process, understanding, and meaning; the researcher is the primary instrument of data collection and analysis; the process is inductive; and the product is richly descriptive" (p. 15). Each characteristic will be described and its relationship to the study stated based on my interpretation of these characteristics.

The first characteristic emphasizes "the overall purposes of qualitative research [which] are to achieve an *understanding* of how people make sense out of their lives, delineate the process... of meaning-making, and describe how people interpret what they experience" (Merriam & Tisdell, 2016, p. 15). The present study is focused on interpreting and understanding the course development experiences of Grade 10 FI Science teachers in Manitoba. I was, however, constrained by the single opportunity that I had to interview participating teachers. More time with the participants would have allowed me to gain an even deeper understanding of their course development experiences.

The second characteristic of qualitative research, that "*the researcher is the primary instrument for data collection and analysis*," results in the benefits of the researcher being able to

"expand his or her understanding through nonverbal as well as verbal communication... [and] check with respondents for accuracy of interpretation" (Merriam & Tisdell, 2016, p. 16). These two benefits are relevant to the present study, as I interviewed teachers: I communicated in person (or by video conference), during which time I asked participants to clarify or elaborate on their responses.

Qualitative research is "*inductive*; that is, researchers gather data to build concepts, hypotheses, or theories rather than deductively testing hypotheses as in positivist research" (Merriam & Tisdell, 2016, p. 17). In the present study, I gathered data on teachers' course development experiences in order to interpret and understand this phenomenon for Grade 10 FI Science teachers in Manitoba.

The last characteristic is that "the product of a qualitative inquiry is *richly descriptive*" (Merriam & Tisdell, 2016, p. 17). While the present study aimed at including "rich descriptions" of the course development experiences of Grade 10 FI Science teachers by describing the participants' experiences in detail and by including direct quotes from participant interviews, it is not truly "richly descriptive," given the limited time that I spent with participants. As such, I consider the "product of [this] qualitative inquiry" as containing detailed descriptions, and not "rich" descriptions. I gave as detailed descriptions as reasonably possible given the data obtained in the 90- to 120-minute interviews. If more time had been spent with participants, truly "rich" descriptions would have been possible.

Research Design

A case study design is used in this study in order to gain an in-depth understanding of the experiences of Grade 10 FI Science teachers in Manitoba. As Creswell (2013) explains:

Case study research is a qualitative approach in which the investigator explores a real-

> life, contemporary bounded system (a *case*) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving *multiple sources of information* (e.g., observations, interviews, audiovisual material, and documents and reports), and reports a *case description* and *case themes*. (p. 97)

He further clarifies that: "The unit of analysis in the case study might be multiple cases (a *multisite* study) or a single case (a *within-site* study)" (Creswell, 2013, p. 97). The unit of analysis in the present case study is "multiple cases" of teachers who teach Grade 10 Science in FI programs in Manitoba. Since the present study includes teachers from different schools across Manitoba, it is a "multisite study."

Stake (1995) provides a specific case study situation in which "we may feel that we should choose several teachers to study rather than just one" (p. 3). Here, he explains, "there will be important coordination between the individual studies" and, therefore, "we may call the work *collective case study*" (pp. 3-4). The present study is identified as a *collective case study*, since more than one Grade 10 FI Science teacher is involved.

I planned to include six to 12 Manitoba Grade 10 FI Science teachers in this multisite study. In the end, I interviewed six teachers. Ideally, I sought to include two FI teachers from each of the three school settings in Manitoba: urban, rural, and northern (a list of the high schools with FI programs in Manitoba is provided in Appendix B). In the end, I interviewed three teachers from urban schools, two teachers from rural schools, and one teacher from a northern school.

As Yin (2014) explains, "once the general definition of the case has been established, other clarifications – sometimes called *bounding the case* – become important" (p. 33). To "bound the case," I decided on the following criteria of inclusion:

- teachers in Manitoba who are currently teaching Grade 10 Science in an FI program or
- teachers in Manitoba who have taught Grade 10 Science in an FI program within the last five years.

According to Yin (2014), "you would want to do case study research because you want to understand a real-world case and assume that such an understanding is likely to involve important contextual conditions pertinent to your case" (p. 16). In other words, in the present study, I am not "[separating] a phenomenon from its context" (Yin, 2014, p. 16); I have studied the "real-world" situations of Grade 10 FI Science teachers in Manitoba by having engaged directly with these teachers in their contexts in order to gain an understanding of their experiences.

The present case study is both "descriptive" and "exploratory." Yin (2014) defines a "*descriptive case study*" as "a case study whose purpose is to describe a phenomenon (the 'case') in its real-world context" (p. 238). The present study was designed to describe the multiple cases of teachers who teach Grade 10 FI Science. Yin defines an "*exploratory case study*" as "a case study whose purpose is to identify the research questions or procedures to be used in a subsequent research study, which might or might not be a case study" (p. 248). The present study includes the development of an online instructional resources database model that could be implemented, and then its effectiveness assessed in a second phase of this study (post-thesis).

The present study also included "in-depth data collection involving multiple sources of information," another important characteristic of case studies (Creswell, 2013, p. 97). These data sources will be discussed in the *Data Collection* section, but briefly, these sources include: semi-structured interviews with teachers, documents (e.g., the resources available from Manitoba Education and Training for the Grade 10 Science course), and a personal reflection on course

development. The importance of various data sources in case studies is supported by Yin (2014): "a case study inquiry... relies on multiple sources of evidence, with data needing to converge in a triangulating fashion" (p. 17).

Creswell (2013) also explains the following characteristic of case studies: "...the researcher can identify *themes* or *issues* or *specific situations* to study in each case. A complete findings section of a case study would then involve both a description of the case and themes or issues that the researcher has uncovered in studying the case." (p. 99) In the present study, the "themes" and "issues" that were studied, mentioned in the research questions, are the practices, challenges, and needs of FI science teachers associated with obtaining and developing instructional resources for the Grade 10 Science course in Manitoba, as well as their experiences with integrating language-learning in this course.

Disadvantages of case studies. McMillan (2016) reminds us that, "although case studies are great for detail, thoroughness, and deep understanding (good for authenticity, context sensitivity, and transparency), they are limited in several ways" (p. 317). One disadvantage is that case studies can take a lot of time because, often, the researcher uses various data sources (McMillan, 2016, p. 317). As explained by McMillan (2016), another disadvantage is generalizability:

> Case studies are difficult to replicate and may have weak generalizability, especially intrinsic investigations of unique persons, events, or issues (confirmability). Sometimes, researchers will try to identify a "typical" case to study. If so, they are concerned with at least some generalization to a larger group or other situations as traditionally defined. (p. 317)

Since I interviewed six Grade 10 FI Science teachers in Manitoba, these teachers are representing the voices of Grade 10 FI Science teachers in Manitoba. As such, if my sample of teachers is not representative of the population of Grade 10 FI Science teachers in Manitoba, it is possible that the results will not be representative of the experiences of this entire teacher population. For example, if my study had involved only teachers in urban schools, and not rural or northern schools, it is possible that my findings would not have adequately represented the experiences of the entire population of Grade 10 FI Science teachers. Therefore, in order to be able to obtain results that are representative of the larger population of these teachers, I planned to include six to 12 teachers in my study who work in different school divisions (urban, rural, and northern) across Manitoba. In the end, I interviewed three teachers from urban schools, two teachers from rural schools, and one teacher from a northern school. A clear limitation of this study is the small number of teachers interviewed.

Even so, it is important to note that, in qualitative studies, "there is no intent to generalize to other participants, settings, instruments, interventions, or procedures" (McMillan, 2016, p. 359). Although it is important to the present study to have a good representation of teachers from across the province, generalizing my findings was never an objective of this study.

Another question that arises in qualitative research is that of "*transferability*":

> Transferability refers to the appropriateness of applying the results to other contexts and settings. It is enhanced by thick descriptions of the site, participants, and procedures used to collect data. This makes it easier for the person wanting to apply the results to his or her setting to know whether or not there is a good fit – if it makes sense to generalize. (McMillan, 2016, p. 359)

Therefore, to help readers decide if the results of the present study could be transferred to another population of teachers, I included detailed descriptions, a strategy that will be discussed in the *Credibility* section.

Another limitation of case studies, or a "threat to the validity of qualitative research" according to McMillan (2016), is "*researcher bias*," which "occurs when you do a qualitative research project and you more or less find what you are looking for, rather than the truth" (pp. 309-17). I will discuss the ways in which I addressed "researcher bias" in the *Credibility* section.

Researcher's Position and Assumptions

I am a French Immersion (FI) science teacher in Manitoba, and my experiences inspired me to pursue this study and have undoubtedly influenced its development. In this section, I will first explain some of the experiences that inspired me to pursue this study. Second, I will outline how I define "curriculum" and how this definition is important in the context of this study.

Some of the researcher's experiences that inspired this study. During my experience teaching Grade 10 Science in French and in English in Manitoba, I developed numerous instructional resources, drawing from a variety of sources. The reasons for developing my own resources included: 1) many resources that I found (or that my colleagues shared with me) that addressed the Grade 10 Science curriculum were in English and not in French; 2) often, the resources that I found in French were not, in my opinion, "classroom-ready" for teaching Grade 10 Science (for example, as a result of the content or the language level); 3) finding resources to support students' language development in French was challenging; 4) compiling information or ideas from a variety of sources into notes/questions booklets facilitated the organization of the content, as well as the use of the technology available in my classroom to teach this content, and; 5) it would often take longer to search for potential classroom-ready resources in French than to

create my own resources.

Although the experience of developing instructional resources for Grade 10 Science was positive in terms of my professional growth, as I developed an understanding of the Grade 10 Science curriculum, it was also a challenge due to the time-consuming nature of this process. Balancing the development of instructional resources for all of the courses in my workload with the other responsabilities of teaching was very challenging. This process was particularly challenging at the start of my career or when I taught a course for the first time. As a result of this time-consuming process of finding and developing Grade 10 Science resources in French, I struggled to balance my teaching career and my personal life.

My colleagues have shared their practices and challenges associated with developing instructional resources with me, and all of them admitted that they have had challenges with the time-consuming nature of finding and developing instructional resources. In fact, these colleagues have not only been FI teachers, they have also been science teachers in the English program. Therefore, in my experience, FI teachers are not the only teachers who have experienced challenges with finding and developing instructional resources on top of their other professional responsibilities and their personal responsibilities.

Since I have taught science courses in French and in English in Manitoba, I have learned that there are more instructional resources available in English than French for teaching these courses. Furthermore, since there are more teachers in English programs compared to teachers in French programs, there are more colleagues who teach in English with whom I was able to collaborate and share resources. As a result, I would often spend a significant amount of time translating instructional resources from English to French in order to use them in my science courses.

Defining "curriculum" and how the researcher envisions curriculum in Canada. To end this section describing my position, I feel that it is important for me to be transparent at the outset regarding my beliefs about curriculum. That is, one way in which I define curriculum and how I envision the future of curriculum in Canada. Nora Allingham's (1992) definition resonates with me and, while it is lengthly, I have chosen to include part of it in this thesis, as it is a springboard for a description of my hope for Canada's future in curriculum. Allingham states:

> Children learn from what surrounds them – not just what the teacher points them to. So the curriculum is the text books and the story books and the pictures – and the seating plan and the group work and the posters and the music, the announcements, the prayers and readings, the languages spoken in the school, the food in the cafeteria, the visitors to the classrooms... the teachers, the administration, the displays of student work, the school teams and sports played, the clubs, the school logo or emblem, the field trips, the assignments and projects, the facial expressions and body language of everybody... it is the whole environment. I would not for a moment suggest that we can control all of this, but we'd better be aware of it. We can be sure our students are. If we don't start thinking of what the effect of **all** this environment is on **all** our students, we'll never develop strategies that **will** work. (p. 1)

Allingham (1992) reminds us that our role as teachers is critical and complex. Consistent with Allingham's view, I believe that teaching is so much more than the handouts we distribute, the activities we plan, and the ways in which we assess. It is not to say that effective handouts, activities, and assessment are not extremely important. In fact, I believe that providing students with quality experiences with the material and with each other in the classroom is absolutely critical for fostering an effective learning environment. However, if teachers are struggling to

work to their potential as a result of stress and time constraints due to demanding workloads, then this situation undoubtedly has a negative impact on classroom environment and, therefore, on students' learning experiences. My argument here can be summarized as follows: If teachers are well-equipped with options of instructional resources to teach the provincial curriculum, then they can spend less time finding and developing resources and more time on other fundamental parts of teaching, such as spending time with students, reflecting on their practice, and engaging with colleagues. They can also spend more time on their own well-being. I believe that talented, effective teachers who are overburdened and lack work-life balance can become even more effective and successful in supporting students if they can more easily maintain a healthy work-life balance.

I believe teachers in Manitoba have a wealth of experience and, through understanding their course development experiences, an online instructional resources database model can be developed to support FI science teachers. It is my view that an instructional resources database would effectively support teachers in developing their Grade 10 Science course. I believe that this database would not inhibit teachers' own creativity in developing their courses; rather, it would foster creativity through providing new ideas and support.

Ethical Considerations

All of the ethical standards described in the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans* (2014) were followed. For example, pseudonyms were used instead of participants' real names. Before beginning participant recruitment, ethics approval was obtained by ENREB (*Education/Nursing Research Ethics Board*) at the University of Manitoba (Approval Certificate in Appendix A).

Participants

Recruitment and sampling procedures. The sampling procedure used to obtain teacher participants was purposeful sampling. Specifically, criterion sampling was used in the first round of participant recruitment. The criteria for inclusion were:

- teachers in Manitoba who are currently teaching Grade 10 French Immersion (FI) Science or
- teachers in Manitoba who have taught Grade 10 FI Science within the last five years.

These criteria for inclusion were chosen because these teachers have recent experience teaching Grade 10 FI Science and would therefore provide insight directly related to the research questions. I sought to interview six to 12 teachers in this case study: at least two FI teachers from each type of school in Manitoba (urban, rural, and northern).

The reason for choosing FI teachers from each school type (urban, rural, and northern), is to include a sample of teachers that is representative of the voices of FI teachers in Manitoba. Based on my knowledge of teaching in Manitoba, the experiences of FI teachers in urban, rural, and northern settings can differ due to the number of immediate colleagues (with rural and northern school teachers generally having fewer colleagues with whom to collaborate) and the number of different courses taught (with rural and northern school teachers generally having a more diverse course load).

Before recruiting teachers, permission was obtained from the superintendent of each school division (list of relevant school divisions and schools in Appendix B). To recruit teacher participants, e-mails were sent to all known Grade 10 FI Science teachers in Manitoba who taught in school divisions from which I had received permission. If a school website did not list the teachers and subjects taught, I contacted the principal or administrative assistant(s) to ask who the FI science teachers are. I also contacted teachers who, to my knowledge, have taught

Grade 10 Science in FI within the last five years. These teachers could have been either currently teaching in FI (just not currently teaching Grade 10 Science in FI), teaching in an English or a Francophone program, on leave from their position (e.g., parental or educational leave), or no longer teaching (retired or left the profession before retirement). The total number of FI schools in Manitoba (not including Winnipeg School Division schools) is 24. I estimated that each school would have between one and three Grade 10 FI Science teachers (average of two). I also estimated that I would send e-mails to between one and three teachers who, to my knowledge, have taught Grade 10 Science in FI within the last five years. As a result, the estimated size of the pool of FI teachers was 50.

If needed, the snowball sampling procedure would have been used for the second round of recruitment. I would have asked the teachers who I had interviewed in the first round of recruitment to recommend other teachers who fit the criteria for inclusion and who would potentially be interested in participating in the study. If more than 12 teachers had expressed interest in participating in this study, I would have selected the first two FI teachers who responded from each of the three school locations (urban, rural, and northern). If one or more of these teachers who had expressed initial interest changed their minds and did not wish to participate, then, time-permitting, I planned to re-contact the teachers who initially expressed interest, and who worked in the type of school needed (urban, rural, or northern), in order to ask them if they would still like to participate.

Data Collection

In this study, the four data sources were: a) personal reflection on course development; b) semi-structured, in-person (or videoconference) interviews with teachers; c) Manitoba curriculum documents, and; d) research literature. Each of these sources will be addressed below.

After gathering information from all of these sources, I was able to analyze this data in order to construct case descriptions.

Personal reflection on course development. To support my engagement in reflective practice, I wrote a personal reflection on course development when I was teaching the Grade 9 French Immersion Science course for the first time, which was at the same time as I was analyzing the data from the present study. While the "lack of clarity" of the term "reflective practice" has been noted (Norrie, Hammond, D'avray, Collington & Fook, 2012, p. 566), there is some consensus on what the term means. Finlay (2008) summarizes the understandings of scholars when she states that reflective practice is "...the process of learning through and from experience towards gaining new insights of self and/or practice" (p. 1). This definition emphasizes that reflective practice is not simply reflecting on our experiences, but rather includes some form of improvement such as "gaining new insights of self." Norton (2009) cautions us to be "particularly careful that reflection does not merely confirm our experiences and personal beliefs and values" (p. 23) and also emphasizes the important role of collaboration in this process (p. 38). I therefore wrote this reflection in order to actively reflect on my own course development experiences in order to strive to gain new insights into myself as an educator and as a first-time researcher. Deeply reflecting on the course development process allowed me to better understand what I was asking participants to explain to me.

In light of the important role of collaboration mentioned above, I also discussed the research process with my advisor and graduate student peers in the Faculty of Education, which will be discussed later on.

Semi-structured interviews with teachers. Interviews with teachers were held in June and July 2016. McMillan (2016) outlines six steps to follow in "designing qualitative

interviews": "Identify Purpose, Identify Participants, Select Type of Interview, Develop Protocol, Select Setting, [and] Pilot Test" (p. 344), each of which will be addressed in this section. After addressing these six steps, literature consulted on conducting qualitative interviews will be discussed.

Identifying purpose of interview and participants. The purpose of conducting interviews in my study is to respond to my research questions by asking Grade 10 FI Science teachers in Manitoba interview questions that directly address the research questions. I planned on interviewing six to 12 FI Science teachers who teach the Grade 10 Science course in Manitoba. The reasons for selecting this group of teachers, and the specific criteria for inclusion, were addressed in the *Participants* section. I believed that valuable insight into teaching Grade 10 Science in Manitoba would be provided by this group of teachers. As Seidman (2013) aptly explains, "at the heart of interviewing research is an interest in other individuals' stories because they are of worth" (p. 9). I believe that Grade 10 French-language Science teachers in Manitoba have extremely important stories to share and can provide invaluable recommendations for supporting FI science teachers in Manitoba.

Selecting the type of interview. Five semi-structured interviews were conducted in-person with individual participants. A sixth interview was conducted by FaceTime videoconference with a teacher from a northern school, since this participant's school was a distance greater than 250 km from Winnipeg.

As McMillan (2016) explains, "with the semi-structured interview, topics and some possible questions are selected in advance, but the researcher decides the sequence and wording of the questions during the interview, and may use pre-established prompts and probes" (p. 345). However, he also explains "one variation of the semi-structured approach," which "has a pre-

established set of questions and prompts that are asked in order" (p. 345). This second approach was taken in this study in order to maintain consistency among the interviews and to be able to respond to all research questions in a detailed fashion. However, although there is a pre-determined order to the interview questions, I was flexible in this sequence in order to maintain a natural flow in conversation with participants. Furthermore, the follow-up questions were undoubtedly dependent on the participants' responses. I agree that this semi-structured interview approach "allows for important topics to be covered but also gives respondents freedom to emphasize other areas" (McMillan, 2016, p. 345). During the interviews, I used "clarifying" and "elaborating" "probes," as needed (McMillan, 2016, p. 345), in order to ensure that I fully understood the participants' responses.

Developing the protocol. The interview protocol, or the "set of questions and prompts" (McMillan, 2016, p. 346), was developed by considering each research subquestion separately in order to ensure that interview questions were developed to specifically address each of these subquestions. In the interview protocol, the interview questions are colour-coded to show to which research question each interview question relates. The interview was conducted in French or English (or a combination of the two languages), depending on the participant's choice.

The key components of the teacher interview protocol are:

a) Teachers' background/experiences;

b) Teachers' practices, challenges, and needs associated with using and developing instructional resources for teaching Grade 10 Science;

c) Teachers' perceptions of, and experiences with, teaching the French-language in their Grade 10 Science course;

d) Teachers' experiences with technology in their teaching; and

e) Teachers' views regarding an online database of instructional resources for the Grade 10 Science curricula in Manitoba.

The interviews were estimated to take between 60 and 90 minutes. With the participants' permission, the interviews were recorded on two digital audio recording devices (one served as a back-up). Shortly after the interview, the audio files were uploaded to my computer, which is encrypted and password-protected in order to ensure confidentiality of the participants. Each interview was then transcribed in a separate document.

Selecting the setting. Ideally, the setting of the interviews with the teachers was their classrooms or another room in their schools. By conducting the interviews in the teachers' classrooms, it was possible for them to show me instructional resources or other items to which they were referring. I believe that being in their classrooms could also have sparked ideas for the teachers. If the teachers consented to be interviewed in their respective schools, we needed to find a space (if it wasn't their classroom) that would be uninterrupted in order to maintain confidentiality and facilitate the recording of the interviews. If a teacher preferred to be interviewed outside of his or her school (or if the school was closed), then a separate location was determined based on the teacher's preference. As described by McMillan (2016), "...it is important to choose a setting that will enhance the comfort level of the participants, while at the same time allow for audio recording of the interview" (p. 346). Additionally, as described above, if meeting in person with a teacher was not possible, a videoconference interview was conducted.

Conducting a pilot test. Before conducting interviews with participants, the protocol was "pilot tested" (McMillan, 2016, p. 346) in order to assess the quality of the questions and to revisit the estimated time ranges for the interviews. The protocol was tested with a graduate student in the Faculty of Education.

Conducting the interviews. McMillan (2016) reminds us of the following important points about conducting interviews:

> The goal is to conduct the interview as an engaged listener, trying hard to hear what is being communicated, with a minimum of interviewer talk. Openness is needed for flexibility and acceptance of participant responses and for appropriate probing that leads to depth of understanding, to richness and complexity. In qualitative language, you need to obtain "thick" descriptions. (p. 346)

I kept these important points in mind throughout the interviews with participants. At the outset of each interview, I also did my best to "establish rapport and trust" (McMillan, 2016, p. 346) with the participant.

Disadvantages of conducting interviews/potential concerns. Two "weaknesses" of the interview data collection method identified by McMillan (2016) are "skill, biases, and expectations of the interviewer may affect results" and "anonymity cannot be assured, which may affect the disclosure of sensitive information" (p. 349). Since I am an FI science teacher, I had to be very cautious to not let my biases and expectations affect the way in which I conducted the interviews, which was further addressed in the *Researcher's Position* section. Since I knew the teachers' identities, it is possible that teachers did not want to disclose all of their experiences or to fully articulate their true feelings. I believe that this issue is potentially problematic in my situation, since I am a fellow science teacher in a small community of FI science teachers in Manitoba. However, since the teachers who agreed to participate were fully informed as to the nature of the study, it is likely that these teachers were reasonably forthcoming in their responses.

Documents and literature. In order to know what resources are currently available for

teaching Grade 10 Science in Manitoba, I listed the provincial documents available for this curriculum (Table #1) on page 43. This table serves to compare the number of provincial documents available in French for Grade 10 Science to the number of provincial documents available in English. In *Chapter 5: Discussion and Conclusions*, I will be comparing the data obtained in the interviews with this list of resources and with information from the literature.

I also invited each teacher participant to explain one instructional resource that he or she has used in their teaching and found to effectively: a) address one or more of the Grade 10 Science outcomes, and b) foster French-language development among students. I asked participants to consent to providing me with an electronic or paper copy of the instructional resource for me to keep. Only one teacher provided me with an instructional resource. I chose not to include this resource in my analysis.

Data Analysis

The interview data was analyzed by coding. As mentioned above, the themes outlined by the coding process were triangulated with the available provincial support documents for teaching Grade 10 Science and with my personal reflection on course development. In this section, I will first describe the coding process that I followed, as supported by literature. Second, I will provide a description of what constitutes "field notes" as outlined by McMillan (2012).

Coding process. As Saldaña (2016) explains, "coding enables you to organize and group similarly coded data into categories or "families" because they share some characteristic – the beginning of a pattern" (p. 10). In order to determine my "categories" of data, I used "Structural Coding": "Structural Coding applies a content-based or conceptual phrase representing a topic of inquiry to a segment of data that relates to a specific research question used to frame the

interview" (MacQueen, McLellan-Lemal, Bartholow, & Milstein, 2008, p. 124 as cited in Saldaña, 2016, p. 98). As MacQueen et al. (2008) explain, "the purpose of this step is to make subsequent analysis easier by identifying all of the text associated with a particular question and associated probes" (p. 124). Determining the categories, therefore, began with a separation of the research sub-questions into more specific research questions. These specific research questions were the "categories" that I used to code the data. These categories (specific research questions) are outlined in the table below.

Table 2: Division of Research Questions for Coding Purposes

Research questions	Division of research questions for coding purposes
1. How do FI science teachers describe their practices, challenges, and needs associated with obtaining and developing instructional resources for the Grade 10 Science course?	How do FI science teachers describe their practices associated with obtaining and developing instructional resources for the Grade 10 Science course?
	How do FI science teachers describe their challenges associated with obtaining and developing instructional resources for the Grade 10 Science course?
	How do FI science teachers describe their needs associated with obtaining and developing instructional resources for the Grade 10 Science course?
2. How do FI science teachers describe their role in fostering French-language development among their students?	*No division*
3. How do FI science teachers describe their practices, challenges, and needs associated with integrating language-learning into their Grade 10 Science course?	How do FI science teachers describe their practices associated with integrating language-learning into their Grade 10 Science course?
	How do FI science teachers describe their challenges associated with integrating language-learning into their Grade 10 Science course?

	How do FI science teachers describe their needs associated with integrating language-learning into their Grade 10 Science course?
4. How do Grade 10 FI Science teachers describe an ideal online instructional resources database that would support them in course development?	*No division*
5. How do Grade 10 FI Science teachers describe the impacts that an online instructional resources database would have on their teaching and personal lives?	*No division*

The codes and subcodes that fell under each category were the participants' responses to the specific research questions. I began the process of determining the codes while I was transcribing the interview data. During this time, I wrote out preliminary code ideas and modified these ideas as I went through the transcribing process.

When the transcriptions of the interviews were completed, I uploaded one of the transcriptions to the NVivo software program. I then listened to the entire interview again, while at the same time reviewing the transcription. While listening to and reading the transcript, I manually assigned passages to the preliminary codes that I had entered in NVivo. During this process, I continued to add codes and modify existing codes. Next, I uploaded another participant's transcript and went through the same process: manually assigned passages to the codes in NVivo, continued to add codes, and continued to modify codes. While going through this process in the second interview transcript, I would have to return to the first transcript, the one with which I started the coding process. I continued this same process with the remaining participants' interview transcripts; I continually reviewed and revised my codes, which meant I continually returned to all of the transcripts to code them to the revised codes.

Once I had coded all data with the final codes and written my *Results* chapter, I discovered three major themes that emerged from the data, which are discussed in the *Discussion and Conclusions* chapter. As Saldaña (2016) explains, "A theme can be an *outcome* of coding, categorization, or analytic reflection, but it is not something that is, in itself, coded" (p. 15).

Defining "field notes." McMillan (2012) explains that "field notes include two kinds of information: "descriptive" and "reflective" (pp. 289-90). "The purpose of the description," McMillan elaborates, "is to use pictures, words, drawings, maps, and diagrams that capture the details of what has occurred" (pp. 289-90). McMillan goes on to provide guidelines as to what should be included in these descriptive field notes, and these guidelines were used in the present study to organize my field notes. McMillan also reminds us that "in the description, interpretations are avoided" and that "as much detail as possible is recorded, including direct quotes or close approximations of what was said" (2012, p. 290). In this study, the interviews were audio-recorded and then transcribed. As such, the descriptive field notes included all direct quotes from the participants. The advantage of transcribing field notes is that it enhances reliability of the data, as it captures exactly what transpired and therefore does not rely on the subjective memory of the researcher, as would be the case if the data were written in point form during the interview (Creswell, 2013, p. 253).

"Reflective" field notes are "researcher speculations, feelings, interpretations, ideas, hunches, and impressions – subjective notions related to the research" (McMillan, 2012, p. 290). McMillan (2012) further elaborates on reflective field notes when he writes "reflections include thoughts about emerging themes and patterns, thoughts about methodological problems or issues, considerations of ethical concerns, and introspective discussions about researcher opinions,

attitudes, and prejudices" (p. 290). As suggested by McMillan (2012), the reflective field notes were written separately from the descriptive field notes (p. 290).

Credibility and Reliability

Credibility. As McMillan (2016) explains:

> The essential validity (or what some would call *trustworthiness*) question with qualitative research is: Do the data and conclusions accurately, fairly, plausibly, and authentically portray reality? A related term, *credibility*, is often used in qualitative research. Credibility usually refers to whether the results accurately portray the views and meanings of the participants, although the term *credible* could also be used to describe validity. (p. 308)

Creswell (2013) explains that there are various "types of qualitative validation" drawn from the work of many scholars, such as Lincoln and Guba (1985) and Whittemore, Chase and Mandle (2001) (pp. 248-50). Creswell (2013) also offers his opinion on the subject: "I consider 'validation' in qualitative research to be an attempt to assess the 'accuracy' of the findings, as best described by the researcher and the participants" (p. 249-50). He uses the term "*validation* to emphasize a process rather than *verification*" (p. 250). For Creswell, this process entails researchers using "validation strategies" to "document the 'accuracy' of their studies" (p. 25). There are eight commonly-adopted validation strategies in qualitative research (Creswell & Miller, 2000 as cited in Creswell, 2013, p. 250) and Creswell (2013) recommends that at least two of these strategies are used and explicitly addressed by researchers (pp. 250-3). The validation strategies that used in the present study are described below.

Triangulation. The process of triangulation "involves corroborating evidence from different sources to shed light on a theme or perspective" (Creswell, 2013, p. 251). In the present

study, the following data will be triangulated: the teacher interview data, the available provincial support documents for teaching Grade 10 Science in Manitoba, and my personal reflection on course development. In other words, I will be comparing the results from these sources in order to see if and how they support one another. If the results corroborate one another, the credibility of my study is enhanced. In other words, in making connections between the interview data, the available provincial support documents, and my personal reflection on course development, I am validating my findings, as well as gaining a better understanding of the experiences of FI science teachers in Manitoba.

Peer review or debriefing. A "debriefer" can be defined as "essentially a noninvolved professional peer with whom the inquirer(s) can have a no-holds-barred conversation at periodic intervals" (Lincoln & Guba, 1985, p. 283). As Creswell (2013) summarizes, a peer debriefer can be described as a "'devil's advocate,' an individual who keeps the researcher honest; asks hard questions about methods, meaning, and interpretations; and provides the researcher with the opportunity for catharsis by sympathetically listening to the researcher's feelings" (Lincoln & Guba, 1985 as cited in Creswell, 2013, p. 251). I asked more-experienced graduate student peers, who are not FI science teachers, to debrief with me throughout the research process, which helps to enhance the credibility of my study.

Negative case analysis. A "negative case" is "information that contradicts themes, patterns, and overall results" (McMillan, 2012, p. 304). In order to "[provide] a realistic assessment of the phenomenon under study," I identified the negative cases (Creswell, 2013, p. 251). I was thorough in presenting the results (Appendix G). Identifying the negative cases not only "enhances the credibility of [my] study" (McMillan, 2012, p. 304), it is also imperative for ensuring a thorough representation of the varied experiences of FI science teachers in Manitoba.

Clarifying researcher bias. This clarification "from the outset of the study is important so that the reader understands the researcher's position and any biases or assumptions that impact the inquiry" (Merriam, 1988 as cited in Creswell, 2013, p. 251). Since I am an FI science teacher in Manitoba, and my experiences in this field inspired me to pursue this study, it is imperative that I address this bias. I included a section entitled *Researcher's Position* in which researcher bias is explicitly addressed.

Member checking. I engaged in member checking by sending each participant an e-mail with the transcript of his or her interview for revision. I sent this e-mail to participants within two weeks of their interviews and asked them to return their feedback to me one week later.

Rich or thick descriptions. "Thick" descriptions are ones that provide lots of detail (Creswell, 2013, p. 252). Providing detailed descriptions helps readers to determine whether the study's findings are transferable to another situation (Erlandson et al., 1993 as cited in Creswell, 2013, p. 252). As previously described, while I did not include truly "rich" (or "thick") descriptions, I included detailed descriptions, for example, by citing participants directly and by describing themes in detail.

Reliability. As Creswell (2013) describes, "in qualitative research, *reliability* often refers to the stability of responses to multiple coders of data sets" (Creswell, 2013, p. 253). When more than one person codes the data, "*intercoder agreement*" can be determined in a variety of ways (Creswell, 2013, p. 253). Since I am conducting this research as a Master's student, it was not possible to have another coder. Another way to increase the reliability of the data is to record the interviews in order to transcribe them verbatim (Creswell, 2013, p. 253). As mentioned in the *Data Collection* section, I recorded the interviews using two audio recording devices that are compatible with my computer (one served as back-up), such that the files could be uploaded

directly to my computer for safe-keeping. The interviews were transcribed verbatim in separate documents.

Summary of Chapter 3

In this chapter, I started by describing this study's theoretical framework (social constructivism), the research approach (qualitative research), and the research design (case study). The beliefs of social constructivism, as well as the characteristics of qualitative research and case studies, inform the methods of my study. After the description of the characteristics of case studies, I presented my position in order to be as transparent as possible. Since I am an FI science teacher in Manitoba, it is essential that I be as transparent as possible throughout my study.

The ethical considerations and the recruitment and sampling procedures were then described. Next, I explained my data sources, namely, semi-structured interviews, documents, and my personal reflection on course development. Finally, I described my data analysis procedure and addressed how I will ensure the credibility and reliability of my study.

Chapter 4: Results

Introduction

The purpose of *Chapter 4: Results* is to provide a description of the findings of this study. As explained by Merriam and Tisdell (2016): "Typically, a 'findings' section begins with a brief overview of the findings, followed by presentation of each separate finding supported by quotes from interviews or field notes or references to documentary evidence" (p. 278). This process was followed in the development of this *Results* chapter: for each category of data (see Chapter 3 for use of the term *category*), a description of the findings is provided along with participant quotes that illustrate the findings under that category.

This chapter is divided into 11 major sections. The first section, *Overview of Findings*, presents a very brief summary of results. The second section, *Participants*, provides a description of each participant. The following nine sections present detailed results for each of the research questions. As explained in Chapter 3, two of the research questions were divided for coding purposes, which resulted in a total of nine questions for coding purposes. The table on page 66 summarizes these nine questions that are also nine of the major sections of this chapter. The reason that I decided to organize this *Results* chapter into these sections was to be faithful to the data by ensuring that I thoroughly and accurately responded to each research question by bringing together the participants' responses to each question. In so doing, I could compare participants' responses to each question in order to gain a deep understanding of the similarities among and the differences between their course development experiences.

As expressed by Merriam and Tisdell (2016): "Knowing how much data to include in support of a category or theme is a judgment call. You need enough to be convincing, but not so much that the reader becomes buried." (p. 280) To fairly and accurately present participants'

voices, I have provided detailed descriptions of the findings under each category. In order to achieve a balance between transparency and a reasonable amount of detail, I selected what I consider to be a reasonable amount of direct quotes from the interviews to illustrate the findings. Furthermore, I have also edited the quotations for ease of review, which I discuss next.

Notes on Participant Quotations. For ease of review, repeated words and phrases that indicate thinking (e.g., "um," "like," "yeah," "you know") are removed from a quotation in order to make the excerpt more fluid. Furthermore, ellipses were used when parts of a sentence are removed. Parts of a sentence have been removed if a) they were not relevant to the topic on which I am reporting, b) if the participant stopped and re-phrased his or her sentence, and c) if this part of the sentence was repetitive.

The participant interviews took place between June and July 2016. For ease of review, the APA format for citing participants (pseudonym of participant, personal communication, date, year) will not be used in this thesis. Instead, the participant's pseudonym will be used.

Overview of Results

Analysis of participating teachers' descriptions of their practices revealed that course development is a complex process for French Immersion teachers. Several teachers described spending a substantial amount of time outside of school hours, especially early in their careers, obtaining and/or developing instructional resources. They obtain resources from a variety of sources, and develop their own resources using a variety of sources. Teaching colleagues are a major source for resources. Participants explained how they will often modify the resources that they obtain from colleagues, and other sources, for reasons that include making the resource fit their teaching style or simplifying the French language. Teachers in this study also use a variety of types of resources, such as student notes, assessments, activities, and videos. While using a

variety of types of resources from a variety of sources, none of the teachers in this study are currently incorporating Aboriginal perspectives into their Grade 10 Science course. Moreover, the participating teachers do not place the same importance on each of the four clusters in the Grade 10 Science curriculum.

Teachers participating in this study described a variety of challenges that they have with obtaining and developing resources. The main challenges mentioned are a lack of instructional resources in French (or fewer resources in French than in English) and a lack of time (to find or to develop resources). Teachers also noted a lack of an updated Grade 10 Science provincial curriculum and a lack of detail in the French Grade 10 Science curriculum. Following from these challenges, the main needs that teachers expressed were for more instructional resources in French that directly align with the Manitoba curriculum and more time to find or to develop resources. A challenge for teachers in rural and and northern settings was a lack of French Immersion colleagues. Even with French Immersion colleagues, however, a challenge for some of the participating teachers was colleagues not wanting to share their instructional resources.

All teachers in this study believe that they have a role in fostering French-language learning among students. They engage in various teaching practices for fostering French-language learning including discussion and writing activities. However, not all six teachers in this study brought up all of the strategies for fostering language learning mentioned by all participants collectively. Two of the challenges expressed with regards to integrating language learning were a lack of instructional resources and a lack of knowledge of strategies. In addition to challenges experienced during course and lesson development, teachers also described challenges that exist at the school level and beyond the school level, for example, lack of French use in the school and in the community.

Teachers described various features of an ideal online instructional resources database (collection of resources). For example, the resources included should be modifiable and current, and they could be made available through a website platform. Teachers mentioned several types of resources to include in the collection, such as videos, activities, assessments, readings, notes for students, and links to websites.

Teachers explained how the collection of resources would have a positive impact on their teaching practice as well as their personal lives. Examples of positive impacts on teaching practice are more time to learn new ideas, to focus on individual student needs, to plan lesson delivery, and to assess student progress. In terms of impacts on personal lives, the participating teachers described how having a collection of Grade 10 Science resources would reduce their stress level and improve their work-life balance.

Participants

Six French Immersion teachers were interviewed in this study. The table below provides the pseudonyms for the teachers and information about their first-language, current school (pseudonym), the location and type of school (urban, rural, or northern and dual-track or single-track), and the number of years of teaching experience as of June or July 2016. Following this table, a narrative of each participating teacher is provided that describes his or her teaching experience and background.

Table 3: Summary of Participants

Name (pseudonym)	First-language	Current school (pseudonym)	Location and type of school	Teaching experience
Mike	English	Collège Maplewood Collegiate	Urban Dual-track	20 years
Sophie	French	École secondaire Spruce High School	Rural Dual-track	15 years
Renée	French	Collège Rivière	Urban	15 years

			Single-track (Francophone)	
Paul	French	Collège Pineville Collegiate	Rural Dual-track	20 years
John	English	Collège Jasper Collegiate	Urban Dual-track	5 years
Michelle	English	Collège Montrose Collegiate	Northern Dual-track	4 years

Mike. Mike started his career at an urban, dual-track, middle school. He taught science and mathematics to French Immersion students in Grades 6, 7 and 8, several social studies courses in French and in English, and Basic French. He was the Science Department Head for the last two years that preceeded his moving to the middle school's feeder dual-track high school, Collège Maplewood Collegiate, also in an urban setting. He continues to teach at Collège Maplewood. Similar to his experience teaching in middle school, Mike has taught a number of different science and mathematics courses in the Collège's French Immersion and English programs. Mike last taught the Grade 10 Science course in French in 2011. He estimates that he taught the course for a total of five years.

Mike's first language is English. While his mother is Francophone, French was not spoken in the home. He started his elementary education in an English program, and switched to French Immersion in Grade 2. He obtained his French Immersion high school diploma from a French milieu (French only) school. Mike obtained a Bachelor of Science degree (major in mathematics, minor in zoology) and a Bachelor of Education degree at the Université de Saint-Boniface (USB) (formerly Collège universitaire de Saint-Boniface). He took courses at the USB's parent school, the University of Manitoba, as part of his Bachelor of Education degree program. Mike always planned to teach in French Immersion after completing his studies.

Sophie. Sophie has been teaching for 15 years in a rural, dual-track high school, École secondaire Spruce High School. She has taught a variety of science and mathematics courses in both the French Immersion and English programs. These courses include: Grade 10 Science (French and English), Grades 11 and 12 Biology (French and English), Grade 11 Topics in Science (English), Grades 10 and 11 Consumer Mathematics (French and English), and Grade 10 Applied Mathematics (English). Sophie has taught the Grade 10 Science course in French Immersion in each of the 15 years of her career. She estimates that she has taught the same course in the English program for 10 years. At École secondaire Spruce, Sophie is one of three French Immersion teachers. She teaches all of the science and mathematics courses that are offered in French. There are no other high schools in her school division that offer Manitoba Education's French Immersion program.

Sophie's first language is French. She is from a small Francophone community in Manitoba. She attended the Francophone elementary school (Kindergarten to Grade 6) and the Francophone high school (Grades 7 to 12) in her community. She completed a three-year science degree and an education degree at the Université de Saint-Boniface (teachable major: general science; teachable minor: chemistry). She is currently completing courses at the Université de Saint-Boniface and the University of Manitoba in the Post-Baccalaureate Diploma in Education (PBDE) program. Her PBDE program has included courses in language and literacy, French-language skills, and Aboriginal perspectives in curriculum.

Renée. Renée graduated with her Bachelor of Education degree 15 years ago, and has been teaching for approximately 13 years. She started her career teaching in a dual-track high school where she taught Grades 9 and 10 Science, Grades 11 and 12 Chemistry, and Grades 11 and 12 Biology in the French Immersion program. Approximately 1.5 years ago, Renée started

teaching in a Francophone high school, Collège Rivière, where she teaches a variety of science and mathematics courses.

Renée last taught Grade 10 Science in the French Immersion program in 2011. She taught Grade 10 Science in the Francophone school during the 2015-2016 school year. In total, Renée estimates that she has taught Grade 10 Science in French Immersion for five or six of the 13 years of her career.

Renée grew up in Manitoba and her first language is French. She attended a Francophone elementary school (Kindergarten to Grade 6) and a Francophone high school (Grades 7 to 12). Renée obtained her Bachelor of Science degree from the University of Winnipeg and her Bachelor of Education degree from the Université de Saint-Boniface.

Paul. Paul has been teaching for 20 years. He has taught in a variety of school settings, including an urban French Immersion high school and a Malaysian school that follows the Ontario curriculum. Approximately half of his career was spent teaching in middle years (all subject areas). Paul currently teaches in a rural French Immersion school in Manitoba, Collège Pineville Collegiate. At the high school level, Paul has taught a variety of science courses including Grade 9 Science, Grade 10 Science, Grades 11 and 12 Physics, Grades 11 and 12 Chemistry, and Grades 11 and 12 Biology. He most recently taught the Grade 10 Science course in French Immersion in 2015, and he has taught this FI course a total of two times. In 2015, he taught the Grade 10 Science course in English for the first time.

Paul is Francophone. He attended a Kindergarten to Grade 12 Francophone school until Grade 9. For Grades 10, 11, and 12, he was a student at a private Anglophone school. He obtained his Bachelor of Science (major in microbiology; minors in zoology and English literature) and Bachelor of Education degrees from the Université de Saint-Boniface. As part of

his Bachelor of Education degree program, he took several courses at the University of Manitoba.

John. John has been teaching for five years. He has taught a variety of subject areas at the middle school and the high school levels. He started his career teaching Grades 7 and 9 French Immersion Mathematics and Grade 9 English. He then moved to an urban dual-track French Immersion high school where he taught Grade 9 Science, Grade 10 Geography, Grade 9 Mathematics, and Grades 9, 10 and 11 Social Studies in the French Immersion program. He then had a short term position teaching a Grade 3-4 multi-age class before being hired to teach at an urban French Immersion dual-track high school, Collège Jasper Collegiate, where he had taught for one semester at the time of the interview and is currently teaching. In 2016, John had the opportunity to teach Grade 10 Science in French Immersion at Collège Jasper. In addition to teaching Grade 10 FI Science for the first time, John taught Grade 9 English and a multi-level Grades 10-11-12 Essentials Mathematics class; a section for all of the French Immersion students enrolled in Essentials Mathematics at the school.

John's first language is English, although his mother is Francophone. John attended urban French Immersion schools from Kindergarten through to Grade 12. His experience with the French language is best described by John himself:

> My mom is from Quebec... when I was a little kid, I sort of learned French at the same time as English... I spoke a lot of French at home, but I wouldn't consider it... my native language, because... for whatever reason, maybe TV, I started to speak English more, and we kind of stopped speaking as much French at my house... (John)

John obtained a Bachelor of Arts and a Bachelor of Education (teachable major in English; teachable minor in psychology) from the University of Winnipeg. Although his degree

is not in science, John took 12 credit hours of science (biology and physics) in university. He explained that science is an "area of interest" for him, "like a hobby."

When asked if he always planned to teach in French Immersion, John responded "not necessarily." Although he seemed to know "that [he] probably was going to." He did not complete any of his practicum experiences in French Immersion.

Michelle. Michelle teaches in a northern dual-track French Immersion high school, Collège Montrose Collegiate. She is the only French Immersion teacher at Collège Montrose, where she has been teaching for the four years of her career. During these four years, she has taught every subject area in French Immersion with the exception of mathematics. She has also taught Grades 9 to 12 Basic French.

Michelle explained that the four dual-track French Immersion high schools in the northern part of Manitoba work together to offer the French Immersion programs through a "virtual high school" program. For example, a teacher in one of the high schools could teach Grade 10 French Immersion Mathematics "in-person" to his or her students while simultaneously teaching students in another high school through a live video-conferencing/teleconferencing program. Michelle teaches a variety of FI courses in this manner. In the same year, FI students at Collège Montrose take additional FI courses by video-conference/teleconference offered by a teacher in one of the other three French Immersion high schools. As Michelle explains it: "We kind of just trade off 'cause there's only one French Immersion teacher in each of those... towns." To explain further, Michelle gave the following example:

> It's live, it's like Skype... Like I did [name of Grade 11 course] this past semester, and I had... six kids in my classroom, and eight kids in a classroom in [name of another town in northern Manitoba], and so that's the class all together... [The students] have

> microphones, and it's just like this would be, or like Skype maybe, or like a Google hang-out, or whatever version you're used to. ...the Math classes are often all four sites at the same time. My [name of course] class tends only to be me and one other place or me and two other places, but the math teacher out of [name of another town in northern Manitoba], he very regularly is teaching to all four towns at the same time. And so you have to kind of juggle those schedules and make everything work and make sure everybody has the right papers... it's a lot of extra admin work sometimes. (Michelle)

Michelle taught Grade 10 French Immersion Science in her second year of teaching. She did not teach this course by teleconference.

Michelle's first language is English. She started French Immersion at a dual-track school in Grade 7 and continued in the program through Grade 12.

Results for the research question *How do FI science teachers describe their practices associated with obtaining and developing instructional resources for the Grade 10 Science course?*

This section is divided into eleven subsections. Each subsection is a category within which the data was organized (see Appendix G for a complete list of categories). As described above, each of these categories was sub-divided using codes to organize the data. In each subsection (for each category), I summarized the results placed under each code, and provided excerpts from participants' interviews that illustrate the codes. It should be noted that participants at times talked about their practices in general, and not necessarily only about Grade 10 Science.

A.01: Teachers in this study use a variety of types of instructional resources.

All six teachers stated that they use the following types of instructional resources: notes, textbooks, assessments, and activities or experiments. Five teachers mentioned using videos and four teachers mentioned using websites (including simulations/virtual experiments). Sophie and Paul were the only two teachers who mentioned using magazine or newspaper articles.

Notes. In John's classroom, students use "notebooks," and in these notebooks there are "notes for [the students] to fill out" and "practice questions." The remaining five of the teachers mentioned making notes using *Microsoft PowerPoint*. For example, Paul's rationale for using *PowerPoint* notes was so that students would "not [spend] any time... with any of the actual mechanical part of writing." In contrast, Mike would have students write out the notes that were on *PowerPoint* slides.

Textbooks. With the exception of John, the teachers mentioned using the *Omnisciences 10* textbook (the French version of the English *Sciencepower 10* textbook). However, John explained that he believes that some of the resources in his colleague's teacher-created note booklets (that John uses as well), are from *Omnisciences 10*. Renée explained that she will sometimes distribute the *Omnisciences 10* textbook to students in order for them to read a section, look at images, or respond to questions. Michelle used the textbook for questions, readings, and introducing a new topic. She also explained how the textbook is "good for subs," who are generally English speaking, for "a couple [of] simple labs," and as additional help for students when needed. Unlike the previous three teachers, Paul used readings from the textbook to fill time, particularly on days when he was "going to be gone" and didn't "have other things." Michelle and Sophie were the only participants who mentioned using a textbook in addition to *Omnisciences 10*.

Assessments. This category includes instructional resources that could be considered a

formative or a summative assessment tool. For example, assignments, quizzes, tests, and projects are considered to be types of assessments. While "experiments" could have an assessment component to them, they are included in a separate category.

Mike, Paul, John, and Michelle mentioned using "quizzes" and "tests." Four teachers mentioned the use of "practice questions" or "assignments" or "worksheets." Although the term "project" was not defined for teachers, all but Mike mentioned using projects. Two of the projects in Renée's course were "building the 3-dimensional" model of a compound and "making the car for Newton's 3rd Law." Paul, in contrast, talked about a "video mash-up" project that asked students to create a digital video with "music and... pictures to illustrate their point."

Activities or experiments. All six teachers mentioned using science activities or experiments. For example, Sophie explained one of her activities in which students explore the effects of bioaccumulation by role-playing as organisms that become affected by a bioaccumulating substance.

Videos. All but Paul mentioned using videos; however, Paul suggested that he uses videos when talking about mentoring new teachers on how to use video. Three of the teachers mentioned showing videos in English. For example, Renée, who is currently teaching science in a Francophone school, explained how she likes to show videos from the YouTube series "SciShow" and "Crash Course." While John noted, "unfortunately they're in English," he also showed videos from "Crash Course" as "they're really well done." John also showed news footage from CBC "to show them [the students] this is a real thing that is happening right now." In contrast, Michelle explained that on YouTube "there's one science teacher that does videos in French" and that she "used them sometimes, especially if someone [a student] was absent, or if [she] was absent."

Sophie mentioned the online videos that teachers in Manitoba can access through "la DREF" (the *Direction des ressources éducatives française*) at the Université de Saint-Boniface (e.g., access to videos on CBC's curio.ca), but she noted that one challenge to using the videos is the level of French: "one has to... watch the video like 10 times before the students can understand" (translation).

Websites. While videos can be obtained from websites, "videos" was given a separate category to distinguish videos from other types of instructional resources found on the Web (such as animations or simulations/online experiments). Four teachers mentioned using websites in the context of their Grade 10 Science course. For example, Sophie used an online simulation called "The Running Man." John used Google Earth, "which was great for the atmosphere and ecosystem stuff, just sort of getting them [the students] to visualize" the Manitoba landscape. While unrelated to the Grade 10 Science curriculum, Michelle mentioned using "virtual microscopes" in science.

Articles. Only Paul and Sophie talked about using articles in the context of their Grade 10 Science course. Paul believed that the biggest obstacle to using magazine or newspaper articles was finding those in French that were written at the reading level of his students and addressed the Manitoba curricular outcomes. Although using resources in English was frowned upon by his administration, he would occasionally use those that were "exceptional" in terms of content and "right to the point." Sophie, on the other hand, made magazines such as *Sciences et vie Junior* and *Sciences et vie* available to her Grade 10 students so that they had opportunities to read in French. Students got to choose what to read and would fill out a reading response sheet from the French version of *Success for all Learners*, a Manitoba Education support document. She also talked about sharing up-to-date science news that she would have read in the Winnipeg Free

Press “because it’s things that [the students] can discuss right when it happens.” On occasion, she would even copy these English newspaper articles to distribute to the students even though “some will say... ‘oh, you should never do that’ [in an FI classroom].”

Renée was one of the teachers who did not make use of articles even though she said, “It might be good” to do so. It was simply a matter of the time required “to look through a bizillion articles” for one “that is pertinent to what we are doing.”

A.02: Teachers in this study obtain instructional resources from a variety of sources. All teachers in this study explained that they develop their own resources in the context of their Grade 10 Science course, as well as obtain resources from colleagues. All six teachers mentioned that they also obtain resources from textbooks or teachers’ guides and websites. Five teachers mentioned using the Manitoba government curriculum support documents. Sophie was the only teacher who mentioned obtaining resources from magazines or newspapers.

Teachers develop their own resources. Mike developed the *PowerPoint* notes that he used with his Grade 10 students. John developed his own “tests and quizzes,” and also some graphing exercises that were based on graphs that he found in English online. While Michelle mostly developed her own resources by translating her colleagues’ resources, she occasionally developed resources “based on stuff from the textbook.” Renée explained her process of developing notes, part of which included the following statement: “I did get a lot of support from my English-speaking colleagues, so I think a lot of my notes probably are modeled on theirs.”

Colleagues. All teachers explained that they obtained resources from colleagues. John described how he was “incredibly happy” when he received “super well-organized” note booklets from his colleague for Grade 10 Science. He also described how obtaining this resource support from his colleague was a “life-saver”:

> ...having these notebooks saved me an incredible amount of time. ...I was starting off, I got some stuff [resources] from [name of former colleague]... I was sort of like, piecing different things together and then... my colleague... gave it [the resources] to me, and… it was a life-saver. (John)

In response to the question, "What did that mean to you, getting the resources from them [colleagues]... how did you feel...?" Michelle responded:

> It meant I got to go to bed. It meant I got to sleep. No, it was great, it was so nice to have them [two English science colleagues] be so supportive and knowing that I could go to them with questions and I could go to them and say... I'm not sure what to do with this topic or with this outcome, and I'm not sure what to do for this lab... it definitely takes away the stress level when you have that kind of support... (Michelle)

Textbooks or teachers' guides. The use of textbooks fell under two categories: the current category (*A.02: Teachers in this study obtain instructional resources from a variety of sources...*) and the previous category (*A.01: Teachers in this study use a variety of types of instructional resources...)*. Given that examples of textbook use were described in the previous subsection, teachers' use of teachers' guides will be described in this subsection.

Mike mentioned the teacher's guide that accompanies the *Omnisciences 10* textbook, but did not state that he uses it. However, he did explain that he "[sees] it as a more valuable resource than [he] used to." Descriptions on how Mike's course development practices have evolved over his career are provided in a later subsection.

John said that he has the teacher's guide that accompanies the *Omnisciences 10* textbook, but didn't mention using it. Sophie alluded to using a teacher's guide for questions that accompany readings. However, she did not mention the title. Renée occasionally used a teacher's

guide to compare her own responses to the textbook questions to the answers provided in the teacher's guide. A teacher's guide was not a resource Michelle mentioned using.

Websites. The code *"Websites"* under this category, "*A.02 Teachers in this study obtain instructional resources from a variety of sources,*" includes reference to obtaining any kind of resource online. For example, as previously stated, five teachers mentioned obtaining videos online. The online resources obtained are summarized as follows:

John:	Videos (YouTube, CBC news), Google Earth, and graphs
Michelle:	Videos (YouTube), virtual experiments (microscopes), general resource-searching
Mike:	Videos, general resource-searching
Paul:	General resource-searching
Renée:	Videos (YouTube, BrainPOP), animations, teacher reference material, images, graphs
Sophie:	Videos (accessed through la Direction des ressources éducatives française), virtual experiment/simulation ("The Running Man")

Michelle explained how she would search for resources by "Googling" after she "had exhausted [her] paper resources and [her] human resources... and everything else." She would take time while searching online to "figure out what comes up that looks like it actually is valid" and noted how sometimes the science information on websites is incorrect. She would also make an effort to find a French equivalent to the English online resources that her English science program colleagues were using.

Renée explained how she uses the Internet more now than earlier in her career. Although "a lot of them [websites] are in English," she "will still use them in English in a French school, because they're just better."

Government curriculum support documents. Participating teachers, with the exception of John, shared that they obtain resources from the *Senior 2 Science: A Foundation for Implementation* document. These five teachers mentioned that they use the "Blackline Master's"/"practice sheets"/"worksheets"/"Appendices" and/or the experiments in the

curriculum document (which are often included in the Appendices). The only participant who mentioned using other curriculum support documents was Sophie. She talked about using *Le succès à la portée de tous les apprenants* (the French version of *Success for all Learners*), *La sécurité en sciences de la nature: Un manuel ressource à l'intention des enseignants, des écoles et des divisions scolaires (de la maternelle à la 12^{e} année)* (the French version of *Science and Safety: A Kindergarten to Grade 12 Resource Manual for Teachers, Schools, and School Divisions)*, and *L'enseignement des sciences de la nature au secondaire*.

Magazines or newspapers. As previously mentioned, Sophie obtains articles from a variety of French-language magazines and sometimes the Winnipeg Free Press. She is the only participant who mentioned obtaining resources from magazines or newspapers.

A.03: Teachers in this study use a variety of software programs.

Microsoft programs (Word, PowerPoint, Excel). All teachers mentioned using either *Microsoft Word* or *Microsoft PowerPoint* in the context of their Grade 10 Science course. Renée mentioned that she has used *Microsoft Excel*.

Notebook software. Mike, Renée, and Michelle have a SMART Board in their classroom and Sophie has a SMART Podium in her classroom. All of these teachers, except for Michelle, mentioned using the Notebook software that accompanies the SMART Technologies hardware. Sophie explained how this software "will allow [her] to write in [her] PowerPoints." Renée didn't think that she has Notebook files for her Grade 10 Science course; she said that "[she] use[s] Smart Notebook more for [her] Math class."

Other software programs. Michelle was the only participant who mentioned using a motion sensor program and a movie maker program., students in Michelle's class enjoyed constructing graphs of their live movements using the motion-sensor program. Michelle

described using a movie-making program "when [she] was making videos of some of the labs that [the students] did."

A.04: Teachers in this study use a variety of lesson delivery equipment.

As previously mentioned, Mike, Renée, and Michelle have a SMART Board in their classroom, and Sophie has a SMART Podium. Michelle, the teacher in the northern setting, explained how she uses the SMART Board in a way that would be uncommon to southern Manitoba teachers:

> With the distance ed program we all have SmartBoards, so that I can write on the board, the kids there at the other schools can see it, they can write on the board and I can see it. We have a connector program that allows our SmartBoards to connect... (Michelle)

Four teachers (Sophie, Renée, John, and Michelle) mentioned using the whiteboard during their lessons. Of these four, Sophie and John also use the video (computer) projector in their lessons.

A.05: Teachers in this study will often modify the resources that they obtain from various sources.

Teachers stated various reasons for modifying resources that they obtain from a variety of sources. The most frequently-cited reason for modifying a resource, mentioned by five of the six teachers (all but Mike), was the need to translate the material from English into French. Michelle explained how she spent "a lot of time translating" resources that she obtained from her colleagues who teach science in English:

> I... spent a lot of time with the English science teachers and just said, you know, what are you guys doing, what can I take from you guys, and then I spent a lot of time translating what they had, because it was easier to just take what they could give me and make my own sheet that was similar. (Michelle)

The second most frequently-cited reason for modifying resources, mentioned by four of the six teachers, was for the resource to better suit their students' needs or their personal teaching style. As John explained:

> I don't think I've ever found something online... across any course, that I've been able to use immediately… especially in French. And I think if it was in English, I think it would be easier, so I honestly, I don't know if it's a language thing or if it's that they don't really exist... it's always like, you take it online and then you, kind of, make it to your style... I've gotten so many different things from people... I take the things that they give me, and then I sort of change them and make them my own. The notebooks in science [from my colleague], these are probably the least I ever changed anything, just because I really like them, I think they sort of matched my style in a sense. (John)

The third most frequently-cited reason for modifying resources, cited by Sophie, Mike, John, was the teachers feel that the language used in the resource needs to be simplified. For example, Sophie explained: "...I take the activities out of the [Omnisciences 10] textbook, but I've adapted them to suit my needs... even if it's just the language, I wrote it in a way that they [the students] were going to understand." In contrast, Mike once considered that the language in resources would often need to be simplified, but he has since changed his viewpoint after having participated in a professional development session called "Reading Apprenticeship." As one example, he explained that, in the past, he would "usually... modify the definition from the curriculum into words that [he would] feel the students would understand better," but now, in Mike's words:

> I would probably not do that anymore though. I would probably challenge my students to take a look at... these definitions and have them discuss them now. So... I'm doing things

> differently than I used to. But yes, that was the process in the past, where I would... dumb things down, is what I would do, and I don't want to do that anymore. (Mike)

Further description on the "Reading Apprenticeship" program is provided in an upcoming section.

Other reasons mentioned by teachers for modifying resources were:

- In order for the resource to match with what they taught (or match with the curriculum). [Cited by John]
- In order for the resource to align with the school division's policies. [Cited by Sophie]
- In order for the resource to suit their particular situation.
    - Make it work "with what we have." [Cited by Paul]
    - Modified based on "equipment or the room," "prep time that I have," "type of class," and "size of the class." [Cited by Renée]
- To make corrections to the French language. [Cited by Renée]

The example Sophie provided to explain her reason for modifying a resource that she obtained from the website "Teachers Pay Teachers" was to give students choice in the assignment. She explained that the school division in which she works is "big on multiple intelligence, differentiated instruction," and wants "the students to have choices." She later mentioned "UDL" (Universal Design for Learning) and said, "I try to incorporate all that into my lessons."

Renée explained that most of the resources she obtained at the beginning of her career were in English. There was, however, one teacher who taught science in French Immersion, and she would occasionally obtain resources from him. Before she would use his resources, she would make changes to "the format, and also the wording, because French is not his first

language."

A.06: Teachers in this study spend a substantial amount of time outside of the school day obtaining or developing resources, especially early in their career or when teaching a course for the first time.

Four teachers made explicit reference to spending a substantial amount of time outside of the school day obtaining or developing resources for their courses. John talked about his first year of teaching and described staying at the school until late in the evening and how these long hours preparing resources would affect his teaching:

> ...it was my first year teaching and I was teaching four different courses... every single thing I made from scratch because the teacher who I was covering for, I know she didn't really want to share her things. So I was like, that's fine, I'll make it myself, and I ended up doing the whole year, and I was just being at school until 7 or 8 on many many nights, sometimes 9, 10... it was hard. And again... when so much focus is on just being ready, having things made and doing all these things, it's almost like the more important things like assessment of individual students and getting to know individual students like... sort of, takes less priority, when I have to focus so so much on just the planning part. (John)

John further painted the picture of spending a significant amount of time on course development:

> ...it's a time consumption... The years where I did the planning on my own, man, the amount of time you consume just sitting by yourself, just writing at a computer, just writing things and planning things until it's dark outside when you leave. (John)

On at least five occasions during the interview, Michelle described spending a lot of time outside of the school day preparing for her courses, especially early in her career. In the following excerpt, Michelle described staying up late preparing for her courses. She also

explained how staying up late to prepare resources inevitably would lead to minor grammar mistakes in her work that her students would notice and politely point them out. Most notably, her students would acknowledge her hard work ethic and recognize the challenges associated with being the only French Immersion teacher in her school:

> ...the first two years I was definitely up very late a lot of nights trying to make sure sheets were ready and... had to triple read them and then, you know, the kids always still find something, and they're like, hey! You forgot an accent! I'm like, thanks guys, sorry. Up to 2:00 AM making this for you, but yes, please point out the one accent grave that I forgot... They're so cute about it though, they're [polite about noticing a mistake]... And I'm like, thanks, I'm glad you noticed it... But now, now that they know me, three years later... they'll look at stuff and they'll be like, so, did you finish this test around 1:00 AM? And I'm like, can you tell?... it's not like it's full of mistakes, but they'll be like, that should have an accent, and I'm like... thank you. And they know how much extra I have to do, being the only one [FI teacher] and so they're not... offended, and they're not, like... she's incompetent. They're just like, so, that was probably a lot of work you had to do this weekend for all of these things. I'm like, yeah, it was. (Michelle)

Michelle further described how her students would notice her at the school late in the evening, and how they would recognize how dedicated she is to teaching:

> ...I'm lucky to have really mature students who are very well-aware of... where they live and what we have and what the possibilities are... and they tease me too, they'll be like, hey, I drove by the school at 9 o'clock and your light was still on, go the heck home... They're very supportive that way and they know that I work hard and they know that I'm trying to give them as much as I can, and so they're a good bunch of kids... (Michelle)

Sophie explained how early in her career it was "literally day-to-day" and that developing resources was "all [she] did."

A.07: Teachers in this study are not currently integrating Aboriginal perspectives throughout their Grade 10 French Immersion Science course.

Mike and John are not currently integrating Aboriginal perspectives throughout their Grade 10 Science course because they do not know how. John explains how "there's probably a way" to incorporate Aboriginal perspectives into the *In Motion* and the *Chemistry in Action* clusters, but he "just [doesn't] know." In the following excerpt from John's interview, the "ums" and "uhs" were retained:

> It's interesting, um. Science is, uh, is not an easy place to, per say, to put Aboriginal perspectives. I really liked doing it when I was doing Social Studies. Geography is great for Aboriginal perspective... Um, in uh, I guess it would, like, physics and chemistry, nope, there's, I mean, I honestly I can't imagine bringing Aboriginal perspectives into those. There's probably a way, I just don't know. The ecology one [cluster], you for sure could, for the same reason you could in the Geography one [course]. Uh... but yeah, aside from that it's hard because, like, the whole thing with Aboriginal perspective it's about, I mean, word-of-mouth traditions and passing down teachings that, sort of, like, are based on observations, but like, in a different sense. Like, physics was years of, like, was like data compounded on data on data on data and required like writing and reading and books, like, and that just isn't a part of Aboriginal history in North America. (John)

Like Mike and John, Renée is also not incorporating Aboriginal perspectives throughout her Grade 10 science course. She explains:

> Well, if they [resources that incorporate Aboriginal perspectives] were more readily-available, I think I would be more likely to sit and read it and then incorporate it in the classroom. So if they were more readily-available, I would definitely read them and try to do something with it, but they're just, they're not, it's not something that I hear of, that I see, so I don't. (Renée)

Three teachers, Mike, Sophie, and John, have participated in professional development about integrating Aboriginal perspectives, but they have not yet integrated the perspective into their Grade 10 French Immersion Science course. Sophie recently completed a course on Aboriginal perspectives, but has not yet looked for resources. John described his professional development experience as follows ("ums" and "uhs" are retained in this quotation):

> I did... an Aboriginal PD in my first year teaching, and there was a chief there, and, uh, he said that he didn't think, he didn't think that White people should teach science to Aboriginal students, like off-the-bat, I was like, ok, this is going to be interesting. Um, but his whole point was, like, he was, um, he's like well how can you teach Biology to an Aboriginal student if you don't take into account, like, the spirit and then I guess at one point he singles me out and he's like, and he's like I mean, I was making an effort to be very respectful and I think I was, and he was saying, he was like, who are you, what makes you "you," like fundamentally on the inside what makes you, "you." And then I was like, well I am a composition of billions of atoms that react in certain chemical ways and those chemical reactions, and, they flow through my body and the combination of the chemical reactions in my brain and my memory of past chemical reactions make me who I am. And he's like, you're missing the most important thing, you're missing the spirit, and I was like, there's no, that's not in science. You don't do that in science. There's no

> spirit. It's everything can be boiled down to these little objects that are moving around in your brain. I mean it's, some people think, well that's not artistic, that's not beautiful. I think if you like science, I think there is beauty in that. That it all comes down to a bunch of little bits and pieces. And so that's, I never forgot that, 'cause I know he's, he has a specific perspective. He doesn't represent the spectrum of, of Aboriginal thinkers, but I couldn't get on board with the way he sees science. (John)

When asked if he would be interested in doing other professional development sessions on integrating Aboriginal perspectives, John responded: "Yeah, I would be... I would love to hear. 'Cause I'm not saying you can't do it, I'm sure you can. I honesty don't know how. I would love to hear someone tell you how you could."

Paul explained how he feels that integrating Aboriginal perspectives does not have a "place" in all the clusters in the Grade 10 Science course. He said:

> ...the Aboriginal perspective in the Grade 10 curriculum, um, I don't think there's really a lot of place for it... like in the motion [cluster]... like, it doesn't matter what colour you are, or what race you are, or what you believe in... F = ma, period... (Paul)

All six teachers expressed interest in integrating Aboriginal perspectives into their Grade 10 Science course. For example, Michelle explained:

> ...obviously it would be great to do in science as well, now, I mean, particularly in my specific case, I don't teach Aboriginal students in my program right now... I don't think I have any, but, that doesn't mean that they shouldn't be learning about the perspective regardless, because it is in our community, and so, if it was something that was available, I would definitely have a look at it. And I definitely was not aware of it [*A Teacher's Guide for the Video Sila Alangotok – Inuit Observations on Climate Change*], but again,

> someone who had gone through the teaching program in Manitoba and who was a science teacher and was looking through all the documents, and not just being like, what do I have to teach tomorrow? Um, probably would have time to do that. (Michelle)

A.08: Teachers in this study work with colleagues on course development.

All six teachers seek support from colleagues for course development. This code overlaps with the code *"Colleagues"* within the category *"A.02: Teachers in this study obtain instructional resources from a variety of sources."* Excerpts from John's and Michelle's transcripts about what collegial support meant to them were provided above under that particular code. The five teachers who were asked about assisting new teachers of Grade 10 Science mentioned sharing, or that they are open to sharing, their resources with these colleagues. It should be noted, however, that I did not have enough time to ask Michelle. Paul explained his view on sharing his resources by stating:

> I've always been the kind of person who, hey, I made this, I'm going to make your life easier, here, take... If I can help a starting teacher, and say, here's your beginning stuff, or go there to find some information, so that you're not wasting your time, you know, spinning your wheels looking for things, that's wonderful. (Paul)

Five teachers, with the exception being John, mentioned how they discuss or are open to discussing with their colleagues information about their course development ideas and strategies. This code was used if: a) The teacher in this study has discussed, or is open to discussing, with their colleagues their *own* ideas or b) the teacher in this study benefited from discussing with their colleagues their *colleagues'* ideas. Mike, Sophie, Renée, and Paul all mentioned how they discuss, or are open to discussing, with their colleagues their own ideas. As previously mentioned, Michelle described on numerous occasions how much support her colleagues

provided her in the form of discussions and resource-sharing.

Four teachers, Sophie, Renée, Paul, and Michelle, mentioned that they try to have some consistency within their courses among colleagues in their school or that they collaborate in course development. Michelle explained that one contributing factor to course development being stressful is trying to have consistency within courses so that the French Immersion students have "the same base of knowledge" as the English program students. Specifically, when discussing experiments for her science courses, Michelle said:

> ...it's stressful, because... you want the kids to have the same experience as the English kids. Again, because they're all going to be in the same class, in our case, in Grade 11. So you want them to have the same base of knowledge that the English kids are going to have. (Michelle*)*

Renée also explained how consistency among colleagues was important to her:

> ...when I first started out, people were really forthcoming with their resources and, it was just nice to... see... how in depth did they go on each concept and so it'd give me a better timeline for the school year. Being new in a school, you kind of want to know, and just make sure that you're covering exactly the same things that they're [her colleagues] covering, and so they've given me whatever they've had and I just would translate it, or decide to use it or not. (Renée)

A.09: In this study, teachers' course development practices evolve over time.

All six teachers explained how they have expanded or modified their course development practices or beliefs over time. As previously mentioned, one example is how Mike's practices changed after attending a professional development session called "Reading Apprenticeship." Reading Apprenticeship is described by Mike as follows:

> Reading Apprenticeship... empowers students... to attack the text basically and to see it as a learning opportunity... I've been using it in some of my other courses this past year and the confidence that the students have in reading textbooks that they normally found difficult is noticeable... and now that we've gone through the steps... and give them tools to use... the most powerful tool is talking amongst themselves and having them discuss it. Now when they're asked to read, they know that it's a social experience, it's not an individual thing and they feel a lot more confident about doing the reading now... (Mike)

All of the teachers expressed interest in expanding or modifying their course development practices. For example, Michelle said that she would use the "Google Classroom" online platform if she were to teach science again. Mike said that he plans on using articles in Grade 10 Science next time he teaches this course.

A.10: Not all teachers in this study teach all four clusters in the Grade 10 Science curriculum (or place equal importance on all four clusters).

Three teachers (Sophie, John, Michelle) emphasized the importance of the *Chemistry in Action* and the *In Motion* clusters over the other two clusters in the Grade 10 Science course (*Dynamics of Ecosystems* and *Weather Dynamics*). For example, John mentioned that "Weather obviously falls by the wayside a little bit for the sake of those two." Similarly, but regarding the *Dynamics of Ecosystems* unit, Michelle explained: "...I did chemistry and physics first, so the biology was kind of a last-minute unit. It was kind of, oh right, we should probably talk about ecology now." When Michelle was asked if that was ok, she replied:

> ...the English teachers said that we normally focus on chemistry and physics first because that's what they're [the students] going to come back to in Grade 11... and ecology is, like, you know, is what you fit into after because that's the only time they're going to see

> it, but it's also not going to come back to bite them in the butt... whereas the chemistry is the base for the Grade 11 Chemistry course. They need all of it and physics as well... so they're [her colleagues] like, make sure that gets covered... That was sort of, the advice I was given, which worked out well and like I say, they seemed to all succeed in their Grade 11 courses, so it must have been a good strategy, I guess. (Michelle)

Sophie and Renée explained that the *Weather Dynamics* cluster is not taught at their schools due to time constraints. Michelle mentioned that she also didn't teach this cluster when she taught the course. John described how some teachers in his school have skipped this cluster as well, but that he "did squeeze [this cluster] in at the end." Sophie shared her situation:

> It was decided in the school a long time ago that we weren't going to teach it... And when I started I taught all of them, and then I was like what do you mean you guys don't teach the Weather unit? I'm like, seriously? I'm like... what the heck am I doing then? So I stopped. I'm like, if you're not going to do it in English, why am I going to do it in French. (Sophie)

When Sophie was asked why it was decided the *Weather Dynamics* cluster would not be taught in her school, she replied:

> I don't know how you would find the time... to be honest, doing the ecology, the physics, and the chemistry, if you want to do those three units well, where are you going to add a fourth unit? And, I mean... you can spend a month on each unit, and... just cover the surface without going into detail with anything. But I think we looked at it as a Department and decided that they need chemistry and physics to go on if they continue in science. You know, they need a really good chemistry base and they... really need that

> good physics base. So those are the units that we definitely spend more time... we've decided that that's what they needed the most in order to continue on in science. (Sophie)

Sophie also added that "Ecology is a repetition of a lot of geography concepts."

A.11: Teachers in this study consider various student-related factors in course development.

In all six of the interviews, teachers mentioned that they consider students' needs and abilities in course development. Two teachers, Sophie and Renée, also mentioned that they consider the size of the class when developing the contents of a course.

Summary of results for the research question *How do FI science teachers describe their practices associated with obtaining and developing instructional resources for the Grade 10 Science course*?

Four of the teachers described spending a substantial amount of time outside of school hours, especially early in their careers, obtaining and/or developing instructional resources. They obtain resources from a variety of sources (e.g., colleagues, textbooks, websites, government curriculum support documents). A major source for resources is teaching colleagues. All six teachers also mentioned developing their own resources using a variety of sources. They explained how they will often modify the resources that they obtain from colleagues, and other sources, for reasons that include translating the resource, making the resource fit their teaching style, and simplifying the French language. Teachers in this study also use a variety of types of resources, such as student notes, assessments, activities, and videos. Some of the teachers mentioned showing English science videos in their French Immersion courses. While using a variety of types of resources from a variety of sources, none of the teachers in this study are currently incorporating Aboriginal perspectives into their Grade 10 Science course. Moreover,

the participating teachers do not place the same importance on each of the four clusters in the Grade 10 Science course. For example, not all of the teachers teach the *Weather Dynamics* cluster.

Results for the research question *How do FI science teachers describe their challenges associated with obtaining and developing instructional resources for the Grade 10 Science course?*

This section is divided into six subsections (categories): B.01 Lack of instructional resources, B.02 Time constraints and commitments, B.03 Challenges related to collaboration and professional development, B.04 Challenges related to the curriculum and curriculum support documents, B.05 Challenges related to addressing all the curricular outcomes and to preparing students for future science courses, and B.06 Other challenges. It should be noted that, while teachers were asked specifically about the Grade 10 Science course, they also gave responses related to other courses that they have taught or were teaching at the time the interview occurred.

B.01 Lack of instructional resources.

All six teachers emphasized a lack of resources in French (or fewer available resources in French compared to English) as a challenge. Teachers explained how they can find more resources online in English compared to French overall, and also how they can find better quality resources in English compared to French. John's explanation summarizes the general consensus of all participants:

> ...when I do a Google search, if I do it in English and do it French, the French doesn't yield nearly the same quality of results or quantity of results. And I look at the English one, man, there's all this great stuff. And then you just put the exact same search in French, and it just doesn't come back with the same stuff…, especially when it comes to

> the things like the Crash Course video series. Like the really cool, well-made, well-produced stuff is just generally more likely to be in English. Like, you're just not going to see that stuff as much in French. (John)

Mike similarly explained that "finding a variety of French resources" was "the main challenge for [him]." Sophie, who has taught Grade 10 Science in French Immersion and in English, explained how she does more in her English course compared to her French course as a result of having fewer resources in French and a lack of stamina to translate the resources she has in English.

Three participants (Sophie, Renée, and Paul) mentioned that it is challenging to find resources at the appropriate French level, particularly, readings and videos. As previously mentioned, Paul explained how it is difficult to find articles that address the Manitoba curricular outcomes and are at an appropriate reading level. He also said that he finds "even the textbook, sometimes can be too cumbersome for them [students]." He goes on to explain: "Just too many vocabulary words, and they [the students] don't get the important stuff. So... I tend to use a lot of the stuff that I've created with the vocabulary that I know they understand." Paul also mentioned that some of the students "are coming in with a Grade 7 reading level, Grade 8 reading level by the time they hit Grade 10." As previously mentioned, Sophie noted how French videos can be difficult for students to understand.

Three participants, Sophie, Renée, and Mike, mentioned a lack of resources that align with the Manitoba curriculum as a challenge. Sophie described this challenge as a "big problem." She stated:

> So, tu prends une petite chose d'ici, une petite chose là... il n'y pas un livre qui est juste pour nous autre. (Translation: So, you take a little thing from here, a little thing there...

there is not one book that is just for us.) (Sophie)

Similarly, when asked about challenges, Renée mentioned not having an updated textbook that aligns with the Manitoba curriculum: *"*An updated textbook, a little bit more often, would be nice as well... that covers provincial outcomes, not from another province". Michelle, the teacher in the northern setting, mentioned a lack of resources that support distance learning, such as virtual experiments:

> ...that's kind of a struggling place... when I went looking for virtual experiments, there isn't a lot, and especially not in French. So that's something that could definitely be used, and, I mean, it's not just for people doing teleconference. It would be good for, you know, students that are doing homeschooling. It would be good for students that are sick and have missed the experiment. That's something that's missing. (Michelle)

In addition to the lack of specific resources, four teachers (Mike, Sophie, Renée, and Michelle) mentioned a lack of resources or classroom-ready resources, generally, as being a challenge.

B.02 Time constraints and commitments.

Each of the six teachers mentioned time constraints as a challenge associated with obtaining and developing instructional resources. More specifically, they mentioned the time to develop resources/the time-consuming nature of developing resources. With the exception of John, they also talked about the time required to search for and go through the resources that are available as well as the time necessary for translating resources (and/or the time needed to ensure the quality of French while developing resources).

As previously mentioned under the code *A.06: Teachers spend a substantial amount of time outside of the school day obtaining or developing resources,* Michelle described how she

would be “up very late a lot of nights” developing resources and trying to ensure the quality of French in her resources. Moreover, developing resources was “all that [Sophie] did” early in her career. In terms of the spending time searching for resources, Sophie painted the picture of her situation clearly: *“*...you could go on your one-hour prep, you can search for a whole hour and still not find anything [resources]... that you like, or that... you would use. There’s lots of stuff, it’s just not always relevant or useful.”

Mike, whose first language is English, mentioned the time needed to ensure the quality of French while developing resources. The time-consuming nature of translating resources, and translating these resources into French correctly, was discussed by Michelle, whose first language is English as well. Michelle said:

> It’s definitely time-consuming. You want to get the vocabulary right, so I had to spend a lot of time kind of going back and forth between... the curriculum and the textbook and what they [her colleagues] had, and. I mean some of the stuff they had was older, and I was like, ok, does it still work? Yes. So you have to spend time checking vocabulary... I can translate instructions, but then, you know, if there’s a certain vocabulary I had to go double-check that I had the right word and so it’s time-consuming for sure... (Michelle)

A time constraint due to one’s teaching load was also mentioned as a challenge. Specifically, the time needed to prepare for other courses, having a challenging course load, and a lack of consistency in course load were all mentioned as challenging. Teaching in a northern setting, Michelle’s situation was unique as the excerpt below makes clear:

> It is so hard... obviously if I was in a big school and I was teaching... three Grade 10 Science classes a day, that’s different, but in my case, I’m teaching science once a day and then I’m teaching four or five or six, depending on how many split classes I have,

> other courses in the day. So I can't spend that much time on science. I have to divide my time, right... You only get so much admin time, and again, it comes down to my piece being different than maybe the other teachers in that I have so many different domains that I'm trying to cover, and, so I kind of have to divvy up my time that way. I'm sure that if I was teaching just science and math, or just science, it would be easier and less-overwhelming, but when I have eight different curriculums of that size in front of me in different domains, it's just like, ok, let's pick one and... see how long I can go before I fall asleep because this is a lot. (Michelle)

John explained how spending "so much time preparing for" his split-level Consumer Mathematics course affected his science course:

> With labs, so far, I can honestly say that I am not super comfortable with yet. That's something that I want to get going with next year because, it was my first time doing it [teaching Grade 10 Science] and with putting in so much time to preparing for that math class, I didn't really get a chance to do any interesting labs... I did some physics stuff where I had them bouncing a ball and measuring time and things like that, but I didn't get to do anything for chemistry, which is unfortunate, but next year I would like [to]. (John)

Paul also gave an example of having a challenging course load, one that included courses in English and in French, and described his experience as "pure survival." He additionally mentioned how a lack of consistency in one's course load can be a challenge for French Immersion teachers in Manitoba.

Paul and Michelle described time constraints due to other demands of teaching. Michelle's described her commitments as follows:

> ...I eventually got involved with... helping to run student council, and I've helped to run our theatre program, and I do flute ensemble, and, so my lunches are kind of booked. So I'm definitely not working at lunch... and all those things I take on willingly, it's not being thrust upon me, it's stuff that I've chosen to do, and I've chosen to let that happen that way [Laughing]... So my days at school... tend to be pretty full, and when I do have prep periods, unless I lock the door or turn off the light, pretend I'm not there, I usually have kids coming in for extra help or whatever it might be. So most of my resource exploring was definitely at home... on the weekends and at night, for sure. (Michelle)

Paul mentioned helping students during the lunch hour as well. He also talked about the time needed for marking, mentoring new teachers, and coaching. In addition to job-related commitments, Renée and Michelle mentioned family/personal commitments.

B.03 Challenges related to collaboration and professional development.

Three teachers, Mike, Sophie, and Renée, mentioned a lack of time to meet with colleagues (other teachers or coordinators) as a challenge. Sophie, a rural teacher, and Michelle, the northern teacher, explained that a challenge for them is a lack of French Immersion colleagues. Michelle expressed it as follows:

> ...you have the other teachers in the other three schools that we share and, I mean, if I have questions about things I can go to them, but it's different, 'cause... I don't have a French department to go to and be like, what have you guys done in the past... for Grade 10 Science, or whatever. I can go to my personal contacts, and I can go online and I can talk to the other teachers in the other schools, but you know, it's not quite the same as having a department there to support you. But at the same time, like I said, the admin is very happy... to support whatever. Whenever I ask for anything, they're very supportive,

> so that's good, because without that, it would be very difficult to do anything given that I'm my own department head. (Michelle)

One of John's challenges related to collaboration in his first year was not feeling like he should ask for course development help from other teachers. He said:

> ...my first year teaching, I thought in my head, I don't want to take things from other people, I want to do things all myself. And I was teaching four things for the first time, and I made everything and... my year, it was the most stressful year of my life. Of just, making everything from scratch. And then, I sort of talked to people, and people were like, yeah, no, you just get things, you get help... I thought there was something like, in a sense, honourable or whatever for making your own stuff, but, it's not ideal because you're putting so much effort into outside the classroom stuff. (John)

Similarly, Michelle mentioned that when she was teaching science, she was "trying to be very independent."

Another challenge related to collaboration that Renée, Paul, and John mentioned was teachers not wanting, or not being happy, to share their resources. Renée summarized these teachers' likely feelings about sharing their resources in this way: "I think that when you're younger, and you do a lot of work, it's hard to just give away your stuff because you've worked so hard."

In terms of challenges related to professional development, Sophie and Renée mentioned a lack of professional development opportunities.

B.04 Challenges related to the curriculum and curriculum support documents.

At the time of the interview, Mike, Sophie, Renée, and Michelle were unaware of some of the Grade 10 Science curriculum support documents available from Manitoba Education.

While they did not mention that being unaware of these documents was a challenge, it was included as a challenge since these supports could have potentially helped them in course development. For example, Michelle and Renée did not know about the *Grade 10 Science Distance Education (Independent Study)* document that is available in English. Michelle, Renée, and Sophie were unaware of the *Grade 10 Science Web-based Course* available in English. Michelle, Mike, and Renée had no knowledge of *A Teacher's Guide for the Video Sila Alangotok – Inuit Observations on Climate Change*, a guide that is also available in English.

Three teachers, Renée, Paul, and Michelle, mentioned a lack of an updated Grade 10 Science provincial curriculum document in French. Michelle described her challenge as follows:

> I looked in the curriculum, but what I find, especially with some of the older curriculums, is that a lot of the stuff is out of date. Like, it says, this webpage or this link and then you go, and it's like, that's not a thing anymore, and you're like, 'Oh, well then I'll go Google it myself...' So... obviously it's a big job to keep something like that up-to-date and there's so many curriculums and it's hard...but should that be someone's job? (Michelle)

When Renée was asked about her challenges with regards to obtaining and/or developing resources, she stated: "So updated provincial documents is number one, I think... If they were updated, a little more on a regular basis, that would help, and it would be even better if it was done in French as well."

Michelle and Renée mentioned a lack of detail in the Grade 10 Science French-language curriculum document. Michelle mentioned a lack of detail in general, while Renée mentioned a lack of detail compared to the Grade 10 Science curriculum document in English. In Renée's words:

> ...this doesn't probably reflect well on the French side of things, but, the curriculum guide in English helps a lot more than the curriculum guide in French... It's more detailed, and it's got a lot more teacher support in it, a lot more explanation. So I find myself referring to the English curriculum... (Renée)

Finally, Sophie mentioned difficulty obtaining a document from Manitoba Education.

B.05 Challenges related to addressing all the curricular outcomes and to preparing students for future science courses.

With the exception of Mike, the teachers mentioned challenges associated with having enough time to teach the entire curriculum, which was also discussed under *A.10 Not all teachers teach all four clusters in the Grade 10 Science curriculum (or place equal importance on all four clusters)*. Michelle stated that she "[finds] that the science curriculum is big and there's a lot to cover" and that "it's definitely overwhelming to start." Paul also explained how teaching the entire curriculum is challenging: "...time is limited, and to try and get to the entire curriculum, is incredibly, is challenging at the best of times."

In terms of managing the time available for teaching Grade 10 Science, John brought up how "organizing" ahead is a challenge. Renée did not explicitly mention course time management as a challenge, but she brought up knowing how much time to spend on each unit as an area in which she has looked to colleagues for support.

Sophie and Michelle mentioned challenges associated with ensuring students are prepared for future science courses. As previously mentioned, Michelle brought up the desire for her students to have the "same experience as the English kids."

Finally, John mentioned challenges associated with ensuring the quality of resources. When asked "If you didn't have [name of colleague's] stuff [resources], what challenges do you

think you would have faced?", John responded: "Making sure that they're [the resources] up to par... that they're good... that they meet the expectations, which again, having someone who's good at their job and knows what they're doing, to use that stuff is such a load of."

B.06 Other challenges.

Other challenges related to course development included Mike, Sophie, John, and Michelle mentioning either "source of stress," feeling "overwhelmed," or feeling "tired." As was previously mentioned, John described his first year teaching, during which he was developing numerous resources, as "the most stressful year of [his] life." Michelle explained that: "...it ups your stress level when you're having to prepare everything AND prepare your little production of what you're going to say." As previously mentioned, in Sophie's experience: "...you get tired, and you don't want to translate anymore."

Mike, Renée, John, and Michelle mentioned challenges related to a lack of content knowledge or less content knowledge for teaching some clusters compared to others. John mentioned that the *Chemistry in Action* cluster was more of a challenge for him than the other three clusters, Mike described the *Weather Dynamics* cluster as challenging, and Michelle and Renée identified the *In Motion* cluster as a teaching challenge for them.

Mike, John, Michelle, and Renée mentioned challenges associated with ensuring the quality of written French in their teacher-developed resources. As Michelle explained:

> ...I have people that live in town or, you know, personal friends that would happily look over things for me. And when it wasn't 1:00 AM, I could send it and say, 'Hey, can you read this for me?' But you know, when I finished it at 1:00 AM and I need it for 8 [laughing], there's not a lot of people up at 2 in the morning willing to proofread. (Michelle)

While it was not mentioned as a challenge by the participant, Renée described taking time to correct the French in the resources that she obtained from a colleague, as previously mentioned.

Mike, Sophie, Renée, and John mentioned, generally, the challenging nature of developing and/or translating resources. For example, with regard to the development of resources, Renée explained: "Well, when you have nothing [no resources], yeah, it's always challenging... But once you gain a lot of resources, resources from here and there, you have a little bit more to choose from, so it becomes easier, I think."

John mentioned the challenge of not knowing what he will be responsible for teaching from semester-to-semester in terms of planning for professional development opportunities. Sophie mentioned the challenge of administration not understanding that French Immersion teachers' needs are unique. She said:

> ...I think this is just a struggle for me personally, maybe, and maybe for all those who are also in dual-track schools, but we have no PD en français, like zero. Zero. And I really wish that, in a sense... I don't know, that time can be spent doing something else instead. I mean, I get that they [administrators] want us to do the same thing that the rest of the school is doing, but at a certain point they have to understand that our challenges are different. And they have to be more flexible in giving us that time to be able to connect with teachers in other schools. (Sophie)

Sophie also mentioned challenges associated with organizing resources and making her teacher-developed resources look "nice." Finally, Paul identified the costs of books as a challenge. He stated: "books are prohibitively expensive and you can rarely ever get permission to order books."

Summary of results for the research question *How do FI science teachers describe*

their challenges associated with obtaining and developing instructional resources for the Grade 10 Science course?

Teachers participating in this study described a variety of challenges that they have with obtaining and developing resources. The main challenges mentioned are a lack of instructional resources in French (or fewer resources in French than in English), the time-consuming nature of finding and/or developing resources, and a lack of time. As one participant noted in frustration, not a single resource designed to address the entire Grade 10 French Immersion Science curriculum exists. Some teachers noted challenges associated with ensuring the quality of written French in their teacher-developed resources. Teachers also noted a lack of an updated Grade 10 Science provincial curriculum and a lack of detail in the French Grade 10 Science curriculum.

A time constraint due to one's teaching load was also mentioned as a challenge. Specifically, the time needed to prepare for other courses, having a challenging course load, and a lack of consistency in one's course load were all mentioned as challenging. Michelle, the teacher in the northern setting, had a particularly challenging course load, teaching numerous different courses in one year.

A challenge for teachers in both rural and and northern settings was a lack of French Immersion colleagues. Even with French Immersion colleagues, however, a challenge for some of the participating teachers was colleagues not wanting to share their instructional resources.

Other challenges related to course development included teachers mentioning either "source of stress," feeling "overwhelmed," or feeling "tired." For example, one participant described his first year teaching, during which he was developing numerous resources, as "the most stressful year of [his] life."

Results for the research question *How do FI science teachers describe their needs associated*

with obtaining and developing instructional resources for the Grade 10 Science course?

This section is divided into four subsections (categories): C.01: Increased availability of instructional resources, C.02: Needs related to time constraints and opportunities for collaboration and professional development, C.03: Needs related to the accessibility of provincial curriculum documents and curriculum support documents, and C.04: Other needs.

C.01: Increased availability of instructional resources.

In general, teachers' needs are implicit in the challenges that they mentioned in Section B. These are more classroom-ready resources, more resources in French, and more resources that align with the Manitoba curriculum. Additionally, Sophie and Renée mentioned more resources at the appropriate French level for the students in their courses, and a textbook in French that aligns with the Manitoba curriculum. Mike explained that his needs include a variety of activities that pertain to the same learning outcome (or group of outcomes), more articles that relate to the curriculum, and more resources at a variety of reading levels. Michelle, given her unique location, mentioned more resources that support distance learning as a need.

More resources that incorporate different perspectives (e.g., Aboriginal perspectives) was a need that Mike, Renée, Paul, and Michelle agreed to having, after being prompted by the researcher. One example of this prompting is included in the following interview exchange:

> Interviewer: Do you think you would do more [to integrate Aboriginal perspectives]... if you had more classroom-ready resources...?
>
> Paul: Yes... If I could find a way to shoehorn it in, without having to create something, you know, just for this... I don't like things that are added into what I'm doing just simply because you have to do this... 'Today we're going to stop... our regular-scheduled

teaching, and we're going to do this one little thing, this one little activity that makes you feel happy... about the Aboriginal perspective.' No, that's not how it goes.

C.02: Needs related to time constraints and opportunities for collaboration and professional development.

Mike, Sophie, and Michelle mentioned more time to find or develop resources as a need. Mike and Sophie also stated that a need for them was to have more time or opportunities to meet with French Immersion colleagues. Finally, Mike and Renée identified more quality professional development opportunities designed specifically for French Immersion high school teachers as a need.

C.03 Needs related to the accessibility of provincial curriculum documents and curriculum support documents.

Renée and Michelle mentioned the need for an updated provincial curriculum in French. As previously mentioned, Renée noted "updated provincial documents" as a priority. Renée also mentioned being better informed about the resources available from Manitoba Education. This need was identified when she was asked if she uses a variety of Manitoba Education resources.

Other needs.

The only need that could not be sorted into one of the three previous categories was money and financial support. Sophie stated "I guess it would take government money, in that sense, to develop those resources." Mike said, "cash," more generally, for obtaining resources.

Summary of results for the research question *How do FI science teachers describe their <u>needs</u> associated with obtaining and developing instructional resources for the Grade 10 Science course?*

Following from the challenges voiced in Section B, the main need that teachers expressed was that of more instructional resources in French that directly align with the Manitoba Grade 10 French Immersion Science curriculum. Some teachers more specifically noted the need for more resources written at the appropriate French level, as well as a textbook in French that aligns with the Manitoba curriculum. The teacher in the northern setting mentioned more resources that support distance learning as a need. Participants also articulated the need for an updated provincial curriculum in French, one of whom mentioned this need as a priority. More time to find or to develop resources was also talked about as a need, as well as more time or opportunities to meet with French Immersion colleagues.

Results and Summary for the research question *How do FI science teachers describe their role in fostering French-language development among their students?*

All teachers in this study believe that they have a role in fostering the French-language development of their science students. Mike articulated his role very clearly when he said: "I believe that a French Immersion science teacher is teaching science and French at the same time."

Results for the research question *How do FI science teachers describe their practices associated with integrating language-learning into their Grade 10 Science course?*

This section is divided into two subsections (categories): D.01: Teachers model and encourage French-language use in all verbal communication (subject matter related and non-subject matter related) and D.02: Teachers use various language-development strategies.

D.01: Teachers model and encourage French-language use in all verbal communication (subject matter related and non-subject matter related).

With the exception of John, the teachers talked about encouraging students to speak in

French. As one example, Michelle, who teaches most subjects for the French Immersion students in her school, explained the focus she puts on communication in French as follows:

> I think it's the same in any course, because the whole idea is for them to get a well-rounded vocabulary and ability to discuss multiple topics in French. So, I mean, the fact that I am their French Language Arts teacher, and everything else, plays into that, but I treat my science class the same way that I treat my French Language Arts class, that I treat any other class. They're there to speak French. They're there to learn new vocabulary. They're there to practice what they have. So discussion, like everything is meant to be in French. Except, I was saying that, transition piece that I did give them where I was like, here's what it's going to look like next year... but the whole goal is for them to expand their vocabulary and to be able to discuss anything and everything in French. So, doing the science class is a major part of it. (Michelle)

Michelle, Renée, and Mike mentioned that they speak French with their students. Michelle mentioned that "everything in my classroom is in French, they enter, French." Renée explained: "I just think that we have to be models for them [the students], and we have to have conversations with them also... side conversations with them in French... it doesn't have to just be the subject that they're learning." Mike was the only teacher who mentioned speaking French with his students outside of the classroom. He stated: "I never speak to them in English, even in the hallways, even when I see them in the community... they know it's always French with me."

Finally, Renée, Paul, and Michelle gave descriptions that fell under the code *"Teachers share their personal experiences with the French language with their students, act as models, and/or show their passion for the French language."* Michelle and Renée mentioned sharing their personal experiences with the French language. Paul mentioned being a model, and Renée

also mentioned demonstrating passion for the French language.

D.02: Teachers use various language-development strategies.

All six teachers mentioned explicitly teaching vocabulary. Paul and Sophie mentioned using a "word wall" where key words are placed on a bulletin board in the classroom. John was the only participant who mentioned "linking French words to English words" in order to "make connections with things they already know." Sophie, who teaches in French and English, also mentioned that she does "lots of vocabulary development" in French Immersion, but she also had a unique perspective when asked "what do you think are the differences between teaching science in French Immersion compared to teaching science in English?" She responded: "...now with our whole move towards literacy and numeracy in the Division, I do a lot of the activities I would do just in French Immersion, I do them in English now too."

All six teachers explained how students engage in speaking (discussion) activities in their science course. Paul explained the importance of speaking as follows:

> ...the fundamental philosophy of Immersion teaching, is to spend a lot more time speaking orally, and we want the students to become bilingual and fluent orally above written. That's the general philosophy..., but then everything we do tends to be the exact opposite... So I think that... one of the things that I'm always trying to, and once you get the content down, you should be looking at ways to promote more interaction, and I think that... where we are now in today's society, it should be less individual to begin with, I think that all kids should be working together to solve things, because that's what we want... I want students leaving my classroom being a literate scientist. (Paul)

The six teachers also explained how students engage in writing activities in their science course. For example, Mike would "ask them [students] to write paragraphs here and there to

summarize various things that [they've] done." While John mentioned that his students write in science, he explained that writing is "hard to fit in." In his words:

> There's not a huge emphasis on writing, just 'cause it's... hard to fit it in. Like when I was doing social studies, I put a huge emphasis on writing... because social studies lends itself to that really well... But, in science, it's... I haven't really gotten to that point yet where I can figure out how to do that. Again, it's one of those things that it's like, I'm sure that there's a way, but I have not yet figured it out. (John)

The interviewer asked John, "What did you mean by 'hard to fit it in"? He replied:

> Like how, when we're doing physics and so there's a question and let's say... Bob is driving his car at this speed over this amount of time and I want to ask their acceleration. Like, do I just say write a full sentence? Bob conduit à [drives at] 5 km/h, like I don't know how, how do I give them opportunities to write? 'Cause... there's certain questions where they have to explain things, but even for those..., I made them do drawings. For the cycle de l'azote [nitrogen cycle], maybe you could actually write a paragraph explaining the process, I did drawings for that stuff. (John)

All of the teachers mentioned that students engage in reading activities in the Grade 10 Science course. For example, Michelle would invite students to read the textbook individually or aloud as a class.

Mike, Sophie, Renée, and Michelle mentioned that students watch videos in French related to the subject matter (when available). Mike, Paul, and John talked about teaching students reading comprehension strategies. Mike, Sophie, and Renée said that they sometimes teach a French grammar lesson during science class, and Renée and John mentioned encouraging students to use a dictionary. Finally, Sophie was the only teacher who talked about having

students respond to listening-comprehension questions (while watching a video) and evaluating students' written French.

Summary of results for the research question *How do FI science teachers describe their practices associated with integrating language-learning into their Grade 10 Science course?*

The participating teachers engage in various teaching practices for fostering French-language learning including encouraging French-language use in all verbal communication, explicit vocabulary teaching and discussion, writing, and reading activities. Not all six teachers in this study mentioned all of the strategies for fostering language learning mentioned by all participants collectively. For example, four teachers mentioned students watching videos in French (when available), three teachers talked about teaching students reading comprehension strategies, and one teacher identified students responding to listening-comprehension questions while watching a video.

Results for the research question *How do FI science teachers describe their challenges associated with integrating language-learning into their Grade 10 Science course?*

This section is divided into four subsections (categories): E.01: Challenges associated with integrating language-learning experienced during course development, E.02 Challenges associated with integrating language-learning experienced in the classroom, E.03 Challenges associated with integrating language-learning experienced at the school level, E.04 Challenges associated with integrating language-learning experienced beyond the school level.

E.01: Challenges associated with integrating language-learning experienced during course development.

A lack of instructional resources came up in the interviews with Mike, Sophie, Renée, and John. A lack of knowledge of instructional strategies came up in John's and Mike's interviews. As previously mentioned, John experienced a lack of knowledge of strategies on how to incorporate writing in science class. Mike explained how, before participating in the "Reading Apprenticeship" professional development, he did not have as many strategies to engage students in reading.

A challenge described by John involved the balance between teaching content and teaching language:

> I hate... to say it's falling by the wayside, but... I mean, am I teaching science? Am I teaching French? I know it's both, but it's like, I always feel like I focus more on the content specifically of the course. I feel myself just pulled in that direction. That this is where the focus is. (John)

For John and Michelle, an implicitly-mentioned challenge of integrating French-language learning was the feeling that they need to prepare students for future science courses. For example, Michelle was concerned about ensuring students were prepared for future science courses in English, so she included English resources in her French Immersion science course: "...I'd give them [students] six sheets in French and... two in English, and be like, ok... now write out all these... chemical formulas in English, too, because next year, this is what they're going to look like." While John did not mention preparing students for future science courses in English, he was also concerned with preparing students for future science courses and for the future, in general. He said:

> ...the main challenge to me... it's like what am I going to prioritize, like what's this kid going to do for the next two years, for the rest of their life. Like they're in science...

> They're here to learn science. And it's where I have to choose... Do I stop this and make sure that the French is good, or do I make sure that they're going to be ready for Grade 11 Physics or Grade 11 Chemistry because maybe this kid's going to be a doctor, this kid's going to be a scientist. Like I need this kid to do this... It's not to say that French is useless. Obviously, it's not. Obviously French is incredibly important. It's incredibly valuable. It's just in terms of preparing that kid for the next year... the challenge for me is I always feel like the curriculum takes priority. And I don't know if that's right, I don't know if I'm wrong, but I feel that pull that it's like, I know it's, like, argh, I should emphasis the French here but it's like... you know, I want them to get this [science] stuff... (John)

Finally, Renée mentioned a lack of time to organize field trips as a challenge, and Sophie mentioned a lack of time to plan or to develop resources. Sophie explained how, in order to integrate more language-learning into her science courses, she would have to modify her existing resources and she doesn't have the time to do so. Sophie gave a specific example on how she does not have time to incorporate some of Roy Lyster's strategies:

> ...because now, I would have to modify everything again. [Laughing]... 'Cause... Roy Lyster will have... like, a whole science lesson, that deals specifically with the "le" and the "la." So now... the whole lesson you would underline those pronouns and then have your worksheet for the students to figure out when to use "le" and when to use "la"... Sometimes I think... that would be so awesome!... I don't have time. (Sophie)

E.02 Challenges associated with integrating language-learning experienced in the classroom.

Class time constraints came up as a challenge for Mike, Sophie, Paul, and John. For example, Paul explained how "the biggest challenge [to explicitly integrating language-learning] is that you have to spend that extra time" and that is difficult because "the curriculum is so charged." Sophie explained that she "[thinks she] could do way better" when it comes to integrating language-learning into her science course, but, like Paul, she recognizes that it is difficult with class time constraints and ensuring that the curriculum is taught. In her words, "there's only so much that I can do in the time that I have... I mean, we see them [students] one hour a day for one semester and we have a curriculum to cover."

Mike, Sophie, and John mentioned challenges associated with students speaking English and Mike and John mentioned getting all students involved in class discussions as a challenge. Mike, Renée, and Michelle mentioned students' lack of motivation or students feeling discouraged or frustrated. For example, Michelle described that students can get "frustrated sometimes" when they understand the science concepts but have trouble explaining them in French.

Renée expressed the challenge of students not viewing language-learning as part of science class. She said: "...the main challenge is they [the students] are in science class, and that's what they think they're there to do. So, it's hard to really push the language part, aspect of learning, because they don't see it as being important in science class."

While not in direct response to the question of challenges, Mike (English first language participant) described the challenge associated with the teacher not speaking French outside of the classroom:

> ...the difficulty I find is... making connections to real-life and then finding the proper terminology to use... Because... Those real-life situations can be different every time. The

> student would bring it up, so then trying to help them find the proper language to use... That's the difficulty for me, is the everyday language that is very useful in class, but is sometimes difficult to find. (Mike)

The response unique to Sophie (French first language participant) was that, as a Francophone, she does not fully understand the French language-learning struggles of French Immersion students. Finally, Renée and Paul mentioned a lack of student resources (e.g., for projects) as a challenge.

E.03: Challenges associated with integrating language-learning experienced at the school level.

Sophie and Renée mentioned the challenge of a lack of French use in dual-track schools. As Renée explained:

> It's hard in a dual-track school where there's nothing outside of the classroom that is done in French. So, to say that learning in French is important, means absolutely nothing to most kids that don't really care, 'cause there's nothing else in the school that's offered or done in French. (Renée)

A lack of French course options was another challenge mentioned by Sophie, and Mike mentioned teachers in the school not being on the "same page" in terms of integrating language-learning into the content areas.

E.04: Challenges associated with integrating language-learning experienced beyond the school level.

Renée mentioned a lack of parental support, as well as a lack of availability of guest speakers (or outside activities) in French. Sophie mentioned a lack of French use in the community.

Summary of results for the research question *How do FI science teachers describe their challenges associated with integrating language-learning into their Grade 10 Science course?*

Two of the main challenges expressed with regards to integrating language learning were a lack of instructional resources and a lack of knowledge of instructional strategies. One participant, who is currently engaging in various language-learning strategies, explained how, in order to integrate more language-learning into her science courses (such as incorporating Roy Lyster's strategies), she would have to modify her existing resources and she doesn't have the time to do so. Class time constraints and challenges associated with students speaking English were also brought up by teachers as challenges. For two participants, an implicitly-mentioned challenge was the feeling that they need to prepare students for future science courses, which, for them, sometimes meant that teaching the science content was a priority over French language teaching. In addition to challenges experienced during course and lesson development, teachers also described challenges that exist at the school level and beyond the school level, for example, lack of French use in dual-track schools and in the community.

Results and Summary for the research question *How do FI science teachers describe their needs associated with integrating language-learning into their Grade 10 Science course?*

With the exception of Mike, the teachers mentioned more instructional resources or time to prepare instructional resources as a need. Mike and Paul mentioned more knowledge or professional development opportunities on how to integrate language-learning. Paul, for example, mentioned the possibility of observing expert teachers integrating language-learning. He said, "...if I can see an expert doing something, that, to me, is awe-inspiring... I love watching a professional do their craft... perform."

Mike mentioned time to meet with French Immersion colleagues in the school about how to integrate language learning. Finally, Renée mentioned a need for more guest speakers who speak French.

Results for the research question *How do Grade 10 FI Science teachers describe an ideal online instructional resources database that would support them in course development?*

This section is divided into three subsections (categories): G.01: General features of online collection of resources, G.02: Specific types of French-language resources to include in collection, G.03: Organization of collection of instructional resources.

G.01: General features of online collection of resources.

All teachers expressed that having modifiable (editable) resources would be an important feature of a collection of resources. In the interview with Mike, Sophie, Renée, and Michelle, current (updated regularly) resources came up as an important feature. Michelle noted this feature in light of her challenges with the current curriculum:

> I think it would be good... [to] have somebody that's going through and updating in terms of the virtual stuff and the websites that are listed, because, many of them are not always, either not useful or not up-to-date or the links don't exist... (Michelle)

Mike, John, and Michelle mentioned that the collection of resources could be a dedicated website (website platform). For example, Michelle explained that, if the curriculum were in a website format, instead of a PDF document, "...you could almost make it where you can just expand the parts you want to look at ...If I can just click on chemistry and then there's a list of whatever many outcomes and I can click on the ones that I want to look at, it's way less overwhelming when it's more focused like that."

Similarly, Mike and John mentioned "easy-to-use," "easy-to-navigate," or "user-friendly," as a necessary feature. Mike and Sophie mentioned including resources that foster language-learning. Renée mentioned relevant resources, those that are "related to our province... and our country... that would be more meaningful to us." Mike explained that having a variety of activities for the same outcome (or group of outcomes) would be helpful. Finally, when prompted, Sophie and Renée agreed that including resources that incorporate various perspectives would be valuable.

G.02: Specific types of French-language resources to include collection.

All six teachers thought that the resource collection should include videos, activities or experiments, and assessments or assessment tools. All but Sophie mentioned that readings could be included. Renée, Paul, John, and Michelle said that student notes would be helpful to include. Sophie, Renée, and Michelle brought up websites, including websites with simulations/virtual experiments. Renée stated that teacher background information would be a helpful resource, and, when prompted, Michelle thought that this type of resource would be helpful as well. Finally, Mike mentioned two items that other participants did not: classroom discussion guides and ideas for field trips.

G.03: Organization of collection of instructional resources.

Mike, Sophie, Renée, and Michelle explained that the resource collection could be organized by unit and curricular outcome or group of curricular outcomes. Mike and Sophie also suggested that the collection could be organized by type of resource (e.g., notes, activities, assessments) as well.

Summary of results for the research question *How do Grade 10 FI Science teachers describe an ideal online instructional resources database that would support them in course*

development?

Teachers described various features of an ideal online instructional resources database (collection of resources). For example, the resources included should be modifiable and current, and they could be made available through a website platform. Teachers mentioned several types of resources to include in the collection, such as videos, activities, assessments, readings, notes for students, and links to websites.

Results for the research question *How do Grade 10 FI Science teachers describe the impacts that an online instructional resources database would have on their teaching and personal lives?*

This section is divided into three subsections (categories): H.01: The collection of resources would allow teachers to spend more time on other aspects of teaching (and less time on creating resources), H.02: Other positive impacts of the collection of resources on teachers' practices, H.03: The collection of resources would have a positive impact on teachers' personal lives.

H.01: The collection of resources would allow teachers to spend more time on other aspects of teaching (and less time on creating resources).

All six teachers mentioned that having a collection of resources would save time. John mentioned that having resources allows him to have more time to focus on individual student needs. He explained this when saying:

> ...when you have to plan something new, it's really hard to take differentiation and different types of learners into account. You're working so hard to get something out, to have to... use different strategies and to have to do adaptations and modifications... is really difficult. So... let's say, your school says, you're teaching this for the first time... if

> you have something good you can go with, you can actually focus on the kids who need something more, who might otherwise not get that from you because you're working so hard to try and develop something, for, just, the general population. (John)

Paul and Michelle mentioned more time to plan, in general, or more time to plan the lesson delivery. For example, Michelle explained, with a collection of resources available, "instead of just knowing that you have a sheet for tomorrow, you could actually develop it and work on your... delivery of the information." Michelle elaborated:

> It definitely, it ups your stress level when you're having to prepare everything AND... prepare your little production of what you're going to say. If the sheets are already there, then you can focus more on your delivery and less on... making sure they [students] have a paper in front of them. (Michelle)

Paul, John, and Michelle mentioned that they would have more time to spend on assessing students' progress or planning assessment. As Paul explained:

> It would allow me to spend less time creating material, more time assessing material, because again, there's only so much time in a day, and every moment that we're spending creating material is time taken away from assessing the students, from planning, and from doing those kinds of things. (Paul)

H.02: Other positive impacts of the collection of resources on teachers' practices.

Sophie, Renée, and John mentioned that the collection of resources would allow them to learn new ideas. Paul believed that the collection of resources would help him to improve his practice. He stated:

> I believe it would make me a more efficient teacher... the more access that I have to material, the more access I have to finding what works for me, the better that I can teach, the better I can plan. (Paul)

Renée explained that the collection would have helped her to be more confident at the start of her career. Michelle explained that the collection would help her with organization and with ensuring that the curricular outcomes have been addressed.

H.03: The collection of resources would have a positive impact on teachers' personal lives.

Sophie and Michelle explained that the collection of resources would improve their work-life balance. Michelle described the impacts of a collection of resources on her personal life as follows: "I would get to sleep! I would get to go to bed before midnight! I would get to see my friends! [Laughing] It would give me more time to pursue my personal interests."

Mike, Renée, John, and Michelle agreed that the collection would reduce their stress level or that they would be or would have been less overwhelmed.

Renée and John explained that the collection would help out new teachers or teachers who are teaching a course for the first time. Mike explained that, with the collection of resources, he'd be "happier."

Summary of results for the research question *How do Grade 10 FI Science teachers describe the impacts that an online instructional resources database would have on their teaching and personal lives?*

Teachers explained how the collection of resources would have a positive impact on their teaching practice as well as their personal lives. Examples of positive impacts on teaching practice are more time to learn new ideas, to focus on individual student needs, to plan lesson

delivery, and to assess student progress. In terms of impacts on personal lives, the participating teachers described how having a collection of Grade 10 Science resources would reduce their stress level and improve their work-life balance.

Summary of Chapter 4

In Chapter 4, the results of this study were presented for each of the research questions. As explained in Chapter 3, two of the research questions were divided for coding purposes, which resulted in nine research questions. Following the *Overview of Findings* and *Participants* sections of Chapter 4, these nine research questions formed the nine major sections of this chapter. In each of these nine sections, I summarized the participants' responses to each of the research questions. By bringing together participants' responses to each research question, I was able to compare their course development experiences in order to gain a collective understanding of their experiences, while at the same time gaining a deep understanding of each participant's individual experience.

In Chapter 5, *Discussion and Conclusions*, the three main themes that were revealed through the detailed analysis of the results will first be discussed. Specifically, the main ideas that fall under each of the main themes will be discussed and related to the research literature. Next, recommendations for provincial government policymakers, administrators, and union leaders will be outlined, as well as recommendations for future research. Finally, I will conclude with some final remarks.

Discussion and Conclusions

The first purpose of this case study was to understand the course development experiences of Grade 10 French Immersion Science teachers in Manitoba. *Course development experiences* was defined in this study as a combination of:

- teachers' practices, challenges, and needs associated with obtaining and developing instructional resources for the Grade 10 Science course, and;
- teachers' experiences in integrating French-language learning into their Grade 10 Science course.

The second purpose of this case study was to develop an online instructional resources database model that holds promise in supporting Grade 10 FI Science teachers in Manitoba and is based on an understanding of these teachers' course development experiences.

A detailed analysis of teachers' course development experiences in Chapter 4 revealed that Manitoba Grade 10 French Immersion Science teachers' experiences are negatively impacted by what I identify as equity issues. These equity issues for teachers negatively impact teachers' well-being. In turn, both the equity issues for teachers and the impacts of these issues on teachers' well-being have negative impacts on the quality of education for French Immersion students in Manitoba. These are the three main themes that were revealed through the detailed analysis of the results. The relationships among these three main themes can be summarized as follows:

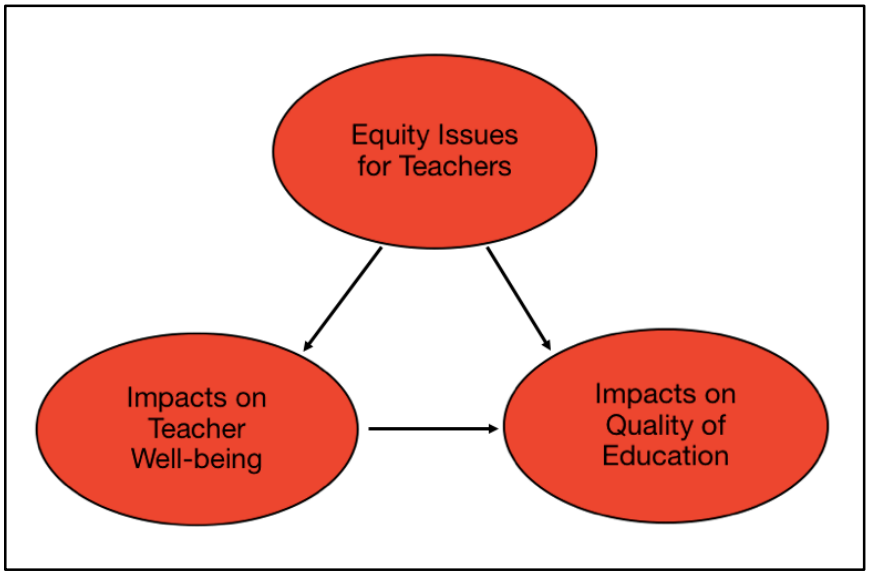

Figure 1: Relationships between the three main themes

In this chapter, the conclusions of this study are embedded in the discussion of results. In the first major section of this chapter, the equity issues for teachers will be discussed. The first equity issue is that there is a lack of resources in French available to support the Manitoba Grade 10 Science curriculum. This lack of resources exacerbates the effects of the second equity issue, that teachers' experiences depend heavily on who they know and the situation in which they find themselves (e.g., urban, rural, northern, course load). The main ideas of this major section can be summarized in the following concept map.

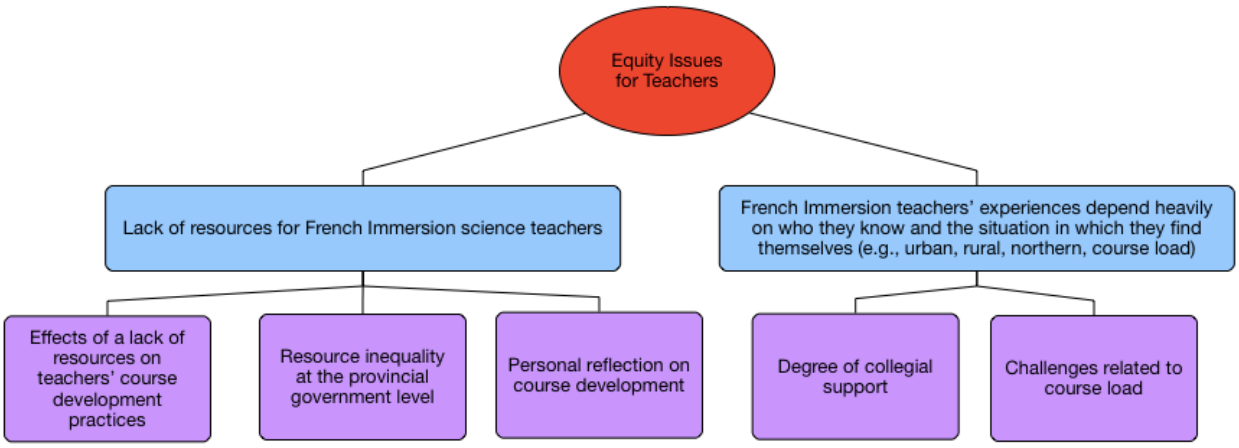

Figure 2: Concept map for first major section (Equity Issues for Teachers)

The second major section of this chapter focuses on the impacts of these equity issues on teachers' well-being. It was found that course development disrupts teachers' work-life balance, as teachers are spending a substantial amount of time outside of the school day obtaining and developing resources, especially early in their careers or when teaching a course for the first time. The results also revealed that course development is a source of stress for teachers. The main ideas of this second major section of this chapter can be summarized in the following concept map:

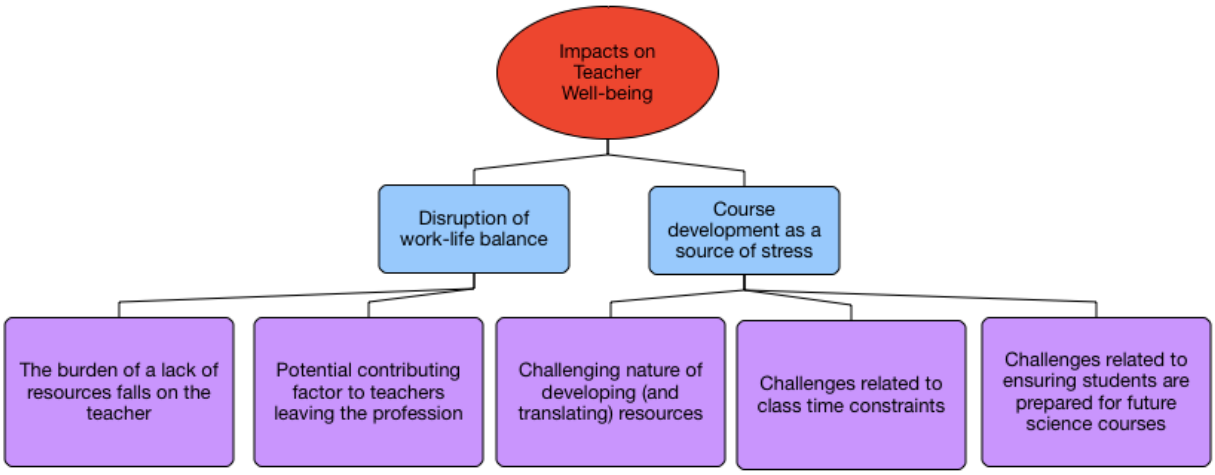

Figure 3: Concept map for second major section (Impacts on Teacher Well-being)

It was found that these equity issues for teachers, as well as their impacts on teacher well-being, negatively affect the quality of education for French Immersion students in Manitoba. These effects will be discussed in the third major section of this chapter. Specifically, the lack of integration of Aboriginal perspectives will be discussed, the impacts on language-learning integration will be outlined, as well as other impacts on teaching and learning. The main ideas of this third major section can be summarized as follows:

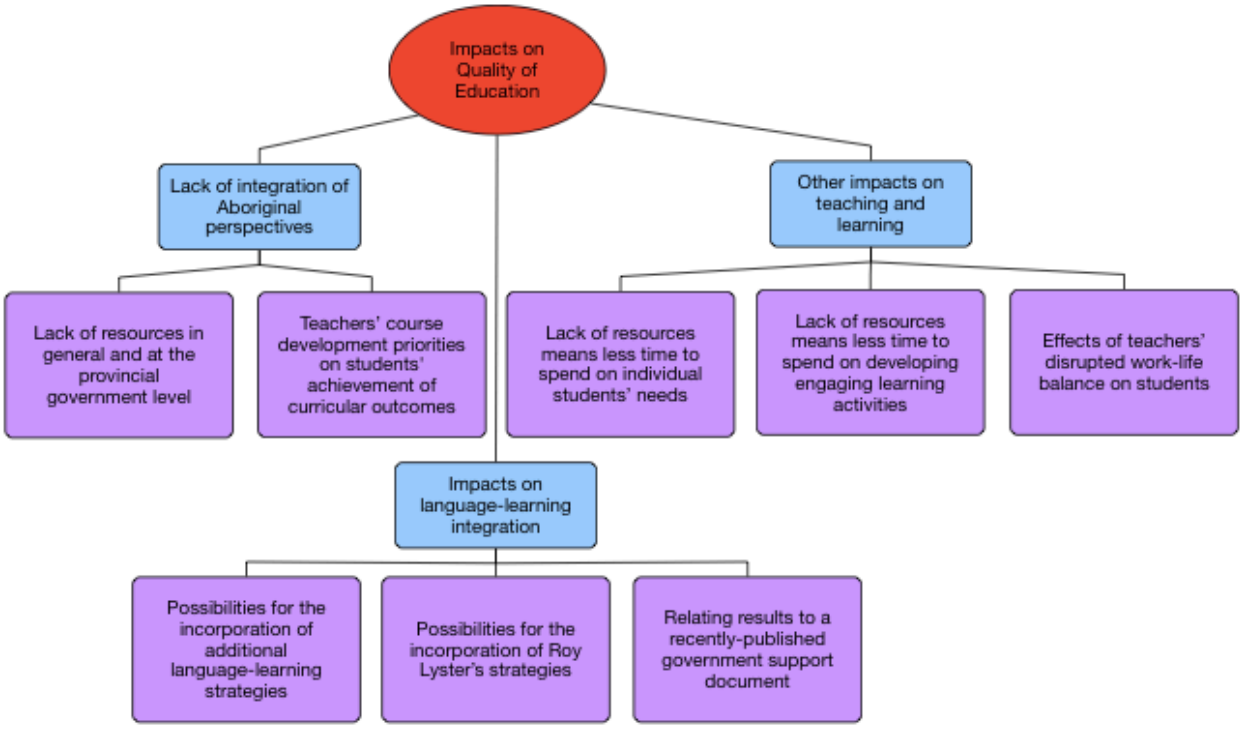

Figure 4: Concept map for third major section (Impacts on Quality of Education)

In the fourth major section of this chapter, recommendations for stakeholders will be outlined. Specifically, based on the results of this study and on literature, I will make recommendations to government policymakers, union leaders, administrators, superintendents, community members, and teachers. In the fifth major section, I will suggest several recommendations for future research. The last section of this thesis will summarize the main themes that arose from this study and will offer some concluding remarks.

Equity Issues for Teachers

French Immersion teachers have fewer available resources than English program teachers.

The six teachers in this study expressed the challenge of a lack of instructional resources in French. This finding is consistent with the results of previous studies and reports (CASLT,

2013 as cited in Standing Committee on Official Languages, 2014, p. 35; Ewart, 2009, p. 485; Karsenti et al., 2008, p. 5; Lewthwaite et al., 2007, p. 325; Rivard & Gueye, 2015, p. 84). Participants explained that there are fewer instructional resources available in French in comparison to the number of resources available in English. Given that Grade 10 French Immersion Science is a course developed and sanctioned by Manitoba Education and Training, and that there are fewer instructional resources available in French from this government department in comparison to the number of resources available in English (see page 43), this lack of French-language resources results in an equity issue for French Immersion and Francophone program teachers in Manitoba.

Participants also noted that there is a lack of resources in French that align with the Manitoba curriculum in general. This overall scarcity of French-language science resources has consequences on teachers' course development practices, on teachers' well-being, and on students' experiences in French Immersion science courses. The effects of a lack of resources on teachers' course development practices is described in the first subsection of *"Equity Issues for Teachers,"* while the effects on teachers' well-being and on students are described in subsequent major sections, respectively, *"Impacts on Teacher Well-being*" and *"Impacts on Quality of Education/Equity Issues for Students."* In the second subsection of "*Equity Issues for Teachers*," the equity issues that arise from the inequality in the resources available from the provincial government (Manitoba Education and Training) will be discussed. In the final subsection, a personal reflection on course development is provided. In this reflection, I outline some of the issues that I recently experienced in preparing to teach a set of outcomes for the Manitoba Grade 9 French Immersion Science course.

Effects of a lack of resources on teachers' course development practices. Several of the teachers in this study spend a substantial amount of time outside of the school day obtaining or developing resources for their courses, especially early in their careers or when teaching a course for the first time. John painted the picture of preparing for courses "until it's dark outside when you leave." Michelle described staying up until late at night, sometimes until 2:00 AM, preparing resources. Sophie explained how, early in her career, developing resources was "all [she] did." Participating teachers explained that they are obtaining resources from a variety of sources to prepare for their courses (e.g., colleagues, textbooks, teacher's guides, curriculum support documents, and websites). This information, alone, provides one explanation for why they are spending a substantial amount of time on course development. When triangulating this finding with an appraisal of the resources available for the Manitoba Grade 10 Science curriculum in French, it is not surprising that teachers are obtaining resources from a variety of sources, as there is not a single textbook or support document in French that addresses this entire curriculum. In Sophie's words, "You take a little thing from here, a little thing there... there is not one book that is just for us" [translation].

After finding relevant resources from various sources, a second factor contributing to the time spent on course development is the need for FI teachers to modify many of the resources obtained. The most frequently cited reason given by the teacher participants for modifying a resource was to translate the material from English into French. The first issue with translation is that it can often be time-consuming and challenging, which was mentioned by participants. The second identified translation issue is in producing a quality translation, one that is well-written and free of errors. While teachers, Francophone and non-Francophone alike, undoubtedly do

their best to write in French error-free, the teachers in this study, as well as the majority of teachers in the general population, are not trained as translators.

The six teachers interviewed also mentioned modifying resources to address their students' needs, to suit their teaching style, and/or to simplify the French language. They mentioned making notes using *Microsoft Word* or *Microsoft PowerPoint*. It was rare to hear participants speak about using textbooks, particularly *Omnisciences 10*, directly, other than for the practice questions and some of the readings. While *Omnisciences 10* does not address all of the outcomes in the Manitoba Grade 10 Science curriculum, it appears that the material in this textbook that does address the outcomes is not meeting the course development needs of teachers. Teachers are relying on other sources for instructional resources, as well as on developing their own resources, to prepare for their French Immersion science courses.

In addition to finding and modifying resources, another factor contributing to participants spending a substantial amount of time on course development is that the curriculum document written to support the teaching of Grade 10 Science, *Senior 2 Science: A Foundation for Implementation*, has not been updated since its publication in 2003 (English version) and 2005 (French version). One issue that was brought up by Michelle was that the links in this curriculum document are not up-to-date. Participating teachers also mentioned spending time searching for resources such as videos and websites to use in their Grade 10 Science courses that are too new to be listed in the *Foundation* documents. As one example, Michelle (the northern teacher) talked about the lack of resources that support distance learning, particularly virtual experiments. The virtual experiments that are currently available would likely not have been around at the time of publication of the *Foundation* documents. Sophie mentioned using recent magazine articles, which also would not have been available at the time of publication of these documents.

The fourth and final factor that is likely contributing to teachers spending a substantial amount of time on course development is the small number of professional development opportunities. More specifically, Sophie and Renée mentioned the lack of professional development opportunities related to the subjects that they teach. Clearly, since there are fewer French Immersion teachers in Manitoba compared to English program teachers, there are fewer French Immersion teachers available to run professional development sessions. With fewer professional development opportunities, there are fewer opportunities for French Immersion teachers to obtain new resources and to share resources.

Resource inequality at the provincial government level. The issue of equity arises in that there are fewer resources in French compared to English that are published by the provincial government (currently Manitoba Education and Training) to support the Grade 10 Science curriculum. A summary of the documents available from the Department of Education and Training was provided in Chapter 2. Three documents of note that are only available in English are as follows: Grade 10 Science Distance Education (Independent Study) course, Grade 10 Science web-based course, and *A Teacher's Guide for the Video Sila Alangotok – Inuit Observations on Climate Change: A Resource for Senior 2 Science* (2003). The Distance Education document provides notes and practice questions that directly address the Manitoba curriculum. The lack of a French version of this document means that there is not a single resource available that is designed to address the entire Manitoba French-language Grade 10 Science curriculum. Without one complete resource in French that addresses the provincial curricular outcomes, Grade 10 French Immersion Science teachers in Manitoba are disadvantaged when compared to teachers of the same course in the English program. By having more resources available in English than in French, the provincial government in Manitoba is

sending the message that science education in French is not as important as science education in English. In other words, this inequality in resources suggests that supporting French-language science education (French Immersion and Francophone programs) is not worth the cost of hiring professional translators to translate the above-mentioned documents. The burden of not having these resources in French falls on the French Immersion and the Francophone school teachers in Manitoba, who are left with the time-consuming and challenging task of developing resources to address all of the provincial science curricular outcomes. As previously mentioned, teachers are not the only ones who are affected by not having these resources available in French. French Immersion students also suffer the consequences, which will be discussed later on.

It is also important to note that the *Senior 2 Science: A Foundation for Implementation* documents available from Manitoba Education and Training in English and in French to support the Grade 10 Science curriculum are not direct translations of one another. One participant in this study, Renée, mentioned that she finds the English document more helpful than the French document, and that she often refers to both documents when developing her courses. This practice is another example of the resource inequality at the government level that is contributing to teachers spending a substantial amount of time preparing for their courses.

Personal reflection on course development (an example of a lack of resources and its effects on course development). At the time of writing the thesis before you, I was teaching the Manitoba Grade 9 French Immersion Science course in an urban school for the first time. In order to provide a specific example of one of my recent course development experiences that has commonalities with participants' experiences, I have chosen to explain part of the process that I went through in order to teach a group of outcomes in the Grade 9 French Immersion Science curriculum. I have not included all of the details of this process in order to remain succinct, and

also to refrain from providing details that would compromise the anonymity or the privacy of the individuals with whom I consulted in the process.

The knowledge outcomes that I prepared to teach in this example are as follows (copied from the English version of the *Senior 1 Science: A Foundation for Implementation* document):

S1-1-12: Differentiate between dominant and recessive traits.

Include: genotype and phenotype

S1-1-13: Describe the relationships among DNA, chromosomes, genes, and the expression of traits.

Include: genetic similarity among all humans.

S1-1-14: Explain the inheritance of sex-linked traits in humans and use a pedigree to track the inheritance of a single trait.

Examples: colour-blindness, hemophilia... (2000, pp. 1.28-1.34)

The first step of the process was reading both the French and English *Senior 1 Science: A Foundation for Implementation* document sections pertaining to these three outcomes. I then followed the suggestion in the French *Foundation* document to refer to a section in the *Omnisciences 9* textbook that the curriculum writers suggested would support the teaching of one of these three outcomes. I checked in this textbook, and most of the concepts needed to address these outcomes were not in this textbook (concepts such as phenotype and genotype are not addressed in *Omnisciences 9*). Furthermore, the textbook provided more detail on the structure of DNA in the genetics section than is required to address the Grade 9 Science outcomes in Manitoba. There were two other textbook references in the curriculum document under this section. One was to a textbook published for the Ontario curriculum in 2000 that my

school did not currently have. The other was to a textbook published in 1993 that my school also did not have.

Next, I checked the appendices in both the French and English versions of the *Foundation* document. The appendices in these two documents are not the same, and, in my opinion, the appendices in the English version are more helpful to address the outcomes than the appendices in the French version, which is consistent with Renée's observations. As one example, in the English version, there is an information sheet on "Single Trait Inheritance Problems" (Appendix 1.7), while there is no comparable sheet in the French version. I subsequently spoke with a French Immersion colleague to ask what he does for pedigrees (to address outcome S1-1-14), since this topic is also not in the *Omnisciences 9* textbook. He said that he searches for examples online. I also spoke with a colleague who teaches Grade 9 Science in English, and she shared her relevant resources with me.

After spending my preparation period, as well as my lunch hour, going through the above steps of the process, the next step of preparing to teach these outcomes was to prepare the notes, practice questions, and activities with which and in which students in my Grade 9 Science class would engage. In order to continue my example of course development, I recorded the details of the process by which I developed the notes and practice questions for these outcomes.

To summarize the process of creating these notes and practice questions, I obtained resources from a variety of sources (the Distance Education document, my colleague, the French *Biologie 11-12* textbook, and the French *Foundation for Implementation* document appendix). I also consulted an online dictionary throughout the process, as well as an English Biology textbook. In total, this process of creating these notes and practice questions took me approximately six hours. This time does not include the time to obtain the resources from my

colleagues and the time that they took to share them with me. It also does not include the time that I took to meet with colleagues to discuss their resources or the time needed for me to re-learn the material. Finally, it also does not include the time for me to develop the answer keys for all the practice questions and the time for me to develop activities (other than practice questions) to engage students in meaningful learning related to these outcomes.

Teachers' success depends heavily on who teachers know and the situation in which they find themselves (e.g., urban, rural, northern, course load).

In this subsection of "*Equity Issues for Teachers*," the impacts of collegial support are discussed, as well as issues related to course load.

Degree of collegial support. The six teachers in this study mentioned that they have obtained resources from colleagues. As a teacher who has taught for six years in Manitoba, these findings are very consistent with my personal experiences: teachers in Manitoba rely heavily on obtaining resources from teachers who have previously taught the course. Teachers talk about "getting stuff" from other teachers. While all teachers in this study mentioned obtaining resources from colleagues, John's stories were particularly noteworthy. John talked about how he obtained note booklets from his colleague prior to teaching the Grade 10 French Immersion Science course for the first time at his current school. He explained how getting these resources was a "life-saver." John also described what it was like when he developed resources on his own, prior to teaching at his current school: "It was the most stressful year of my life." John's contrasting experiences clearly illustrate how collegial support can have a huge impact on teachers' course development experiences.

Sophie, a rural teacher, and Michelle, a northern teacher, explained that a challenge for them is a lack of French Immersion colleagues. Sophie talked about starting her position in a

rural school with “nothing.” Michelle talked about starting her career in a northern school with very supportive English science teachers, but no French Immersion science teachers in her building. As such, she spent time translating resources from her English colleagues, sometimes staying up until 2:00 AM preparing for her challenging course load. In contrast, John, teaching Grade 10 French Immersion Science for the first time in an urban school, benefited substantially from a high degree of support from his colleague who also teaches science in the French Immersion program at the same school.

Since collegial support has a profound impact on teachers’ course development experiences, it follows that teachers’ course development experiences are profoundly shaped by the teachers they know. Whether or not teachers have positive course development experiences depends significantly on whether or not they know teachers who are willing to share their resources, and also on whether or not these teachers have quality resources. For example, urban French Immersion science teachers who are well-connected to the teaching community in Winnipeg are more likely to have connections to other French Immersion science teachers, which gives them a higher probability of knowing someone who is willing to share his or her resources and who has quality resources. In contrast, a teacher who is more isolated in a rural or a northern Manitoba community does not have the same opportunity for making connections with other French Immersion science teachers. While “degree of collegial support” could be a factor affecting English program teachers as well, the negative impacts of limited or no collegial support are arguably more significant for French Immersion teachers, given that there are simply fewer resources available in French in the first place.

Clearly, having French Immersion colleagues does not necessarily mean that teachers will be open to sharing resources. Renée, Paul, and John mentioned teachers not wanting to share

their resources or not feeling happy about sharing their resources. Renée summarized the feelings that teachers such as these may have about sharing their resources: "I think that when you're younger, and you do a lot of work, it's hard to just give away your stuff because you've worked so hard." When French Immersion teachers have to spend a substantial amount of time obtaining and developing resources that results in time away from family and personal activities, it follows that some teachers may feel resentment towards the system, the course development process, or even towards other teachers who appear to be not "working as hard." As such, as Renée explains, "It's hard to just give away your stuff because you've worked so hard."

The lack of resources and high dependence on collegial support means that there are some French Immersion science teachers who are spending a substantial amount of time developing resources, and other French Immersion science teachers who are not and may be relying on these other resource-developing teachers. This situation, when practiced, could potentially lead to some of the hardest working and most diligent French Immersion teachers leaving the profession owing to burn-out.

Challenges related to course load. The two teachers in this study with five or fewer years of teaching experience mentioned challenges related to having a difficult course load (e.g., high number of different courses, teaching a split-level class, and teaching in English and in French in the same year). Michelle, who worked in northern Manitoba, was uniquely affected by this challenge, as she is the only French Immersion teacher in her school. She teaches all of the French Immersion courses that are offered at her school, resulting in a high number of different courses to prepare. Although Michelle's situation was unique to the northern setting, John, an urban teacher, faced a similar challenge. While John did not teach as many different courses as Michelle, his course load included a high number of different courses when he taught a split-

level French Immersion mathematics course in addition to the other courses he taught that semester. These situations potentially contrast with English program teachers who teach in schools with overall student populations similar to Michelle's and John's, but have two or three sections of the same course in one day due to more students enrolled in the English program compared to the French Immersion program, resulting in fewer courses to prepare.

In addition to French Immersion teachers having a challenging course load due to the high number of different courses taught in one year, it is also possible to have a challenging course load due to the number of new courses taught in one year and each successive year (a high number of different courses taught over several years). This challenge is addressed in the following comment from Paul:

> If a teacher was only teaching Grade 10 Science, then you can spend a ton of time, but you know, let's face it, especially in Manitoba, as an Immersion teacher, a lot of times things [courses] can be one-offs... you know, the principal comes up to you, I have a hole in my timetable and you are filling it. (Paul)

These "one-offs" are courses that a teacher only teaches once in his or her career. As such, a teacher can spend a substantial amount of time preparing for a course and then not have the opportunity to use the prepared resources again.

Clearly, it is not to say that English program teachers may not experience challenges related to course load. Depending on the size of the school in which they are teaching, and the philosophy of the school division or administration (whether or not teachers typically teach a variety of courses or specialize in a select number of courses), English program teachers could certainly be equally affected by this challenge. However, the results of this study suggest that having a challenging course load can be a situation that is more often experienced by French

Immersion teachers. And again, since French Immersion teachers have access to fewer resources than English program teachers, the effects of having a challenging course load are arguably exacerbated for French Immersion teachers.

Impacts on Teacher Well-being

It follows from the challenges posed by a lack of resources, a difficult course load, and a lack of a support network, that course development can negatively impact teachers' well-being. The results of this study suggest that course development does have an impact on teachers' work-life balance and teachers' stress levels. Both are described in the following subsections.

Disruption of work-life balance.

The results of this study show that course development can have a substantial impact on French Immersion teachers' work-life balance. As previously mentioned, Michelle explained how she would sometimes be up until 2:00 in the morning preparing for her courses. Sophie explained how, early in her career, developing resources was "all [she] did." The burden of a lack of resources in French falls on the French Immersion teacher, who needs to spend a substantial amount of time outside of the school day finding and developing resources, especially early in one's career or when teaching a course for the first time. In addition, the teachers who lack French Immersion colleagues, whose colleagues are unwilling to share resources, or whose colleagues do not have quality resources, are the teachers who are more likely to suffer the consequences of fewer resources. It is the teachers in northern and rural communities who are more likely to be the only French Immersion science teacher in their school or even school division and are therefore, unfairly, more likely to suffer the consequences of being isolated with a lack of resources.

The substantial time commitment necessary for obtaining and developing resources early in one's career could have an impact on the French Immersion teachers who choose to remain in the profession. Teachers with young families may not be able to balance course development and family responsibilities, resulting in these teachers leaving the profession or taking on other roles in the school setting. In my six years of teaching experience, I have personally known one teacher who left the profession, and one teacher who left teaching in French Immersion. Their decisions were, in part, made as a result of the impacts of course development on their work-life balance and stress level.

Course development as a source of stress.

Teachers in this study described course development as a source of stress, and expressed feeling "overwhelmed" and getting "tired" when asked about challenges associated with course development. As previously mentioned, John described what it was like when he developed resources on his own: "It was the most stressful year of my life." Michelle was one of the teachers who mentioned the feeling of "overwhelmed." Her explanation follows:

> So, I find that the science curriculum is big and there's a lot to cover and... there's units that some people just don't do... But it is... fairly well-structured and... achievable to a point if you cut out weather [laughing]. So... it's definitely overwhelming to start, but like I say, as with any of the other curriculums, once you do it a couple times and see what you can... leave out... it's a little easier to handle. (Michelle)

Since several teachers in this study explained that they do not teach the *Weather Dynamics* cluster, or place the same emphasis on each of the four Grade 10 Science clusters, it means that, at some point, they had to make decisions on what not to include in their teaching of the course, as Michelle explained. It is possible that when a teacher is new to a school, the decisions about

what not to teach have already been made by the teachers currently teaching Grade 10 Science at the school. However, it is also possible that the decisions are up to each individual teacher, which can be a challenging and stressful experience when "the science curriculum is big and there's a lot to cover." Paul also mentioned the challenge of addressing all of the outcomes in the curriculum: "Time is limited, and to try and get to the entire curriculum, is incredibly, is challenging at the best of times."

There are Manitoba schools that require teachers to teach all four Grade 10 Science clusters mandated by Manitoba Education and Training. This situation presents a different challenge to teachers in these schools, since they are charged with the task of developing resources that are at an appropriate level of detail to ensure that all of the outcomes can be addressed in the course. Again, without even a single resource available in French that directly aligns with the Manitoba Grade 10 Science curriculum, this resource development can be a very challenging and stressful task, particularly for new teachers without collegial support.

Similar to the challenge of ensuring that all of the outcomes are addressed in the Grade 10 Science course are the challenges associated with ensuring students are prepared for future science courses (identified by Sophie and Michelle). Michelle mentioned the desire for her students to have the "same experience as the English kids." Her concern is expressed in the following statement:

> ...it's stressful, because... you want the kids to have the same experience as the English kids, again, because they're all going to be in the same class, in our case, in Grade 11, so you want them to have the same base of knowledge that the English kids are going to have. (Michelle)

Without the same number of resources available in French compared to English, it can be challenging (and "stressful") to offer the same opportunities (e.g., activities, projects) to students in the French and English programs, which will be further discussed in the next major section.

Based on the results of this study, personal experiences, and observing my colleagues' experiences, it is not surprising that, in the "Teacher Workload Survey" conducted in 2010 by the Manitoba Teachers' Society, 70% of respondents indicated that "the teaching job has negatively impacted their health," and 82% indicated that "the stress experienced on the job, especially the time-related aspects of a teacher's job, frequently and adversely spills over into one's personal and/or family life" (Dyck-Hacault & Alarie, 2010, p. 24). This stress experienced by Manitoba teachers has consequences on their performance in the classroom: "73 percent [of teachers] stated that on the job stress has negatively impacted their work performance" (p. 24).

The equity issues for teachers described in the first major section, as well as the impacts of these issues on teacher well-being, affect the quality of education for students in Manitoba, which will be discussed in the next section.

Impacts on Quality of Education/Equity Issues for Students

In this major section, I will explain how the equity issues for teachers described above, as well as the impacts of these equity issues on teacher well-being, affect the quality of education for French Immersion students in Manitoba. First, I will explain how a lack of resources is one contributing factor to teachers' lack of integration of Aboriginal perspectives into their Grade 10 Science course. Second, I will triangulate the teachers' responses to research questions #2 (*How do FI science teachers describe their role in fostering French-language development among their students?)* and 3 (*How do FI science teachers describe their practices, challenges, and needs associated with integrating language-learning into their Grade 10 Science course?*) with

the literature to discuss how a lack of resources and professional development is impacting teachers' language-learning integration into their science courses. Finally, I will describe the impacts that a high focus on resource development has on other aspects of teaching and learning.

Lack of integration of Aboriginal perspectives.

As explained in Chapter 4: Results, none of the teachers in this study are currently integrating Aboriginal perspectives into their Grade 10 Science course for reasons such as not knowing how to do so and feeling that integrating Aboriginal perspectives does not have a "place" in all four of the units in the course. Sophie, who has taken courses on integrating Aboriginal perspectives, and who has integrated Aboriginal perspectives into her Grade 10 Science course in English, mentioned that she has not yet looked for resources to incorporate the perspective into her French Immersion Grade 10 Science course. However, all six teachers expressed interest in integrating Aboriginal perspectives into their course.

Other than the present study, no known research has been conducted to assess the degree to which French Immersion science teachers in Manitoba are incorporating Aboriginal perspectives into their science courses. According to the *CTF* [Canadian Teachers' Federation] *Survey on Teachers' Perspectives on Aboriginal Education in Public Schools in Canada (Summary Report)* conducted in 2015, 65% of the teachers surveyed (n = 1881) "incorporate [in their current teaching practice] any issues, content or perspectives that are related to Aboriginal people" (p. 2). The percentage of teachers in the study who were French Immersion teachers, and what percentage of these French Immersion teachers incorporate Aboriginal perspectives, were not provided in this report. Furthermore, the percentage of teachers in the study who were high school science teachers, and what percentage of this group of teachers incorporate Aboriginal perspectives into their science course, were also not included in this report. Therefore, more

information is needed to determine whether or not the experiences of the six teachers in the present study, with regards to their lack of integration of Aboriginal perspectives, are shared by other French Immersion high school science teachers in Manitoba and Canada.

The finding that teachers in this study do not know how to incorporate Aboriginal perspectives is supported by the findings of the CTF survey: "Another recurring theme was related to a lack of knowledge about Aboriginal content and perspectives and hence, a need for more professional learning in order to improve teacher knowledge and increase understanding" (p. 21). When asked about resources, teachers in the present study expressed a need for more resources to integrate Aboriginal perspectives. Again, participants who took the CTF survey shared the same thoughts:

> Respondents told us they need resources that are age/grade-appropriate and curriculum-based. They also want up-to-date accurate accessible resources, resources on specific topics such as treaty rights and residential schools, resources focused on the local Aboriginal population and local issues, quality French resources, and more funding for resources. (p. 22)

Three of the quotations that were chosen to be included in this summary report of the CTF survey were about the need for resources in French, one of which stated "more materials for the French immersion classroom" specifically (p. 22). "Teachers' lack of knowledge" and a "lack of resources" were also "perceived" by teachers as "challenges/impediments to the meaningful integration of Aboriginal perspectives in their schools and classrooms" in Kanu (2011, p. 176).

Teachers in this study were perceived as being very dedicated and diligent professionals, having spent a significant amount of time preparing resources. It is clear, therefore, that these

teachers are choosing to focus their energy on aspects of course development that do not include incorporating Aboriginal perspectives. Based on the results of this study, teachers are focusing their energy on ensuring that as many curricular outcomes as possible are taught in their courses, on fostering students' understanding of science concepts related to the curricular outcomes, and on engaging students in learning.

Since participants' placed emphasis on achieving curricular outcomes, I looked to the Grade 10 Science *Foundation for Implementation* document to assess the degree to which Aboriginal perspectives, or other cultural perspectives, are mentioned throughout the document. I found that the following two Cluster 0 Skills and Attitudes outcomes made reference to "culture":

> S2-0-8e Discuss how peoples of various cultures have contributed to the development of science and technology.
>
> S2-0-9a Appreciate and respect that science and technology have evolved from different views held by women and men from a variety of societies and cultural backgrounds. (2003, pp. 0.7-0.8)

I performed a "key word" search for a series of words (Table #4 below) in the curriculum document as a means to assess the extent to which the curriculum addressed the above two Cluster 0 outcomes. I recorded the number of *specific examples* that were provided as suggestions on how to integrate *"how peoples of various cultures have contributed to the development of science and technology"* or how to foster an *"[appreciation] and [a] respect that science and technology have evolved from different views held by women and men from a variety of societies and cultural backgrounds."* In other words, I was not interested in the number of times that these words appeared in sentences that mentioned the words in a generic context. For

example, I considered the following sentence as the use of a "key word" in a generic context: "Manitoba's cultural diversity provides opportunities for embracing a wealth of culturally significant references and learning resources in the Senior Years science classroom" (Manitoba Education and Youth, 2003, p. 25). However, I included the number of times the key word appeared in total (including generic contexts) to provide additional information.

Table 4: The frequency of the appearance of "key words" in the Senior 2 Science: A Foundation for Implementation document in the context of specific examples on how to address SLOs S2-0-8e and S2-0-9a

Key Word	Number of Times Key Word Appeared in Search	Number of Times Key Word Appeared in Specific Examples
Aboriginal	2	1 ("evaluate the evidence for climate change as seen through traditional environment knowledge (TEK) of Canada's northern Aboriginal peoples") (p. 209)
Cultural	16	0
Culture	3	0
Diversity	18	0
Ethnic	0	0
Ethnicity	0	0
First Nations	1	1 ("There are several instances of bioaccumulation in Manitoba and in Canada; where possible, use local or regional examples [e.g., PCBs in beluga whales, mercury poisoning in the Grassy Narrows First Nations community of northern Ontario, methyl-mercury in northern Manitoba lakes"]). (p. 1.6) (However, it should be noted that this example does not address the SLOs in question.)
Identities	1	0
Identity	2	0
Indigenous	0	0
Inuit	1	1 ("Sila Alangotok: Inuit Observations on

		Climate Change") (p. 4.31)
Métis	0	0
Race ("race" as in a "competition" was not included in count)	0	0
Racial	1	0
Tradition	0	0

As a result of this analysis, I found that there was only one example of how to integrate Indigenous perspectives into the Grade 10 Science curriculum, namely the suggestion to "evaluate the evidence for climate change as seen through traditional environment knowledge (TEK) of Canada's northern Aboriginal peoples" (Manitoba Education and Youth, 2003, p. 209). The curriculum writers suggest the use of the film *"Sila Alangotok: Inuit Observations on Climate Change"* (Manitoba Education and Youth, 2003, p. 4.31) as a specific example on how to incorporate Indigenous perspectives on climate change. As previously mentioned, Manitoba Education has published a teacher's guide for this video entitled *"A teacher's guide for the video Sila Alangotok – Inuit observations on climate change: A resource for Senior 2 Science"* (http://www.edu.gov.mb.ca/k12/docs/support/sila_video/), however, this resource is not available in French. The fact that this resource document is not available in French provides another example of a lack of equity in terms of the number of resources available in English compared to French from the Province of Manitoba. Again, by not making this document available in French, Manitoba Education and Training is sending the message that it is not a priority to have this document translated to support French Immersion science teachers in the integration of Aboriginal perspectives into the curriculum. As previously discussed, the burden of translating the necessary resources in this document (provided that the teacher decides to show this English video) falls on the teacher. However, the consequences of this resource inequality is not only felt by the teacher, it is the students who suffer as well, as the teacher may not choose to incorporate

a video (or other resource) regarding Aboriginal perspectives on climate change if he or she does not have easily-accessible resources or enough time to translate the English resources. Therefore, students in the English science program in Manitoba are arguably more likely to be exposed to Aboriginal perspectives on climate change, compared to French Immersion students, due to this resource inequity.

Impacts on language-learning integration.

As outlined in Chapter 4: Results, teachers in this study described themselves as having a role in fostering students' French-language learning, and they incorporate various language-learning strategies into their science course. The importance of linguistic activities (reading, writing, speaking) in promoting language development among students learning science in FI and Francophone-minority schools, as well as in fostering students' understanding of science concepts, is highlighted by several researchers (Cormier, Pruneau, Rivard, & Blain, 2004a; Cormier, Pruneau, & Rivard, 2010; Rivard & Cormier, 2008; Rivard et al., 2012; Rivard & Gueye, 2015). While teachers in this study are integrating language-learning into their science course to a certain degree, the results suggest that teachers could benefit from more readily-available resources to facilitate this integration, as well as more time and opportunities to learn new strategies for integrating language-learning. These two main themes are the focus of this section of the discussion.

This section is divided into three subsections. First, the specific areas in which there appears to be room for the incorporation of additional language-learning strategies by teachers will be discussed (reading/use of a variety of texts, discussion techniques, and use of video). Second, since two teachers mentioned the incorporation of more strategies developed by Roy Lyster into their courses, some of these strategies will be explained and discussed in light of

participants' challenges. Finally, how the results of the present study relate to items mentioned in the recently-published government support document entitled *La langue au coeur du programme d'immersion française: Une approche intégrée dans la pédagogie immersive* will be discussed.

Possibilities for the incorporation of additional language-learning strategies. Sophie mentioned the lack of time to plan or to develop resources as a challenge associated with integrating language-learning into her science courses. Mike and John were the only two teachers who noted that they could benefit from learning more strategies on how to integrate language-learning into their science course. However, when comparing the language-learning strategies mentioned by participants and those noted in the literature, the results suggest that teachers could benefit from having more time and opportunities to learn how to incorporate additional language-learning strategies. This result is not surprising, given the challenges of lack of time, lack of resources, and lack of relevant professional development opportunities experienced by participants.

Reading activities and use of a variety of texts. Reading "authentic scientific texts" (or "real-world texts") such as "articles published in journals, magazines, and newspapers, as well as brochures, government pamphlets, and Websites" (Karchmer, 2001 as cited in Rivard et al., 2012, p. 93) in FI science courses "provides a rich language experience for L2 [FI] learners" (Rivard et al., 2012, p. 93). While five participants mentioned that students engage in reading activities in their science course, only Sophie and Paul talked about incorporating the use of articles into their science course. Renée explained that she does not incorporate articles due to time constraints; she mentioned that "[she doesn't] have time necessarily to look through a bizillion articles." This lack of time and resources is corroborated by Rivard and Gueye (2015, pp. 84-5). In my personal experiences developing a course for the first time, I have certainly

experienced the challenge of a lack of time to look for articles in French that address the curricular outcomes and that are at an appropriate reading level.

Rivard et al. (2012) recommend explicitly teaching reading comprehension strategies in FI science courses, as "strategic teaching of reading strategies scaffolds FI students' text comprehension, thereby making them more effective science learners" (p. 94). In the present study, only half of the teachers mentioned that they explicitly teach reading comprehension strategies.

Discussion techniques. While all six participating teachers mentioned that students engage in speaking (discussion) activities in their science course, the results suggest that there is a need for more strategies on how to encourage students to speak in French, and how to include all students in discussions. It is clear that teachers in this study understand the value of discussions in learning, which is supported by numerous scholars (e.g., Cormier et al., 2004a; Cormier et al., 2010; Rivard & Cormier, 2008; Rivard et al., 2012; Rivard & Gueye, 2015, Swain, 2005 as cited in Rivard et al., 2012, p. 92).

Videos and listening comprehension exercises. As mentioned in Chapter 4, four of the teachers indicated that they show videos in French related to the subject matter when available. Only Sophie mentioned having students sometimes answer listening comprehension questions after watching a video. A recurring point mentioned by several teachers in this study is that they will often show videos in English to foster science understanding. While no known research corroborates this finding, it is evident that using videos in English was common practice for some teachers in this study. In order to foster French language learning, as well as science understanding, teachers would likely benefit from having readily-available videos in French that directly address the curricular outcomes. This was a need mentioned by teachers in this study.

While no known research mentions the benefit of using listening comprehension questions specifically in French Immersion science classrooms, it is plausible that this strategy could be effective in supporting French-language growth and science understanding among students.

Strategies developed by Roy Lyster. Sophie and Mike believed that they could enhance their practice by incorporating the use of strategies developed by Roy Lyster. Sophie explained that she would like to incorporate Lyster's strategies into her courses, but that she does not have the time to plan to do so. Mike expressed the challenges of knowing how to incorporate these strategies, of getting all French Immersion staff on board, and having the time to meet with colleagues to plan for the incorporation of these strategies.

In Chapter 5 of Lyster's recent publication (2016), he explains the "approche intégrée proactive," ("proactive integrated approach") in which language learning is integrated with content learning (pp. 53-9). One example he provides illustrates how Grade 5 students can discover gender grammatical rules while learning about the founding of Québec. Lyster outlines a series of four steps: "perception," "conscientisation" ("awareness"), "pratique guidée" ("guided practice"), and "pratique autonome" ("independent practice") (p. 53). Generally, these four steps provide students with opportunities to discover grammatical patterns, practice these patterns in guided activities, and then independently put into practice these patterns, all within a specific content area (pp. 53-9). Lyster suggests that these steps can be approached in an interdisciplinary fashion; for example, the "perception" and "pratique autonome" steps can be completed in a content area ("non-linguistic discipline") and the other two steps can be completed in the students' français language course (p. 58). He notes that: "This planning is relatively easy in immersion when one teaches both French and other disciplines. If you share these responsibilities with other teachers, it's in these cases where collaboration between colleagues

plays a key role." (translation, p. 59) An evident challenge to collaboration is having the time to do so. In addition to time to collaborate, time to develop resources is also important for the integration of Lyster's strategies. Sophie and Mike emphasized this need for time to integrate Lyster's strategies into their science courses.

Relating the results to a recently-published government support document. In 2016, the Province of Manitoba's *Division du Bureau de l'éducation française*, published *La langue au coeur du programme d'immersion française: Une approche intégrée dans la pédagogie immersive*, a support document for Manitoba teachers. Largely based on Roy Lyster's work, this document has the following objective: "Dans le but d'atténuer des lacunes langagières chez les élèves pour qu'ils communiquent avec plus de précision, ce document propose une approche pédagogique renouvelée qui vise à appuyer les enseignants manitobains" (p. 4). This objective can be translated as: "With the goal of reducing students' language gaps/shortcomings such that they communicate with more precision, this document proposes a renewed pedagogical approach that aims at supporting Manitoba teachers." It is stated at the outset of this document that "it is evident that [FI] students need to further develop their linguistic competencies more actively in all subject areas" and that "students in immersion do not always attain an appropriate level of bilingual competence for their age group" (translation, p. 3). Furthermore, the authors state: "Students say that they do not speak in French enough in their school environment" (translation, p. 3). This last statement is supported by the results of the present study, as teachers in this study expressed the challenge of encouraging students to speak in French, and two teachers mentioned the challenge of a lack of French use in dual-track schools.

This 2016 government support document also states that "all teachers of the French Immersion program are responsible for students' French-language development, as well as for

the teaching of the content required for each subject area" (translation, p. 4). The French Immersion science teachers interviewed in the present study would agree with this statement, as they believe that they have a dual-role, that of science teacher and French-language teacher. The authors of the support document explain that "même s'il existe quantité d'exemples d'enseignants intégrant habilement la langue au contenu, ceci est loin d'être la norme et il est étonnant de constater que l'enseignement de la langue et l'enseignement du contenu disciplinaire continuent d'être séparés" (p. 4). This can be translated as: "Even if there are a number of examples of teachers skilfully integrating language into content, this is far from the norm and it is surprising to note that language teaching and content area teaching continue to be separated" (translation, p. 4). The authors do not explain the extent to which language and content teaching are being separated, or what this "separation" really looks like in the classroom. Regardless, what the present study adds to this discussion is that high school science teachers in Manitoba are integrating language-learning into their courses to different degrees and in various ways. Contrary to the support document authors' statement, it is not surprising that teachers in this study, at times, separate language and content teaching given the lack of resources to support this integration, lack of preparation time, and the lack of professional development opportunities.

Other impacts on teaching and learning.

When French Immersion teachers are spending a substantial amount of time obtaining and developing resources, less time and energy can be placed on other aspects of teaching, such as attention on individual students, assessment, and collaboration with colleagues. Teachers also have less time to spend on developing meaningful learning activities. For example, Sophie, who has taught Grade 10 Science in French and in English, explained how she does more in her English course compared to her French course as a result of having fewer resources in French

and a lack of stamina to translate the resources she has in English. During the interview, she said:

> I like the [Ecology] unit. I just find I could do so much more because I have the English one, and I do so much more in the English one... I just, you get lazy, and you get tired, and you don't want to translate anymore... So, you go with what you have. [Laughing] Which is better than nothing. (Sophie)

French Immersion teachers having to spend more time than English teachers on basic resource development is another example of how French Immersion students are arguably at a disadvantage compared to students in English programs in Manitoba. With more resources available in English from Manitoba Education and Training and from textbook publishers, English program high school science teachers are able to spend less time on developing basic resources. As a result, they have more time to spend on individual students' needs and on incorporating engaging learning activities into their science courses.

In summary, with more instructional resources available that address the specific learning outcomes of the Manitoba Grade 10 French Immersion Science curriculum, French Immersion teachers would have more time to, for example: work one-on-one with students, assess students' progress and provide students with feedback, adapt for individual students' needs, collaborate with other colleagues on how to support individual students, collaborate with colleagues on programming, learn more strategies on how to integrate language-learning activities into their science courses, integrate Aboriginal perspectives into their science courses, learn how to incorporate other engaging activities into their science courses, focus on planning (including lesson delivery), communicate with parents in support of students' progress, and participate in the school community.

Three participants in this study summarized this point well:

I think the main area where it would help is, ‘cause when you have to plan something new, it’s really hard to take differentiation and different types of learners into account. You’re working so hard to get something out, to have to... use different strategies and to have to do adaptations and modifications, like that, is really difficult. So, I think, if you have say, let’s say, your school says, you’re teaching this for the first time, here you go, if you have something good you can go with, you can actually focus on the kids who need something more, who might otherwise not get that from you because you’re working so hard to try and develop something, for, just, the general population. (John)

Instead of just knowing that you have a sheet for tomorrow, you could actually develop it and work on your... delivery of the information, instead of being like, here’s a sheet, alright, so the instructions say, and you’re just reading it to them, because that’s all you’ve had time to prepare. But... if I had the sheet for a weekend, a time when I could look at it and say, ok, I’m going to do this first, do what you’re supposed to do in teacher’s college... Instead of being like, alright, kids, chemistry today, here’s a sheet, alright, somebody read the first instruction, excellent, cool, that’s what we’re doing... it definitely, it ups your stress level when you’re having to prepare everything AND prepare what you’re going to, you know, prepare your little production of what you’re going to say. If the sheets are already there, then you can focus more on your delivery and less on... making sure they have a paper in front of them. (Michelle)

It would allow me to spend less time creating material, more time assessing material, because again, there’s only so much time in a day, and every moment that we’re spending creating material is time taken away from assessing the students, from planning, and from doing those kinds of things. (Paul)

As previously mentioned, the results of this study show that course development can have a negative impact on French Immersion teachers' work-life balance and stress levels. While work-life imbalance and stress directly affect teachers, it is clear that students would be indirectly affected by these issues. As mentioned above, the 2010 MTS *Teacher Workload Survey* revealed that stress experienced by Manitoba teachers can have consequences on their performance in the classroom (i.e., "73 percent [of teachers] stated that on the job stress has negatively impacted their work performance") (p. 24).

Recommendations for Stakeholders

Based on the results of this study and reports in the published literature, I have outlined recommendations for stakeholders that will help to address the course development challenges and needs of Manitoba French Immersion science teachers. These recommendations are presented the following sections of this chapter. Specifically, I make recommendations to government policymakers, union leaders, administrators, superintendents, community members, and teachers. After these recommendations to stakeholders, I make several recommendations for future research.

Recommendations for government policymakers.

In this section, I outline two recommendations to provincial government policymakers. The first recommendation is that the "Independant Study Option" (Distance Education) documents available to teach Manitoba science courses be translated into French. Furthermore, these documents should be made readily-available for teachers to order from the Manitoba Text Book Bureau. The "Independent Study Option" science courses currently available can be found at http://www.edu.gov.mb.ca/k12/dl/iso/senior/index.html). The "Independent Study Option"

science courses available at the time of publication of this thesis are: Science 10F, Science 20F, Biology 30S, Chemistry 30S, Physics 30S, Biology 40S, Chemistry 40S, and Physics 40S.

Translating the Distance Education documents would not only support French Immersion and Francophone program teachers in course development, it would also provide French Immersion and Francophone students with the opportunity to study science courses outside of the traditional school setting. At the time of publication of this thesis, if a French Immersion or a Francophone program student needs to be away from school for personal reasons, then he or she would not be able to continue his or her French-language science studies unless the teacher has developed a distance education package for the science course. Again, the burden of the lack of resources in French falls on the teacher, who needs to develop distance education resources. If the teacher is unable to develop these resources (or if the quality of the teacher-developed resources is less than the English government-developed resources), then it is the French Immersion or Francophone program students who are at a disadvantage compared to the English program students.

The second recommendation for government policymakers is to update the Manitoba science curricula to a new curriculum model that more effectively supports teachers in course development. In this section, I recommend a new curriculum model that I developed based on the results of this study (see pages 127-128) and on published literature. I have named the curriculum model that I am proposing the *"Living Curriculum"* (LC) model. This curriculum model is an online instructional resource database model designed to support teachers in course development. It should be made clear that this database has not been created, I am simply proposing the model (framework) for the creation of this database. I am recommending that the government develop and implement this database based on the model that I am proposing.

The *"Living Curriculum"* model is based on the following four belief statements:

1. If French Immersion teachers are well-equipped with instructional resources to teach the provincial curriculum, then they can spend less time finding and developing resources and more time on other fundamental, and arguably more important, aspects of teaching, such as attention on individual students.
2. If French Immersion teachers are well-equipped with instructional resources to teach the provincial curriculum, they are more likely to integrate Aboriginal perspectives into their science courses and to incorporate more effective language-learning strategies to help students improve their French-language proficiency.
3. If French Immersion teachers are well-equipped with instructional resources to teach the provincial curriculum, they can spend less time finding and developing resources and more time on maintaining their own well-being. Talented, effective teachers who are overburdened and lack work-life balance can become even more effective and successful in supporting students if they can more easily sustain a healthy work-life balance.
4. If French Immersion teachers are well-equipped with instructional resources to teach the provincial curriculum, they are less likely to suffer from stress and burn-out, which could reduce the number of dedicated, talented, and qualified French Immersion teachers who leave FI or the profession in Manitoba.

The features of the *"Living Curriculum"* model are as follows:

a) The provincial curriculum is an ever-evolving or "living" website.

It is recommended that the curriculum be a dedicated website. The word "living" is used to describe two fundamental features of the *Living Curriculum*: 1) the curriculum website is "living" in that it is updated at least every five years and 2) the curriculum website is "alive" or

"active" in that, throughout the curriculum website, there are links embedded to facilitate navigation to various instructional resources that address specific learning outcomes or groups of specific learning outcomes. This is not to say that an entirely new curriculum website is created every five years, as I do not believe that is feasible or necessary. I am suggesting that the curriculum be a collection of webpages that can be easily updated.

Currently, the *Senior 2 Science: A Foundation for Implementation* curriculum documents (English and French versions), as well as the other Manitoba science curricula, are available as PDF documents. These documents cannot be updated. As previously discussed, the fact that the curriculum cannot be easily modified means that the website links recommended in the document become outdated. It also means that articles pertaining to current world issues cannot be added to the curriculum to support teachers in course development. With the *Living Curriculum*, that can be updated/modified, the curriculum is an ever-evolving website that can meet the needs of today's teachers. The presence of links to instructional resources throughout the document (that can be added or removed) maintains the relevancy of the curriculum. In other words, the curriculum remains current and relevant to teachers and students.

Furthermore, by having a *Living Curriculum*, the provincial government's publications/resources that are intended to support the curriculum (e.g., *A Teacher's Guide for the Video Sila Alangotok – Inuit Observations on Climate Change: A Resource for Senior 2 Science*) can be uploaded directly to the curriculum website to facilitate the use of the resource by directly linking the resource to the relevant curricular outcomes. This direct integration would also help teachers become aware of these newly-developed resources. By having all of the provincially-developed resources in one location, and linked to curricular outcomes, this website

platform promotes easy-access to resources, as well as easy-navigation within the curriculum website.

In summary, the recommendations outlined in the above subsection include:

- That the curriculum be a *Living Curriculum*: a collection of webpages that can be easily updated.
- That the *Living Curriculum* be updated at least every five years.
- That the instructional resources in the *Living Curriculum* be linked to curricular outcomes or groups of curricular outcomes to facilitate easy-navigation throughout the website.

b) The Living Curriculum is an effective teacher support website.

It is recommended that links are provided within the curriculum website to modifiable, provincially-developed, classroom-ready instructional resources. This way, teachers have easy-access to instructional resources that directly address the Manitoba curricular outcomes.

Currently, the classroom-ready resources that are in the French and English versions of the *Foundation for Implementation* curriculum documents are provided as modifiable appendices (not directly attached to curricular outcomes by website-embedded links). There are also not enough resources provided in these appendices to address all of the curricular outcomes, and there are no resources contained in this document that integrate Aboriginal perspectives. Furthermore, the English and French versions of these *Foundation* documents are not the same.

To be an effective teacher support curriculum website, the following are recommendations related to the instructional resources that should be included on the curriculum website:

- That there are enough resources in the *Living Curriculum* to address all of the curricular outcomes.

- That the resources included in the *Living Curriculum* are of various types: student notes, activities (including experiments), websites (including resources that support distance learning such as virtual experiments), videos, and magazine and newspaper articles.
- That the resources included in the *Living Curriculum* support the integration of language-learning into science courses.
- That the resources included in the *Living Curriculum* represent various cultural perspectives, including Aboriginal perspectives.

I believe that this online instructional resource database would foster teacher creativity, as teachers could be inspired to modify their practices after reading the resources contained in the *Living Curriculum*. They could also be inspired to develop new resources based on ideas obtained from resources in the database. Moreover, since the resources would be modifiable, teachers could easily modify the document for their unique group of students or to suit their teaching style and philosophical beliefs.

I also believe that this instructional resources database would support teachers in gaining a better understanding of the science concepts to be taught and of the intentions of the curricular outcomes (e.g., level of detail to be taught). It would also support teachers in learning new strategies for how to teach the science concepts.

c) The Living Curriculum is the product of on-going teamwork.

It is recommended that the curriculum website be modified every five years by a new committee chosen and managed by Manitoba Education and Training. It is recommended that the committee include experienced teachers, the provincial French and English science program consultants, science curriculum experts, and science subject area specialists. This committee would discuss ways to improve the *Living Curriculum*. Moreover, individuals or groups of

individuals on the committee would provide quality, peer-reviewed instructional resources that can be added to the curriculum. The experienced teachers included in the process should be from urban, rural, and northern Manitoba schools, and the number of teachers should be equally distributed (to the extent possible) between French Immersion, Francophone, and English program teachers.

In order to maintain organization and to avoid an overwhelming number of instructional resources added to the resource database, the provincial science consultants would manage the process. I believe that the insight and ideas provided by a new committee every five years would foster positive collaboration among teachers. Teachers across Manitoba meeting every five years would also allow for teachers to connect with each other and to share ideas, reducing the feelings of isolation that could arise when teaching in rural or northern communities.

In summary, the recommendations outlined in the above subsection include:

- That the individuals involved in updating the *Living Curriculum* include experienced science teachers, the provincial science consultants, science curriculum experts, and science subject area specialists.
- That the committee be representative of teachers from urban, rural, and northern schools and of teachers from French Immersion, Francophone, and English programs.

d) The Living Curriculum provides equitable access to instructional resources.

As previously discussed, there is currently an inequality in the instructional resources available in English and in French from the provincial government. There are more instructional resources in English published by the government that support the Manitoba Grade 10 Science curriculum, thus, disadvantaging French Immersion and Francophone school teachers. There are also no textbooks published in French that directly align with the Manitoba Grade 10 Science

curriculum. Since the development of curricula is a provincially-governed task in Canada, I believe that it is the provincial government's role to ensure that there are quality instructional resources to support French Immersion and Francophone school teachers. By creating a provincial *Living Curriculum* website in French and in English, teachers would have equitable access to instructional resources that are aligned with the provincial curriculum.

In summary, the following is recommended to support Manitoba teachers:

- That there are an equal number of instructional resources included in French and in English in the *Living Curriculum*, which would provide equitable access to resources to French Immersion and Francophone school teachers.
- That the resources included in the *Living Curriculum* are the same (to the extent possible) in English and in French. In addition to promoting equity, having identical or nearly identical resources would support teachers who teach the same course in English and in French. Clearly, links to videos or to websites that are only available in English or in French would be in the respective curriculum. To the extent possible, however, if a video on a certain topic is included in the English curriculum, a video of similar quality should be included in the French curriculum.

Figure 5 below summarizes the features of my *Living Curriculum* model.

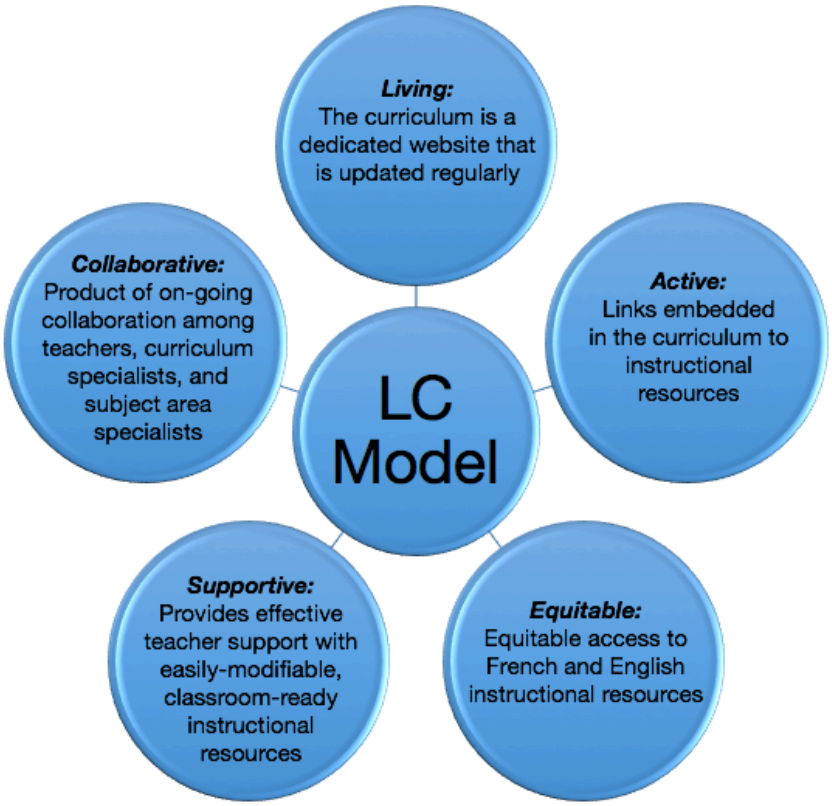

Figure 5: The Living Curriculum Model

Recommendations for union leaders.

In order to help support French Immersion teachers in Manitoba, the following recommendations for union leaders are provided:

- That union leaders be aware that there is not a single instructional resource available in French that is written to support the Manitoba Grade 10 Science curriculum. The results of this study suggest that this lack of a single resource contributes to teachers spending a substantial amount of time on course development, especially early in their careers or when teaching a course for the first time, disrupting work-life balance and contributing to increased stress levels.

- That the Manitoba Teachers' Society "Teacher Workload Survey" include an option for teachers to identify as a "French Immersion Classroom Teacher" or a "Francophone Program Classroom Teacher." For example, on 2017 version of the survey, this option could be added to Question #8 ("Which ONE of the following BEST describes your position"?). In this way, French Immersion teachers' responses can be compared to English and Francophone program teacher responses.
- That the Manitoba Teachers' Society "Teacher Workload Survey" include an option for teachers to select "Increased number of classroom-ready instructional resources" in Question #11 of the 2017 version of the survey ("In the LEFT HAND column, indicate which of the following factors would be PRACTICAL SOLUTIONS to help to deal with your workload issues"). In this way, information can be gathered on whether other groups of teachers could benefit from having more instructional resources to support them in course development.
- That union leaders advocate to the Minister of Education and Training and the Minister responsible for Francophone Affairs in support of French Immersion education. Specifically, it is recommended that union leaders advocate to these ministers on behalf of French Immersion teachers for the increased number of instructional resources for the French-language science curricula. For example, I am recommending that the "Independent Study Option" (distance education) science course documents be translated. For further recommendations on instructional resource support see page 166. If teachers are well-equipped with instructional resources to teach the provincial curriculum, they can spend less time finding and developing resources and more time on other fundamental, and arguably more important, aspects of teaching, such as attention on individual students. Results of this

study suggest that they would also have an improved work-life balanced and decreased stress levels.

Recommendations for administrators.

In order to help support and retain French Immersion teachers in Manitoba schools, the following recommendations for administrators in Manitoba French Immersion schools are provided:

- That administrators be aware that there is not a single instructional resource available in French that is written to support the Manitoba Grade 10 Science curriculum. The results of this study suggest that this lack of a single resource contributes to teachers spending a substantial amount of time on course development, especially early in their careers or when teaching a course for the first time, disrupting work-life balance and contributing to increased stress levels.
- That administrators consider the time-consuming and challenging nature of course development when preparing teachers' schedules. It is recommended that administrators dialogue with French Immersion teachers to discuss what is a reasonable course load given the teacher's experience. Certainly, teachers' ideal schedules will vary with interest and years of experience. However, in general, teaching a high number of different courses in one year, or over several years, is challenging due to the substantial time commitment required to prepare for each individual course. Therefore, especially early in a teacher's career, it is recommended that teachers are not given many different courses in one year, or across several years. This way, teachers can have enough time for course development.
- That administrators meet with French Immersion teachers in their school as required to discuss their challenges and needs.

- That administrators provide time for French Immersion teachers in their schools to meet with each other in order to discuss course development and to share instructional resources. It would also be beneficial for teachers to have time to meet with teachers of the same subject area in different schools.
- That administrators write to the Minister of Education and Training and the Minister responsible for Francophone Affairs in support of French Immersion education. Specifically, it is recommended that administrators write to these ministers to advocate for the increased number of instructional resources for the French-language science curricula. For example, I am recommending that the "Independent Study Option" (distance education) science course documents be translated. For further recommendations on instructional resource support see page 166. If teachers are well-equipped with instructional resources to teach the provincial curriculum, they can spend less time finding and developing resources and more time on other fundamental, and arguably more important, aspects of teaching, such as attention on individual students in Manitoba schools. They would also be more likely able to contribute effectively to extra-curricular activities.

Recommendations for school division superintendents.

In order to help support and retain French Immersion teachers in Manitoba school divisions, the following recommendations for superintendents and assistant superintendents in Manitoba French Immersion schools are provided:

- That superintendents be aware that there is not a single instructional resource available in French that is written to support the Manitoba Grade 10 Science curriculum. The results of this study suggest that this lack of a single resource contributes to teachers spending a substantial amount of time on course development, especially early in their careers or when

teaching a course for the first time, disrupting work-life balance and contributing to increased stress levels.

- That superintendents meet with a group of French Immersion teachers in their school division every three years (or more often if required) to discuss their challenges and needs.
- That superintendents write to the Minister of Education and Training and the Minister responsible for Francophone Affairs in support of French Immersion education. Specifically, it is recommended that superintendents write to these ministers to advocate for the increased number of instructional resources for the French-language science curricula. For example, I am recommending that the "Independent Study Option" (distance education) science course documents be translated. For further recommendations on instructional resource support see page 166. If teachers are well-equipped with instructional resources to teach the provincial curriculum, they can spend less time finding and developing resources and more time on other fundamental, and arguably more important, aspects of teaching, such as attention on individual students in Manitoba school divisions. They would also be more likely able to contribute effectively to extra-curricular activities.

Recommendations for community members.

In order to help support French Immersion education in Manitoba communities, the following recommendations for community members (e.g., parents of French Immersion students, former French Immersion students, or any other interested member of the community) are provided:

- That community members be aware that there is not a single instructional resource available in French that is written to support the Manitoba Grade 10 Science curriculum. The results of this study suggest that this lack of a single resource contributes to teachers spending a

substantial amount of time on course development, especially early in their careers or when teaching a course for the first time, disrupting work-life balance and contributing to increased stress levels.

- That community members write to the Minister of Education and Training and the Minister responsible for Francophone Affairs in support of French Immersion education. Specifically, it is recommended that community members write to these ministers to advocate for the increased number of instructional resources for the French-language science curricula. For example, I am recommending that the "Independent Study Option" (distance education) science course documents be translated. For further recommendations on instructional resource support see page 166. If teachers are well-equipped with instructional resources to teach the provincial curriculum, they can spend less time finding and developing resources and more time on other fundamental, and arguably more important, aspects of teaching, such as attention on individual students in Manitoba communities.

Recommendations for teachers.

The following recommendations for Grade 10 French Immersion Science teachers are provided:

- That teachers be aware that there is not a single instructional resource available in French that is written to support the Manitoba Grade 10 Science curriculum. The results of this study suggest that this lack of a single resource contributes to teachers spending a substantial amount of time on course development, especially early in their careers or when teaching a course for the first time, disrupting work-life balance and contributing to increased stress levels. Therefore, if teachers are spending a significant amount of time on course

development, their experience is shared by others and they should not feel "alone" in their experience.

- That teachers contact the Manitoba Teachers' Society if they feel that their work-life balanced is disrupted and/or they are experiencing stress.
- That teachers write to the Minister of Education and Training and the Minister responsible for Francophone Affairs in support of French Immersion education. Specifically, it is recommended that teachers write to these ministers to advocate for the increased number of instructional resources for the French-language science curricula. For example, I am recommending that the "Independent Study Option" (distance education) science course documents be translated. For further recommendations on instructional resource support see page 166. If teachers are well-equipped with instructional resources to teach the provincial curriculum, they can spend less time finding and developing resources and more time on other fundamental, and arguably more important, aspects of teaching, such as attention on individual students. Results of this study suggest that teachers would also have an improved work-life balanced and decreased stress levels.

Recommendations for Future Research

The results of this study reveal the need for future research in a variety of areas. The following are suggested areas for future research:

1. That the same research study be conducted with French Immersion teachers in Manitoba who teach science courses at different grade levels. These teachers' course development experiences could be compared to the experiences of the teachers in the present study. The results of this future study could further inform government policymakers on how to further support French Immersion teachers in Manitoba.

2. That a study be conducted to determine the extent to which Grade 10 French Immersion teachers are incorporating sustainability and sustainable well-being into their science courses.
3. That a study be conducted to assess the quality of resources designed to address the provincial French-language curricula that Manitoba teachers are using other than provinciallly-developed resources (e.g., *Omnisciences 10*).
4. That a more-focused research study be conducted with Grade 10 French Immersion Science teachers in Manitoba regarding which specific learning outcomes they are leaving out of their teaching (including Cluster 0 Specific Learning Outcomes).
5. That a more-focused research study be conducted with French Immersion science teachers in Manitoba of different grade levels (other than Grade 10) to determine which clusters or specific learning outcomes they are leaving out of their teaching (including Cluster 0 Specific Learning Outcomes). If more than one group of teachers of different grade levels is studied (in the same school division), then the impacts of leaving out these clusters (or specific learning outcomes) can be evaluated. For example, if a Grade 6 teacher in Manitoba is not teaching the *Electricity* cluster, how is this omission affecting the teaching of the Grade 9 *Nature of Electricity* cluster (to the same group of students)?
6. That a more-focused research study be conducted with Grade 10 French Immersion science teachers to gain further insight on how these teachers are incorporating language-learning into their science courses. This future study could add to the present study's results by providing more information on the specific strategies used by these teachers and what this integration looks like in the classroom (i.e., by observing teachers incorporating these strategies).

7. That the same study be conducted in different Canadian provinces that have a textbook and support documents designed specifically for their curriculum. By conducting this future study, French Immersion teachers' course development experiences in other provinces can be compared to the experiences of French Immersion teachers in Manitoba.
8. That the same study be conducted with Grade 10 Science teachers in Manitoba who teach in the Francophone program, as well as with teachers who teach this course in the English program. These teachers' course development experiences could be compared to French Immersion teachers' experiences.
9. That a study be conducted with former French Immersion students who chose to study science at the post-secondary level in order to learn about their impressions of their French Immersion education. Specifically, the extent to which their French Immersion education prepared them for communicating in French, as well as the extent to which it prepared them for success in post-secondary science.
10. That a study be conducted with French Immersion science teachers who teach in French Immersion centres to understand their course development experiences. French Immersion centres are schools in which French Immersion is the only program offered, in contrast to dual-track schools in which both French Immersion and the English program are offered. Since the present study only included teachers who have taught Grade 10 French Immersion Science in dual-track schools (with one teacher who has taught Grade 10 French Immersion Science in a dual-track school and a Francophone school), it would be valuable to compare the experiences of teachers in dual-track schools with the experiences of teachers in French Immersion centres.

11. That the same study be conducted with a larger population of Grades 9 and 10 French Immersion Science teachers in Manitoba to determine the challenges that they may have as novice French Immersion science teachers and as experienced French Immersion science teachers.
12. That the Manitoba government implement the *Living Curriculum* model (online database of instructional resources) proposed in the present study and that researchers determine the effectiveness of this model in supporting French Immersion and Francophone program science teachers in Manitoba.

Conclusions

The first purpose of this case study was to understand the course development experiences of Grade 10 French Immersion Science teachers in Manitoba. It was found that Manitoba Grade 10 French Immersion Science teachers' experiences are negatively impacted by equity issues. These equity issues for teachers negatively impact teachers' well-being. In turn, both the equity issues for teachers and the impacts of these issues on teachers' well-being have negative impacts on the quality of education for French Immersion students in Manitoba.

It was found that Manitoba Grade 10 French Immersion Science teachers suffer from a lack of resources. The first issue of equity arises in that there are fewer resources available in French compared to English from the provincial government. This lack of resources exacerbates the effects of the second equity issue, that teachers' experiences depend heavily on who they know and the situation in which they find themselves (e.g., urban, rural, northern, course load). The results of this study suggest that these equity issues negatively impact teachers' well-being by disrupting their work-life balance and by contributing to their stress levels. In turn, these equity issues, as well as the negative impacts on teacher well-being, have negative effects on the

quality of education for French Immersion students in Manitoba.

The second purpose of this case study was to develop an online instructional resources database model based on an understanding of these teachers' course development experiences that holds promise in supporting Grade 10 FI Science teachers in Manitoba. An online instructional resources database model was developed entitled the *Living Curriculum* (LC) model. This model promotes equitable access to instructional resources for teachers in Manitoba. In this model, the curriculum is a dedicated website that is updated regularly. There are links to instructional resources embedded within the curriculum website to facilitate easy-access to quality, classroom-ready instructional resources that align with the provincial curricular outcomes. The instructional resources are developed through on-going collaboration among teachers, provincial science consultants, curriculum specialists, and subject area specialists. The *Living Curriculum* model is based on the belief that, if teachers are provided with an ample supply of quality instructional resources designed to address the provincial curricular outcomes, the quality of teaching and learning in French Immersion programs in Manitoba can be improved by reducing the time that teachers are spending developing resources and by positively impacting French Immersion teachers' well-being. In turn, French Immersion teachers are less likely to leave the profession, further improving the quality of French Immersion education in Manitoba.

References

Allingham, N. (1992). Anti-racist education and the curriculum: A privileged perspective. *Keynote speech to Ontario Teachers' Federation*.

About USB. (2014). Retrieved from http://ustboniface.ca/page.aspx?pid=979

Bruning, R. H., Schraw, G. J., Norby, M. M., Ronning, R. R. (2004). *Cognitive psychology and instruction* (4th ed.). Upper Saddle River, NJ: Pearson Education.

Canada. Parliament. House of Commons. Standing Committee on Industry, Science and Technology. (2013). *Evidence*. Meeting 68, May 7. 41st Parliament, 1st Session. Retrieved from http://www.parl.gc.ca/HousePublications/Publication.aspx?DocId=6145966&Language=E&Mode=1

Canada. Parliament. House of Commons. Standing Committee on Official Languages. (2013). *Evidence*. Meeting 82, May 23. 41st Parliament, 1st Session. Retrieved from http://www.parl.gc.ca/HousePublications/Publication.aspx?Language=E&Mode=1&DocId=6174656

Canada. Parliament. House of Commons. Standing Committee on Official Languages. (2014, February). *The state of French second-language education programs in Canada*. 1st Report. 41st Parliament, 2nd Session. Retrieved from http://www.parl.gc.ca/content/hoc/Committee/412/LANG/Reports/RP6433979/langrp01/langrp01-e.pdf

Canadian Parents for French. (2014). *French second language enrolment statistics 2008 – 2009 to 2012 – 2013*. Retrieved from http://cpf.ca/en/files/2014-Enrolment-Stats.pdf

Canadian Teachers' Federation. (2015). *CTF survey on teachers' perspectives on Aboriginal education in public schools in Canada: Summary report*. Retrieved from

https://www.ctf-fce.ca/Research-Library/CTF-Survey-Teachers-Perspectives-on-Aboriginal-Education-Summary-Report-web.pdf

Cormier, M., Pruneau, D., Rivard, L., & Blain, S. (2004a). Un modèle pédagogique pour améliorer l'apprentissage des sciences en milieu linguistique minoritaire. *Francophonies d'Amérique, 18*, 21-35. doi:10.1353/fda.2005.0004

Cormier, M., Pruneau, D., & Rivard, L. (2004b). S'approprier un vocabulaire scientifique en milieu minoritaire. *Cahiers Franco-Canadiens de l'Ouest, 16*(1-2), 175-197.

Cormier, M., Pruneau, D., & Rivard, L. (2010). Améliorer les apprentissages en sciences en milieu francophone minoritaire : résultats de l'expérimentation d'un modèle pédagogique. *Revue des sciences de l'éducation, 36*(2), 343-363. doi:10.7202/044481ar

Cormier, M. & Turnbull, M. (2009). Une approche littératiée : apprendre les sciences et la langue en immersion tardive. *La revue canadienne des langues vivantes, 65*(5), 817-840.

Creswell, J. W. (2013). *Qualitative inquiry & research design: Choosing among five approaches* (3rd ed.). Los Angeles, CA: SAGE.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Los Angeles, CA: SAGE.

Division scolaire franco-manitobaine. (2015). *Budget 2015 – 2016*. Retrieved from https://www.dsfm.mb.ca/ScriptorBD/documents/713925/Budget%202015-2016%20-%20présentation%20publique%20v2%20-%2023%20février.pdf

Driscoll, M. P. (2005). *Psychology of learning for instruction* (3rd ed.). Upper Saddle River, NJ: Pearson Education.

Dyck-Hacault, G., & Alarie, R. (2010). *Teacher workload: MTS task force on teacher workload final report*. Winnipeg, MB: Manitoba Teachers' Society. Retrieved from

http://www.mbteach.org/library/archives/issues/workload/workload_report.pdf

Finlay, L. (2008). Reflecting on 'reflective practice'. Retrieved from http://www.open.ac.uk/

Éducation Manitoba. (n.d.). In *Government of Manitoba website*. Retrieved from http://www.edu.gov.mb.ca/m12/frpub/ped/sn/dmo_s2/index.html

Éducation et Enseignement supérieur Manitoba. (2016). *La langue au coeur du programme d'immersion française : Une approche intégrée dans la pédagogie immersive.* Winnipeg, MB: Le gouvernement du Manitoba représenté par le ministre de l'Éducation et de l'Enseignement supérieur.

Ewart, G. (2009). Retention of new teachers in minority French and French immersion programs in Manitoba. *Canadian Journal of Education, 32*(3), 473-507. Retrieved from http://www.jstor.org/stable/canajeducrevucan.32.3.473

French immersion surge could force changes at Winnipeg schools. (2015, February 10). Retrieved from http://www.cbc.ca/news/canada/manitoba/french-immersion-surge-could-force-changes-at-winnipeg-schools-1.2951355

Froese-Germain, B., & Riel, R. (2014). *Highlights of CTF survey on the quest for teacher work-life balance.* Ottawa, ON: Canadian Teachers' Federation. Retrieved from http://www.ctf-fce.ca/Research-Library/Work-Life-Balance-Survey-DW-CAPTO.pdf

History of the University of Manitoba. (n.d.). In *University of Manitoba website*. Retrieved from http://www.umanitoba.ca/about/history.html

Kanu, Y. (2011). *Integrating Aboriginal perspectives into the school curriculum.* Toronto, ON: University of Toronto Press.

Karsenti, T., & Collin, S. (2013). Why are new teachers leaving the profession? Results of a Canada-wide survey. *Education*, *3*(3), 141-149.

doi:10.5923/j.edu.20130303.01

Karsenti, T., Collin, S., Villeneuve, S., Dumouchel, G., & Roy, N. (2008). *Why are new French immersion and French as a second language teachers leaving the profession? Results of a Canada-wide survey*. Ottawa, ON: Canadian Association of Immersion Teachers. Retrieved from http://www.acpi.ca/documents/summary.pdf

Lewthwaite, B., Stoeber, R., & Renaud, R. (2007). Les facteurs qui influencent l'offre des sciences dans les milieux minoritaires francophones. *Canadian Journal of Science, Mathematics and Technology Education, 7*(4), 317-334. doi:10.1080/14926150709556738

English version available at: http://www.mern.ca/reports.asp?id=3

Lincoln, Y. S. & Guba, E. G. (1985). *Naturalistic inquiry*. Newbury Park, CA: Sage Publications, Inc.

Lincoln, Y. S, Lynham, S. A., & Guba, E. G. (2011). Paradigmatic contoversies, contradictions, and emerging confluences, revisited. In N. K. Denzin & Y. S. Lincoln (Eds.), *The SAGE handbook of qualitative research* (4th ed., pp. 97-128). Thousand Oaks, CA: SAGE Publications, Inc.

Lyster, R. (2016). *Vers une approche intégrée en immersion.* Montréal, Canada: Les Éditions CEC.

MacQueen, K. M., McLellan-Lemal, E., Bartholow, K., & Milstein B. (2008). Team-based codebook development: Structure, process, and agreement. In G. Guest & K. M. MacQueen (Eds.), *Handbook for team-based qualitative research* (pp. 119-35). Lanham, MD: AltaMira Press.

Manitoba Education, Training and Youth. (2001). *Senior 2 Science: Manitoba curriculum*

framework of outcomes. Winnipeg, MB: The Crown in Right of Manitoba as represented by the Minister of Education, Training and Youth.

Manitoba Education, Training and Youth. (2002). *French immersion in Manitoba.* Winnipeg, MB: The Crown in Right of Manitoba as represented by the Minister of Education, Training and Youth.

Manitoba Education and Youth. (2003). *Senior 2 Science: A foundation for implementation*. Winnipeg, MB: The Crown in Right of Manitoba as represented by the Minister of Education and Youth.

McMillan, J. H. (2012). *Fundamental of educational research* (6th ed.). Boston, MA: Pearson.

McMillan, J. H. (2016). *Fundamental of educational research* (7th ed.). Boston, MA: Pearson.

Merriam, S. B. & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation* (4th ed.). San Francisco, CA: John Wiley & Sons, Inc.

Norrie, C., Hammond, J., D'avray, L., Collington, V., & Fook, J. (2012). Doing it differently? A review of literature on teaching reflective practice across health and social care professions. *Reflective Practice, 13*(4), 565-578. doi:10.1080/14623943.2012.670628

Norton, L. (2009). *Action research in teaching and learning: A practical guide to conducting pedagogical research in universities*. New York, NY: Routledge.

Office of the Commissioner of Official Languages. (2013). *Annual report 2012 - 2013*. Ottawa: Copyright Minister of Public Works and Government Services Canada. Retrieved August 9, 2015 from http://www.ocol-clo.gc.ca/html/ar_ra_2012_13_e.php

Rivard, L. P. (2001). Summary writing: A multi-grade study of French Immersion and

Francophone secondary students. *Language, Culture and Curriculum, 14*(2), 171-186. doi:10.1080/07908310108666620

Rivard, L. P. (2009). Écrire dans les cours de sciences de la nature au secondaire : pourquoi et comment ? *Cahiers franco-canadiens de l'Ouest, 21*(1-2), 179-210. doi:10.7202/045328ar

Rivard, L. & Cormier, M. (2008). Teaching science to French-speaking students in English Canada using an instructional congruence model involving discourse-enabling strategies. *L1 Educational Studies in Language and Literature, 8*(1), 23-41. Retrieved from http://www.l1research.org

Rivard, L. P, Cormier, M., & Turnbull, M. (2012). Reading strategies in French immersion science classes: Preparing our students for tomorrow. *Canadian Journal of Science, Mathematics and Technology Education, 12*(1), 86-102. doi:10.1080/14926156.2012.649051

Rivard, L. & Gueye, N. (2015). Une formation continue en littératie destinée aux enseignants en sciences de la nature oeuvrant en situation minoritaire : que disent les divers acteurs ? *Cahier franco-canadiens de l'Ouest, 27*(1), 57-103. doi:10.7202/1031242ar

Rivard, L. P. & Straw, S. B. (2000). The effect of talk and writing on learning science: An exploratory study. *Science Education, 84*, 566-593.

Saldaña, J. (2016). *The coding manual for qualitative researchers* (3rd ed.). Thousand Oaks, CA: SAGE Publications Inc.

Schunk, D. H. (2000). *Learning theories: An educational perspective* (3rd ed.). Upper Saddle River, NJ: Prentice-Hall.

Seidman, I. (2013). *Interviewing as qualitative research: A guide for researchers in education &*

the social sciences (4th ed.). New York, NY: Teachers College Press.

Sherlock, T. (2015, April 21). Shortage of French teachers acute across B.C., report finds. *The Vancouver Sun*. Retrieved from http://www.vancouversun.com/life/Shortage+French+teachers+acute+across+report+finds/10992557/story.html

Slavin, R. E. (2015). *Educational psychology: Theory and practice* (11th ed.). Upper Saddle River, NJ: Pearson Education.

Stake, R. E. (1995). *The art of case study research.* Thousand Oaks, CA: Sage Publications, Inc.

Stoeber, R. (2012). Projet PEER: Établir une communauté virtuelle d'apprenants pour répondre aux besoins des enseignants en contexte francophone minoritaire. *Canadian Journal of Science, Mathematics and Technology Education, 12*(1), 103-120. doi: 10.1080/14926156.2012.649050

Vygotsky, L. S. (1962). *Thought and language.* (E. Hanfmann & G. Vakar, Trans.). Cambridge, MA: The Massachusetts Institute of Technology. (Original work published 1934)

Woolfolk, A. E., Winne, P. H., & Perry, N. E. (2012). *Educational psychology* (5th ed.). Upper Saddle River, NJ: Pearson Education.

Yin, R. (2014). *Case study research: Design and methods* (5th ed.). Thousand Oaks, CA: SAGE Publications.

Appendix A: Ethics Approval Certificate

UNIVERSITY OF MANITOBA | Research Ethics and Compliance
Office of the Vice-President (Research and International)

Human Ethics
208-194 Dafoe Road
Winnipeg, MB
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APPROVAL CERTIFICATE

June 7, 2016

TO: **Lauren Norquay** **(Advisor: Barbara McMillan)**
Principal Investigator
[redacted]

FROM: **Zana Lutfiyya, Chair**
Education/Nursing Research Ethics Board (ENREB)

Re: **Protocol #E2016:058 (HS19734)**
"Teaching Grade 10 Science in French Immersion Programs in Manitoba: What are Teachers' Experiences?"

Please be advised that your above-referenced protocol has received human ethics approval by the **Education/Nursing Research Ethics Board**, which is organized and operates according to the Tri-Council Policy Statement (2). **This approval is valid for one year only and will expire on June 7, 2017.**

Any significant changes of the protocol and/or informed consent form should be reported to the Human Ethics Secretariat in advance of implementation of such changes.

Please note:

- **If you have funds pending human ethics approval, please mail/e-mail/fax (261-0325) a copy of this Approval (identifying the related UM Project Number) to the Research Grants Officer in ORS in order to initiate fund setup. (How to find your UM Project Number: http://umanitoba.ca/research/ors/mrt-faq.html#pr0)**

- **If you have received multi-year funding for this research, responsibility lies with you to apply for and obtain Renewal Approval at the expiry of the initial one-year approval; otherwise the account will be locked.**

The Research Quality Management Office may request to review research documentation from this project to demonstrate compliance with this approved protocol and the University of Manitoba *Ethics of Research Involving Humans*.

The Research Ethics Board requests a final report for your study (available at: http://umanitoba.ca/research/orec/ethics/human_ethics_REB_forms_guidelines.html) **in order to be in compliance with Tri-Council Guidelines.**

Appendix B: List of Schools with French Immersion Programs in Manitoba by Division

Note: The following map from Manitoba Education was used to categorize the school divisions as either urban, rural, or northern: (www.edu.gov.mb.ca/k12/schools/schooldivmap.html)

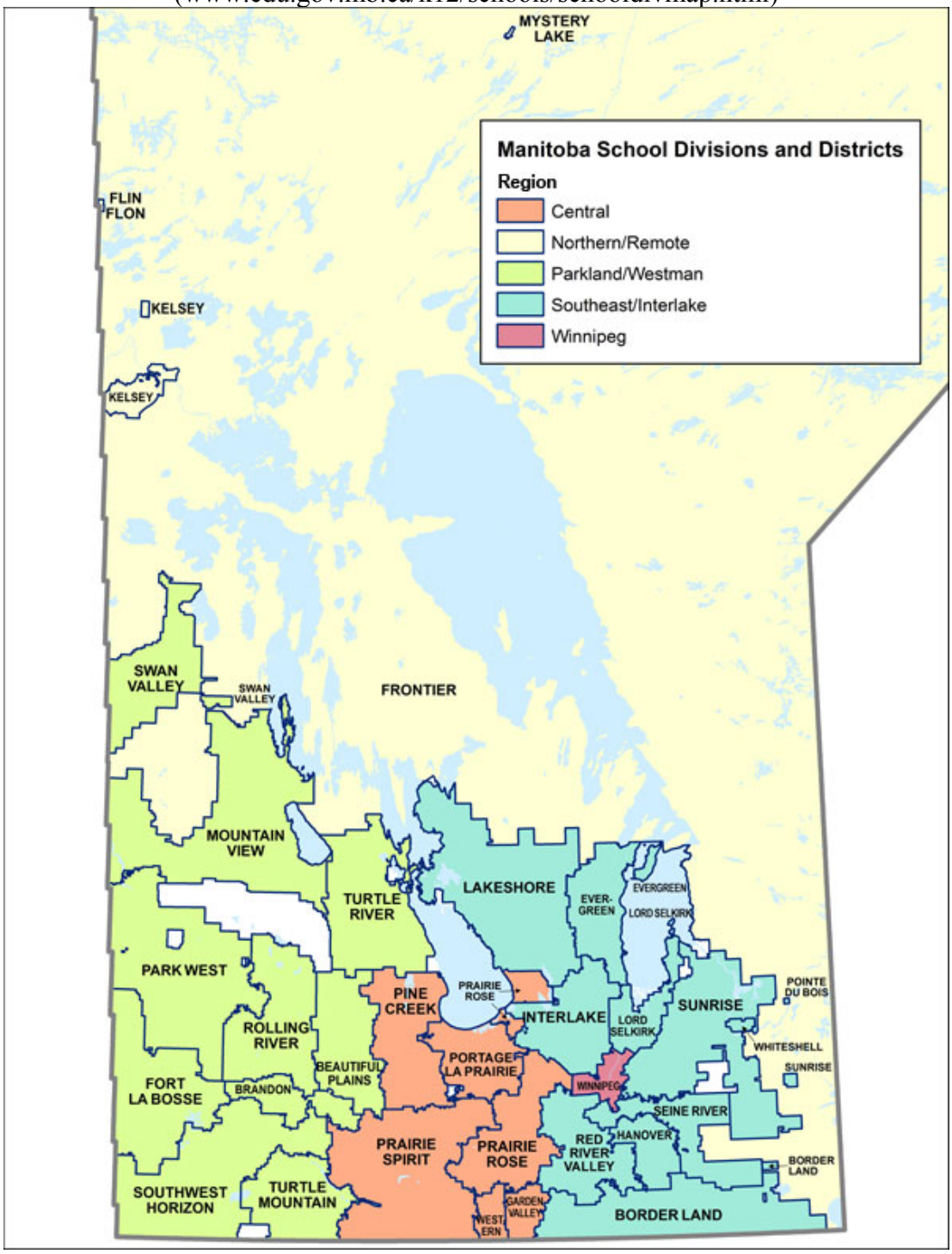

Table 5: List of urban schools with French Immersion programs in Manitoba

School Division	School(s), Grade levels, Number of Students
Louis Riel	*Collège Béliveau* 296 chemin Speers Grades 7 – 12 652 students Immersion Centre
	Collège Jeanne-Sauvé 1128 rue Dakota Grades 9 – 12 612 students Immersion Centre
Pembina Trails	*École secondaire Oak Park High School* 820 Charleswood Road Grades 9 – 12 748 students
	Institut Collégial Vincent Massey 975 Dowker Avenue Grades 9 – 12 1237 students
River East Transcona	*Collège Pierre Elliot Trudeau* 216 rue Redonda Grades 9 – 12 356 students Immersion Centre
	Institut collégial Miles Macdonell 757 Roch Street Grades 10 – 12 916 students
Seven Oaks	*Collège Garden City Collegiate* 711 Jefferson Avenue Grades 9 – 12 1363 students
St. James-Assiniboia	*Collège Sturgeon Heights Collegiate* 2665 Ness Avenue Grades 9 – 12 1182 students
Winnipeg	*Collège Churchill* (not including)
	École secondaire Kelvin High School (not including)
	École Sisler High School (not including)

Table 6: List of rural schools with French Immersion programs in Manitoba

School Division	School(s), Grade levels, Number of Students
Border Land	*Institut collégial W. C. Miller Collegiate* 181–6th St. SE, Altona Grades 9 – 12 423 students
Brandon	*École secondaire Neelin High School* 1020 Brandon Avenue Grades 9 – 12 774 students
Lord Selkirk	*École secondaire régionale Lord Selkirk Regional Comprehensive Secondary School* 221 Mercy Street, Selkirk Grades 10 – 12 1142 students
Portage la Prairie	*Institut collégial Portage Collegiate* 65–3rd Street S.W. Grades 9 – 12 1089 students
Prairie Rose	*Institut collégial Saint-Paul's Collegiate* P.O. Box 70, Elie Grades 7 – 12 181 students
Red River Valley	*Institut collégial Saint-Pierre Collegiate* Case Postale 188, St. Pierre-Jolys Grades 9 – 12 71 students
Seine River	*Collège Lorette Collegiate* 1082 Dawson Road Grades 9 – 12 490 students
	Collège Saint-Norbert Collegiate Grades 9 – 12 371 students
Sunrise	*École Edward-Schreyer School* Box 20, Beauséjour Grades 6 – 12 659 students
	École Powerview School P.O. Box 157, Powerview Grades K – 12 414 students
Swan Valley	*École secondaire régionale Swan Valley Regional Secondary School* Box 5000, Swan River Grades 9 – 12 475 students

Table 7: List of northern schools with French Immersion programs in Manitoba

School Division	School, Grade levels, Number of Students
Flin Flon	*Institut collégial Hapnot Collegiate* 115 Green Street, Flin Flon Grades 9 – 12 272 students
Kelsey	*Institut collégial Margaret-Barbour Collegiate* 429 Smith Avenue, The Pas Grades 9 -12 490 students
Mystery Lake	*Institut collégiale R. D. Parker Collegiate* 272 Thompson Drive North, Thompson Grades 9 – 12 1002 students

Appendix C: Superintendent Letter of Information

UNIVERSITY OF MANITOBA | Faculty of Education

June _, 2016

(Version française suit)

Dear [name of Superintendent],

My name is Lauren Norquay and I am a Master of Education student at the University of Manitoba.

I am conducting a study entitled ***Teaching Grade 10 Science in French Immersion Programs in Manitoba: What are Teachers' Experiences?***

This research is sponsored by the *Social Sciences and Humanities Research Council* (SSHRC) of Canada and supervised by Dr. Barbara McMillan.

I would like to invite the *[name of school division]* to participate in this study. Specifically, I am seeking your permission to approach Grade 10 French Immersion Science teachers at *[name of school(s)]*.

The purpose of this study is to understand the course development experiences of Grade 10 French Immersion Science teachers in Manitoba. The teacher participants will be providing valuable information about their teaching experiences and about potential ways in which this group of teachers could be further supported with regards to instructional resources.

I would greatly appreciate your permission to invite current and former Grade 10 French Immersion Science teachers to participate in this study, as I believe that this research will provide important insight on supporting and retaining French Immersion teachers in your Division and in Manitoba.

To participate in this study, teachers need to answer "yes" to at least one of the following questions:

1. *Are you a teacher in Manitoba who is currently teaching Grade 10 Science in a French Immersion program?*

2. *Are you a teacher who has taught Grade 10 Science in Manitoba in a French Immersion program within the last five years?*

Participants will be asked to consent to an individual interview with me, the principal investigator of this study, lasting between 60 and 90 minutes. They will also be invited to bring to the interview and explain an instructional resource of their choice that they find effectively addresses one or more of the Grade 10 Science outcomes while concurrently fostering French-language development among students.

I am kindly requesting your permission to conduct the interview at the teacher's school, either in the teacher's classroom, or in another location at the school that is reasonably private. If the school is further than approximately 250 km from Winnipeg, I would be delighted to arrange a telephone or video conference interview with the teacher.

In order to represent the voices of Grade 10 Science French Immersion teachers across Manitoba, I will seek to interview an equal number of teachers from each type of school in Manitoba (at least two teachers from each of the three types of schools – urban, rural, and northern). If more than 12 teachers express interest in participating in this study, I will select the first two teachers who respond from each of the three types of schools. If one or more of these teachers who expressed initial interest do not end up participating, I will re-contact the teachers who initially expressed interest, and who work in the type of school needed (urban, rural, or northern), in order to ask them if they would still like to participate. If more than one of these teachers (who expressed initial interest) express interest the second time, then I will choose the first teacher to respond.

Approval from the *Education/Nursing Research Ethics Board* at the University of Manitoba has been obtained (please see attached approval form). Written informed consent will be obtained from participants.

Upon request, I would be happy to provide you with the following documents: the Informed Consent form for teachers and the interview questions.

I have attached an Informed Consent form that contains additional information.

Please do not hesitate to contact me by e-mail or telephone if you have any questions.

Thank you very much for your consideration.

Sincerely,

Lauren Norquay
Master of Education student
University of Manitoba
E-mail:
Telephone:

UNIVERSITY OF MANITOBA | Faculty of Education

Le _ juin 2016

Cher *[nom du surintendant]*,

Je m'appelle Lauren Norquay et je suis étudiante à la maîtrise à l'Université du Manitoba.

Je mène une étude qui est intitulée ***Teaching Grade 10 Science in French Immersion Programs in Manitoba: What are Teachers' Experiences?***

Cette recerche est subventionnée par le *Conseil de recherches en sciences humaines* (CRSH) du Canada et supervisée par Dr Barbara McMillan.

J'aimerais inviter la *[nom de la division scolaire]* à participer à cette étude. Plus précisement, je vous demande la permission de contacter les enseignants des sciences au niveau de la 10e année au *[nom de l'école/les écoles]*.

Le but de cette étude est de comprendre les expériences de développement de cours des enseignants des sciences au niveau de la 10e année dans les programmes immersion française au Manitoba. Les enseignants qui participent contribueront de l'information importante au sujet de leurs expériences et des manières dans lesquelles ce groupe d'enseignants au Manitoba pourrait être appuyé davantage par rapport aux ressources pédagogiques.

J'apprécierais beaucoup la permission d'inviter vos enseignants (actuels et anciens) du cours de sciences au niveau de la 10e année en immersion française à participer à cette étude, car je crois que cette recherche fournira un aperçu important au sujet d'appuyer et de retenir les enseignants en immersion française dans votre Division et au Manitoba.

Afin de participer à cette étude, l'enseignant doit répondre « oui » à au moins une des questions suivantes:

1. *Est-ce que vous êtes enseignant(e) au Manitoba qui enseigne actuellement les sciences au niveau de la 10e année au Manitoba dans un programme immersion française ?*

2. *Est-ce que vous êtes enseignant(e) qui a enseigné les sciences au niveau de la 10e année dans les dernières cinq années au Manitoba dans un programme immersion française ?*

Les participants seront invités à participer à une entrevue individuelle avec moi, la chercheuse principale de l'étude, qui durera entre 60 à 90 minutes. Ils seront aussi invités à partager une ressource pédagogique de leur choix avec moi qui est efficace pour promouvoir à la fois l'apprentissage de la langue française et la compréhension scientifique.

Je vous demande chaleureusement de mèner l'entrevue dans la salle de classe de l'enseignant, ou dans une autre salle de l'école qui est raisonnablement privée. Si l'école est située plus loin qu'environ 250 km de Winnipeg, je serais ravie d'arranger une entrevue par téléphone ou par conférence-video avec l'enseignant.

Afin de représenter les voix des enseignants des sciences au niveau de la 10e année en immersion française à travers le Manitoba, je cherche à mener des entrevues avec un nombre égal d'enseignants de chaque type d'école au Manitoba (au moins deux enseignants de chacun des trois types d'écoles – urbain, rural, et du nord). Si plus que 12 enseignants sont intéréssés à participer à cette étude, je vais choisir les deux premiers enseignants qui répondent de chacun des trois types d'écoles. Si un ou plus de ces enseignants qui ont exprimé de l'intérêt ne participent pas finalement, je vais re-contacter les enseignants qui ont exprimé de l'intérêt, et qui travaillent dans le type d'école requis (urbain, rural, ou du nord), afin de leur demander s'ils aimeraient toujours y participer. Si plus qu'un de ces enseignants (qui ont exprimé de l'intérêt au début) sont intéressés la deuxième fois, je vais choisir le premier enseignant qui répond.

Cette recherche a reçu l'approbation du comité d'éthique *(Education/Nursing Research Ethics Board)* de l'Université du Manitoba (certificat d'approbation en annexe). Le consentement informé de chaque participant sera obtenu par écrit.

Sous demande, je serais ravie de vous fournir les documents suivants : la lettre de consentement pour les enseignants et les questions d'entrevues.

Vous trouverez ci-joint une lettre de consentement avec plus de renseignements.

N'hésitez pas de me contacter par courriel ou par téléphone si vous avez des questions.

En espérant une réponse favorable de votre part, je vous prie d'agréer mes sentiments distingués.

Cordialement,

Lauren Norquay
Étudiante de maîtrise
l'Université du Manitoba
Courriel:
Téléphone:

Appendix D: Teacher Letter of Information

UNIVERSITY OF MANITOBA | Faculty of Education

June 2016

(Version française suit)

Dear *(name of teacher)*,

My name is Lauren Norquay and I am a Master of Education student at the University of Manitoba. I am also a French Immersion Science teacher in Manitoba.

I am writing to you today to invite you to participate in my research project entitled ***Teaching Grade 10 Science in French Immersion Programs in Manitoba: What are Teachers' Experiences?***

Your school division gave me permission to invite you to participate in this study.

This research is sponsored by the *Social Sciences and Humanities Research Council* (SSHRC) of Canada and is supervised by Dr. Barbara McMillan.

You were contacted about this study because you are identified on your school's website as a Grade 10 French Immersion Science teacher, or one of your colleagues identified you as a current or former teacher of this course.

The purpose of this study is to understand the course development experiences of Grade 10 French Immersion Science teachers in Manitoba. By participating in this study, you will be providing valuable information about your teaching experiences and about potential ways in which this group of teachers could be further supported with regards to instructional resources.

I would greatly appreciate your participation in this study, as I believe that this research will provide important insight on supporting and retaining French Immersion teachers.

To participate in this study, you need to answer "yes" to at least one of the following questions:

1. *Are you a teacher in Manitoba who is currently teaching Grade 10 Science in a French Immersion program?*

2. *Are you a teacher who has taught Grade 10 Science in Manitoba in a French Immersion program within the last five years?*

If you accept this invitation to participate, you will be asked to consent to an individual interview with me, the principal investigator of this study, lasting between 60 and 90 minutes. I am kindly asking to conduct this interview in your classroom or in another location in your school that is reasonably private.

If your school is further than approximately 250 km from Winnipeg, I would be delighted to arrange a telephone or video conference interview with you.

You will also be invited (optional) to bring to the interview and explain an instructional resource of your choice that you find effectively addresses one or more of the Grade 10 Science outcomes while concurrently fostering French-language development among students.

If you decide to participate in this study, please be assured that you can withdraw your participation at any time and/or you can refuse to respond to certain questions simply by letting me know.

In order to represent the voices of Grade 10 Science French Immersion teachers across Manitoba, I will seek to interview an equal number of teachers from each type of school in Manitoba (at least two teachers from each of the three types of schools – urban, rural, and northern). If more than 12 teachers express interest in participating in this study, I will select the first two teachers who respond from each of the three types of schools. If one or more of these teachers who expressed initial interest do not end up participating, I will re-contact the teachers who initially expressed interest, and who work in the type of school needed (urban, rural, or northern), in order to ask them if they would still like to participate. If more than one of these teachers (who expressed initial interest) express interest the second time, then I will choose the first teacher to respond.

Approval from the *Education/Nursing Research Ethics Board* at the University of Manitoba has been obtained (please see attached approval form).

If you are possibly interested in participating, please contact me by e-mail or by telephone.

Thank you very much for your consideration.

Sincerely,

Lauren Norquay
Master of Education student
University of Manitoba
E-mail:
Telephone:

UNIVERSITY OF MANITOBA | Faculty of Education

Juin 2016

Cher/chère *(name of teacher)*,

Je m'appelle Lauren Norquay et je suis étudiante à la maitrîse à l'Université du Manitoba. Je suis aussi enseignante de sciences en immersion française au Manitoba.

Je vous écris aujourd'hui pour vous inviter à participer à mon projet de recherche intitulé ***Teaching Grade 10 Science in French Immersion Programs in Manitoba: What are Teachers' Experiences?***

Votre division scolaire m'a accordé la permission de vous inviter à participer à cette étude.

Cette recherche est subventionnée par le *Conseil de recherches en sciences humaines* (CRSH) du Canada et supervisée par Dr Barbara McMillan.

Je vous contacte au sujet cette étude parce que vous êtes identifé(e) sur le site Web de votre école comme enseignant(e) des sciences au niveau de la 10e année, ou un de vos collègues vous a identifié(e) comme enseignant(e) des sciences à ce niveau.

Le but de cette étude est de comprendre les expériences de développement de cours des enseignants des sciences au niveau de la 10e année dans les programmes immersion française au Manitoba. En participant à cette étude, vous contribuerez de l'information importante au sujet de vos expériences comme enseignant(e) de ce cours et des manières dans lesquelles ce groupe d'enseignants au Manitoba pourrait être appuyé davantage par rapport aux ressources pédagogiques.

J'apprécierais beaucoup votre participation, car je crois que vous pouvez fournir un aperçu important au sujet d'appuyer et de retenir les enseignants en immersion française.

Afin de participer à cette étude, il faut répondre "oui" à au moins une des questions suivantes:

1. *Est-ce que vous êtes un(e) enseignant(e) au Manitoba qui enseigne actuellement les sciences au niveau de la 10e année au Manitoba dans un programme immersion française?*

2. *Est-ce que vous êtes un(e) enseignant(e) qui a enseigné les sciences au niveau de la 10e année dans les dernières cinq années au Manitoba dans un programme immersion française?*

Si vous acceptez l'invitation de participer à cette étude, vous serez invité(e) à une entrevue individuelle avec moi, la chercheuse principale, qui durera entre 60 et 90 minutes.

Je vous demande chaleureusement de mèner cette entrevue dans votre salle de classe, ou dans une autre salle de votre école qui est raisonnablement privée.

Si votre école est située plus qu'environ 250 km de Winnipeg, je serais ravie d'arranger une entrevue par téléphone ou par conférence-video.

Vous serez aussi invité(e) à partager une ressource pédagogique de votre choix avec moi (facultatif) qui est efficace pour promouvoir à la fois l'apprentissage de la langue française et la compréhension scientifique.

Si vous décidez de participer à cette étude, vous serez libre de vous retirer du project à n'importe quel moment et/ou de refuser de répondre à certaines questions simplement par me laisser savoir.

Afin de représenter les voix des enseignants des sciences au niveau de la 10e année en immersion française à travers le Manitoba, je cherche à mener des entrevues avec un nombre égal d'enseignants de chaque type d'école au Manitoba (au moins deux enseignants de chacun des trois types d'écoles – urbain, rural, et du nord). Si plus que 12 enseignants sont intéréssés à participer à cette étude, je vais choisir les deux premiers enseignants qui répondent de chacun des trois types d'écoles. Si un ou plus de ces enseignants qui ont exprimé de l'intérêt ne participent pas finalement, je vais re-contacter les enseignants qui ont exprimé de l'intérêt, et qui travaillent dans le type d'école requis (urbain, rural, ou du nord), afin de leur demander s'ils aimeraient toujours y participer. Si plus qu'un de ces enseignants (qui ont exprimé de l'intérêt au début) sont intéressés la deuxième fois, je vais choisir le premier enseignant qui répond.

Cette recherche a été approuvée par le comité d'éthique (*Education/Nursing Research Ethics Board*) de l'Université du Manitoba (certificat d'approbation en annexe).

Si vous êtes possiblement intéressé(e) à participer à cette étude, je vous prie de me contacter par téléphone ou par courriel.

En espérant une réponse favorable de votre part, je vous prie d'agréer mes sentiments distingués.

Cordialement,

Lauren Norquay
Étudiante de maîtrise
l'Université du Manitoba
Courriel:
Téléphone:

Appendix E: Informed Consent Form for Teacher Participants

UNIVERSITY OF MANITOBA | Faculty of Education

Informed Consent Form for Teacher Participants

Research Project Title: *Teaching Grade 10 Science in French Immersion Programs in Manitoba: What are Teachers' Experiences?*

Principal Investigator and Contact Information:
Lauren Norquay
E-mail:
Telephone:

Research Supervisor and Contact Information:
Dr. Barbara McMillan, Associate Professor
Department of Curriculum, Teaching, and Learning
Faculty of Education, University of Manitoba
E-mail:
Telephone:

Sponsor: Social Sciences and Humanities Research Council (SSHRC)/
Conseil de recherches en sciences humaines (CRSH)

This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Purpose of this research:

The first purpose of this case study is to understand the course development experiences of Grade 10 French Immersion Science teachers in Manitoba. At this stage in the research, *course development experiences* is generally defined as a combination of:

- teachers' practices, challenges, and needs associated with obtaining and developing instructional resources for the Grade 10 Science course, and;
- teachers' experiences in integrating French-language learning into their Grade 10

Science course.

The second purpose of this case study is to develop an online instructional resources database model that holds promise in supporting Grade 10 French Immersion Science teachers in Manitoba and is based on an understanding of these teachers' course development experiences.

By participating in this study, you will be providing valuable information about your experiences and about potential ways in which Grade 10 Science teachers in French Immersion programs in Manitoba could be further supported.

Procedures:

You are asked to consent to one individual interview lasting approximately 60 to 90 minutes with the principal investigator of this study. The interviews will be held in approximately May or June 2016. The interview will be held at your school provided that you are comfortable with this location and there is a reasonably private room available. If an in-person interview is not possible, a telephone or video-conferencing interview is also an option. You can choose to be interviewed in French or English.

You are also invited to bring to the interview and explain an instructional resource of your choice that you find effectively addresses one or more of the Grade 10 Science outcomes while concurrently fostering French-language development among students. You may bring a paper copy to the interview for the principal investigator to keep or you may send it to her electronically prior to the interview.

Within one week of the interview, you will receive the transcript of your interview by e-mail that the principal investigator has transcribed in order for you to have the opportunity to review and make changes to the interview transcript if you wish. This review is estimated to take approximately 30 minutes. You are asked to return your feedback on the interview transcript to the principal investigator within one week of being sent the interview transcript. Six days after being sent the interview transcript, the principal investigator will send you an e-mail to remind you that you are welcome to provide feedback if you wish by the following day. If no feedback is received within one week of being sent the interview transcript, it will be used as written.

In order to represent the voices of Grade 10 Science French Immersion teachers across Manitoba, the principal investigator will seek to interview an equal number of teachers from each type of school in Manitoba (at least two teachers from each of the three types of schools – urban, rural, and northern). If more than 12 teachers express interest in participating in this study, the principal investigator will select the first two teachers who respond from each of the three types of schools. If one or more of these teachers who expressed initial interest do not end up participating, the principal investigator will re-contact the teachers who initially expressed interest, and who work in the type of school needed (urban, rural, or northern), in order to ask them if they would still like to participate. If more than one of these teachers (who expressed initial interest) express

interest the second time, then the principal investigator will choose the first teacher to respond.

Recording device to be used:

If you agree to participate in this study, you will be asked to give your consent to have your interview recorded using two audio recording devices (one is for back-up in the event of technological difficulties). The audio files will be uploaded to the principal investigator's computer immediately following the interview in order to maintain your confidentiality. This computer is encrypted and password-protected.

Benefits of your participation:

A potential benefit of participating in this study is the opportunity to share and reflect on your experiences teaching Grade 10 French Immersion Science in Manitoba. Additionally, by receiving the summary of this study's results, you could also gain a better understanding of your experiences, learn about other teachers' experiences, and have the opportunity to learn how your experiences compare to other teachers' experiences. An indirect benefit of participating in this study is that you are contributing to the body of research in Canada regarding teaching science in French Immersion schools and how these teachers could be further supported.

Potential risk of your participation:

This study has minimal foreseeable risk (minimal risk is defined as those risks that may be encountered in everyday life). You are not obligated to answer any questions in this study that you do not wish to answer and you are free to withdraw from the study at any time, simply by telling the principal investigator that you so wish. In the event that you may find discussing your experiences upsetting, you may withdraw from the study without consequence, and the principal investigator will provide you with contact information for services at the Manitoba Teachers' Society.

Confidentiality:

Your identity will be kept confidential. The following measures will be taken to maintain your confidentiality:

- Your interview will be audio-recorded using two audio-recording devices (one will serve as a back-up). The audio files will be uploaded to the principal investigator's encrypted, password-protected computer immediately after the interview and will subsequently be deleted from the audio-recording devices. These audio files will be saved under your pseudonym, but they will inevitably have personal identifiers (e.g., your school name). The principal investigator will be the only one with access to these audio files.
- The interviewer (the principal investigator) will transcribe the interview data on her

encrypted, password-protected computer, leaving out identifiers (e.g., your school name). Like the audio files, the file names of the interview transcripts will be the participants' pseudonyms. The audio files and the transcripts will be saved in separate folders on the principal investigator's encrypted, password-protected computer. The reference list of the participants' names and pseudonyms will also be saved in a separate folder from the audio files and transcripts. Other than the principal investigator, the individuals who will potentially have access to these anonymized interview transcripts will be the principal investigator's advisor (if requested) and the peer with whom the principal investigator will be discussing throughout her research (a graduate student in the Faculty of Education chosen in consultation with her advisor).

- Written notes will also be taken during the interviews as a precautionary measure in the unlikely event that both of the audio devices fail. After the interview, the principal investigator will scan these notes and upload them to her encrypted, password-protected computer and saved under the participant's pseudonym. Although revealing information (identifiers) will be contained in these notes, they will also be saved in a separate folder (separate from the audio files, the transcript files, and the participant name-pseudonym reference list file).
- If a printed copy of an instructional resource is provided, it will be stored in a locked filing cabinet at the principal investigator's house in a file and drawer separate from the signed consent forms. The electronic copies of the resources will be saved on her computer in a separate file from all other documents.
- Your signed Informed Consent form will be stored in a locked filing cabinet at the principal investigator's house.
- All of the electronic documents (audio files, transcripts, notes, signed electronic Informed Consent forms, reference list of the names and pseudonyms, and instructional resources) will also be backed-up on an external, password-protected hard drive). The principal investigator will be the only individual with access to this hard drive.
- All of these electronic documents (audio files, transcripts, notes, signed electronic Informed Consent forms, reference list of the names and pseudonyms, and instructional resources) will be deleted from the principal investigator's computer five years following the successful defence of her thesis (approximately January 2022). The signed Informed Consent forms, as well as any printed copies of the instructional resources provided by participants, will be destroyed (shredded and recycled) at the principal investigator's home on the same date that the interview data will be deleted from her computer.

Withdrawing from the study:

You may withdraw from this study at any time without any negative consequences

by contacting the principal investigator by e-mail, phone, or by letting her know that you wish to withdraw during the interview. If you choose to withdraw from the study, all your data will be destroyed. Specifically, the audio files of your interview, the transcript of your interview, and the scanned notes from your interview will be deleted from the principal investigator's computer, the electronic or print copy of your instructional resource will be deleted or shredded, and your electronic or print copy of this Informed Consent form will be deleted or shredded.

Debriefing:

As stated above, within one week of your interview, you will receive an e-mail from the principal investigator with the transcript of your interview if you wish to review it and provide feedback.

Dissemination of research results:

The results of this study will be available on the University of Manitoba thesis database (mspace.lib.umanitoba.ca). It is also possible that the results will be published in journals or used in presentations. The purposes of dissemination will be to contribute to the literature on teaching science in French Immersion and to increase awareness of the potential challenges of teaching in this area. The publications or presentations will be in French or English. The superintendents of the participating school divisions will also have the option to receive a brief (1-3 pages) summary of the results of this study by approximately December 2016.

Your confidentiality will be maintained in all publications and presentations. As previously mentioned, you will be assigned a pseudonym, and no revealing information will be provided in any publications or presentations. For example, a description of your school will be provided – the name of the school will not be given. In any publications or presentations, the principal investigator might include direct quotations from participants. If a direct quotation is included, a translation might also be provided for this quotation below the original.

Summary of results provided to you:

The principal investigator will provide you with a brief (1-3 pages) summary of the results of this study, if you wish, by approximately December 2016. At the end of this form, there is a space for you to indicate whether or not you would like to obtain this summary of results and, if yes, whether you would like to receive this summary by e-mail or mail.

Destruction of confidential data:

The interview audio files, interview notes, interview transcripts, any electronic copies of the Informed Consent forms, and any electronic copies of instructional resources provided by teachers will be deleted from the principal investigator's computer and external hard drive approximately January 2022. Any printed teachers' Informed Consent forms

with their signatures, as well as any printed copies of instructional resources, will be shredded and recycled approximately January 2022.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and /or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

The University of Manitoba may look at your research records to see that the research is being done in a safe and proper way.

This research has been approved by the Education and Nursing Research Ethics Board. If you have any concerns or complaints about this project you may contact any of the above-named persons or the Human Ethics Coordinator at 204-474-7122 or humanethics@umanitoba.ca. A copy of this consent form has been given to you to keep for your records and reference.

Participant's Full Name: _____

Participant's Signature: _____ Date:_____

Researcher's Signature: _____ Date:_____

Would you like to obtain a summary of the results of this study?
Please circle: **Yes** *or* **No**

If you would like to obtain a summary of the results, please provide your e-mail address OR your mailing address in the box below:

Appendix F: Teacher Interview Protocol (English and French Versions)

Research Questions and Colour-Coding Scheme:

1. How do FI science teachers describe their practices, challenges, and needs associated with obtaining and developing instructional resources for the Grade 10 Science course?
2. How do FI science teachers describe their role in fostering French-language development among their students?
3. How do FI science teachers describe their practices, challenges, and needs associated with integrating language-learning into their Grade 10 Science course?
4. How do Grade 10 FI Science teachers describe an ideal online instructional resources database that would support them in course development? For example, what online platform would best support teachers' use of this database? What kinds of instructional resources would be most useful to include in this database? What are the characteristics of an ideal online instructional resources database for Manitoba science teachers?
5. How do Grade 10 FI Science teachers describe the impacts that an online instructional resources database would have on their teaching and personal lives?

Red = Background Questions
Black = Introduction and Transitions

I would like to thank you again for participating in this study and agreeing to have this conversation with me today.
J'aimerais te remercier encore pour participer à cette étude et pour me rencontrer aujourd'hui.

Just some house-keeping items before we begin.
Il y a simplement quelques tâches routinères avant de commencer.

First, do you have any questions about the Informed Consent form?
Premièrement, est-ce que tu as des questions au sujet du formulaire de consentement informé?
[Take out a printed copy of the Informed Consent form.]

Your identity will be kept confidential, as well as any identifiers like the name of your school.
Ton identité sera confidentielle, ainsi que des informations qui compromiseraient ton identité, par exemple, le nom de ton école.

I would also like to ask your permission to audio-record our conversation, just so I can refer back to our conversation and not have to rely on note-taking during our conversation. I will use two recording devices if that's ok with you, just in case of technological difficulties. The audio recordings will be safely uploaded to my encrypted, password-protected computer

later today and will be deleted from the recording devices. I will be taking some brief notes during our conversation, just in case of the unlikely event that both audio devices fail.
J'aimerais aussi te demander la permission d'enregistrer notre conversation, simplement pour que je puisse référer directement à notre conversation, et je n'ai pas besoin de compter sur ma prise de notes pendant notre conversation. Je vais utiliser deux enregistreurs si tu es correct avec cela, au cas où il y aurait des difficultés technologiques. Les enregistrements seront mis de façon sécuritaire à mon ordinateur chiffré, qui est protégé par mot de passe. Plus tard aujourd'hui, les enregistrements seront supprimés des deux enregistreurs.

Are you ok with me audio-recording our conversation?
Est-ce que tu correct si j'enregistre notre conversation?

Do you have any [other] questions at this time?
Ok, thank you. Here is the consent form that you can sign now if you don't have any [other] questions.
Just a reminder that you can withdraw your participation in this study at any time simply by letting me know, and you can also choose not to respond to any of the questions – please let me know if I ask a question that you would like to skip.
Est-ce que tu as [des ou d'autres] questions à ce temps-ci?
D'accord, merci beaucoup. Voici le formulaire de consentement que tu peux signer si tu n'as pas [des ou d'autres] questions.
Simplement un rappel que tu peux te retirer de l'étude à n'importe quel moment simplement en me laissant savoir. Aussi, tu peux choisir de ne pas répondre à toutes les questions – s'il te plaît, laisse-moi savoir si on arrive à une question que tu aimerais sauter.

I'd like to begin with questions that will help me to learn about your teaching career, your education background, and your experience with the French language.
J'aimerais commencer avec des questions qui vont m'aider à apprendre au sujet de ta carrière en enseignement, ta formation, et ton expérience avec la langue française.

Let's begin with your teaching career.
Commençons avec ta carrière en enseignement.

For how many years have you been teaching?
Pendant combien d'années enseignes-tu?

Where have you taught?
Où as-tu enseigné?

What courses have you taught?
Quels cours as-tu enseignés?

What courses are you teaching this year?
Quels cours est-ce que tu enseignes cette année?

For how many years have you taught Grade 10 Science in French?
Pendant combien d'années as-tu enseigné le cours de Sciences 10e année en français?

How many times have you taught Grade 10 Science in French?
Combien de fois as-tu enseigné le cours de Sciences 10e année en français?

Now, I'd like to learn a little bit about your education background.
Maintenant, j'aimerais apprendre un peu au sujet de ta formation.

What schools did you attend from kindergarten through to Grade 12?
Quelles écoles as-tu fréquentées de la maternelle à la 12e année?

What university or universities did you attend?
Quelles universités as-tu fréquentées?

What did you study in university?
Qu'est-ce que tu as étudié à l'université?

Did you always plan to teach in French Immersion?
Est-ce que tu as toujours voulu enseigner en immersion française?

So now I'm interested in learning about your experience with the French language.
Alors, maintenant je suis intéréssée à apprendre au sujet de tes expériences avec la langue française.
How did you learn French?
Où as-tu appris le français?

Thank you for sharing your background with me. At this time, I'd like to transition from the background questions to ask you about your experience teaching Grade 10 Science in French and the challenges, if any, you have faced in teaching this course.
Merci beaucoup de partager tes expériences avec moi. À ce moment, j'aimerais faire une transition des questions introductoires à des questions au sujet de tes expériences à enseigner le cours de Sciences 10e année et les défis, s'il y en a, que tu as affrontés pendant l'enseignement de ce cours.

How comfortable are you with teaching Grade 10 Science in French?
Comment à l'aise est-ce que tu te sens avec l'enseignement du cours de Sciences 10e année en français?

With more experience teaching Grade 10 Science, did you become more comfortable with teaching this course? What do you think helped to increase your confidence?
Avec plus d'expérience à enseigner ce cours, est-ce que tu es devenu plus à l'aise?

Qu'est-ce que tu penses t'as aidé à rehausser ton niveau de confiance en soi?

How would you help a teacher who has never taught the Grade 10 Science course before?
Comment aiderais-tu un nouveau enseignant du cours de Sciences 10e année?

I'd now like to ask you some questions about the instructional resources that you use in the context of your Grade 10 Science course. I'm using the term "instructional resources" or simply "resources" to refer to any teaching resources, print or electronic, that you use in the context of the Grade 10 Science course. They can be used by you as the teacher or they can be used by students. For example, notes, textbooks, websites, lab manuals, assessments, etc.
Maintenant, j'aimerais te poser des questions au sujet des ressources pédagogiques que tu utilises dans le contexte de ton cours de Sciences 10e année. J'utilise le terme "ressources pédagogiques" ou simplement "ressources" pour référer à n'importe quelle ressource pour l'enseignement, imprimée ou électronique, que tu utilises dans le contexte du cours de Sciences 10e année. Elles peuvent être utilisées par toi comme enseignant, ou elles peuvent être utilisées par les élèves. Par exemple, des notes, des textes, des sites Web, des manuels de labo, des évaluations, etc.

What types of instructional resources do you use to teach your Grade 10 Science course in French?
Quelles sortes de ressources pédagogiques est-ce que tu utilises pour enseigner le cours de Sciences 10e année?

Where do you obtain resources for your Grade 10 Science course?
D'où est-ce que tu obtiens des ressources pour ton cours de Sciences 10e année?

Do you use these resources directly in your classroom? Or do you usually modify them?
Est-ce que tu utilises ces ressources directement dans ta salle de classe? Ou est-ce que tu les modifies souvent?

How difficult is it for you to find quality, classroom-ready resources online that you can use in your teaching of Grade 10 Science?
Comment difficile est-ce que c'est pour toi de trouver des ressources de qualité en ligne, prêtes pour l'usage dans la salle de classe, que tu peux utiliser pour l'enseignement de ton cours de Sciences 10e année?

What about print resources, like textbooks or teaching guides? How difficult is it for you to find quality, classroom-ready resources in textbooks or teaching guides that you can use in your teaching of Grade 10 Science?
Et des ressources imprimées, telles que des textes ou des manuels de prof? Comment difficile est-ce que c'est pour toi de trouver des ressources de qualité dans les textes ou des manuels de prof, prêtes pour l'usage dans la salle de classe, que tu peux utiliser pour l'enseignement de ton cours de Sciences 10e année?

How useful do you find textbooks or teaching guides for teaching, or for preparing to teach, your Grade 10 Science course?
Comment utile est-ce que tu trouves les textes ou les guides d'enseignement pour enseigner, ou pour préparer à enseigner, ton cours de Sciences 10e année?

Do you usually modify the resources that you pull from these print resources before using them with students?
Est-ce que tu modifies souvent les ressources que tu tires de ces ressources imprimées avant de les utiliser avec les élèves?

How do you modify these resources?
Comment est-ce que tu modifies ces ressources?

Do you use any Manitoba Education resources for your Grade 10 Science course? Which ones?
Est-ce que tu utilises des ressources de l'Éducation Manitoba pour ton cours de Sciences 10e année? Lesquelles?

How do you use these resources from Manitoba Education?
Comment est-ce que tu utilises ces ressources de l'Éducation Manitoba?

How useful or helpful do you find these Manitoba Education resources?
Comment utile est-ce que tu trouves ces ressources de l'Éducation Manitoba?

Have your colleagues played a role in the instructional resources that you use in your Grade 10 Science course? How do you describe this role?
Est-ce que tes collègues ont joué un rôle par rapport aux ressources pédagogiques que tu utilises dans ton cours de Sciences 10e année? Comment décrirais-tu ce rôle?

Have you played a role in the resources that your colleagues use in their Grade 10 Science course?
Est-ce que tu as joué un rôle par rapport aux ressources que tes collègues utilisent dans leur cours de Sciences 10e année?

What challenges, if any, have you faced with regards to obtaining and/or developing instructional resources for Grade 10 Science?
What challenges do you currently face?
Quels défis, s'il y en a, as-tu affrontés par rapport à obtenir et/ou à développer des ressources pédagogiques pour le cours de Sciences 10e année?
Quels défis est-ce que tu affrontes actuellement?

What do you think helped you (or could help you) to overcome these challenges?
Qu'est-ce que tu penses t'a aidé (ou pourrait t'aider) à surmonter ces défis?

Do you ever develop your own instructional resources to teach your Grade 10 Science course?
Est-ce que tu développes tes propres ressources pédagogiques pour enseigner ton cours de Sciences 10e année?

Do you find that developing your own instructional resources to teach your Grade 10 Science course challenging?
Est-ce que tu trouves que développer tes propres ressources pédagogiques pour enseigner ton cours de Sciences 10e année est difficile?

What about the time needed to develop your own instructional resources? Do you find this process time-consuming?
Et le temps nécessaire pour développer tes propres ressources pédagogiques? Est-ce que tu trouves que ce processus prend beaucoup de temps?

Can you explain to me how you develop your own resources? What is your process?
Est-ce que tu peux m'expliquer comment tu développes tes propres ressources? Quel est ton processus?

How would you describe your needs, if any, with regards to obtaining and developing instructional resources for Grade 10 Science?
Comme décrirais-tu tes besoins par rapport à obtenir et à développer des ressources pédagogiques?

How would you describe your needs with regards to obtaining and developing instructional resources when you taught Grade 10 Science for the first time?
Comment décrirais-tu tes besoins par rapport à obtenir et à développer des ressources pédagogiques quand tu as enseigné les Sciences 10e année pour la première fois?

Thank you for helping me to understand how you obtain and develop resources for your Grade 10 Science course. At this time, I'd like to learn about your views on the role of a French Immersion science teacher in terms of helping Grade 10 students improve their French-language abilities.
Merci beaucoup de m'aider à comprendre comment tu obtiens et développes des ressources pour ton cours de Sciences 10e année. Maintenant, j'aimerais apprendre au sujet de tes opinions sur le rôle d'un enseignant de sciences en immersion française en ce qui concerne aider les élèves de 10e année à améliorer leurs compétences en français.

First, what do you think are the differences between teaching science in French Immersion compared to teaching science in English?
Premièrement, qu'est-ce que tu penses sont les différences entre enseigner les sciences en immersion française comparé à enseigner les sciences en anglais?

As a French Immersion science teacher, what role, if any, do you think you have in fostering students' French-language development?

Comme enseignant de sciences en immersion française, quel rôle est-ce que tu penses que tu joues par rapport à promouvoir le développement de la langue française chez les élèves?

How do you think your French Immersion science colleagues would describe their role in fostering students' French-language development?
Comment penses-tu que tes collègues, qui enseignent les sciences en immersion française, décriraient leur rôle par rapport à promouvoir le développement de la langue française chez les élèves?

What do you do, if anything, to foster French-language development among your Grade 10 Science students?
Qu'est-ce que tu fais pour promouvoir le développement de la langue française chez les élèves de sciences au niveau de la 10e année?

What do you think are the challenges with explicitly integrating language-learning into your Grade 10 Science course?
Or, in other words, what do you think are the challenges associated with helping students to improve their abilities in French in your Grade 10 Science class?
Que penses-tu sont les défis associés à l'intégration explicite de l'apprentissage de la langue dans ton cours de Sciences 10e année?
Ou, en d'autres mots, que penses-tu sont les défis associés à aider les élèves à améliorer leurs compétences en français dans ta classe de Sciences 10e année?

What instructional resources do you use, if any, to help students to improve their abilities in French in Grade 10 Science?
Quelles ressources pédagogiques est-ce que tu utilises pour aider les élèves à améliorer leurs abilités en français en Sciences 10e année?

How would you describe your needs with regards to obtaining and developing instructional resources that foster French language-learning among students?
Comment décrirais-tu tes besoins par rapport à obtenir et à développer des ressources pédagogiques qui promeuvent le développement de la langue française chez les élèves?

At this time, I'd like to invite you to share the resource that you brought with you.
À ce temps-ci, j'aimerais t'inviter à partager la ressource que tu as apportée avec toi.

What can you tell me about your resource? Where did you obtain this resource?
Qu'est-ce que tu peux me raconter au sujet des ta ressource?
D'où as-tu pris cette ressource?

How do you think that using this resource fosters French-language development among students?
Comment est-ce que tu penses qu'utiliser cette ressources promeut le développement de la langue française chez les élèves?

Thank you for sharing your resource and your valuable insight into your role as a French Immersion science teacher. At this time, I'd like to learn about your experiences with technology.
Merci de partager ta ressource et ton aperçu important par rapport à ton rôle comme enseignant de sciences en immersion française.
Maintenant, j'aimerais apprendre au sujet de tes expériences avec la technologie.

What software programs do you use in the context of your Grade 10 Science course?
Quels programmes à l'ordinateur est-ce que tu utilises dans le contexte de ton cours de Sciences 10e année?

What about your science colleagues, do you know what software programs they use for their Grade 10 Science course?
Et tes collègues de sciences, est-ce que tu sais quels programmes à l'ordinateur qu'ils utilisent pour leurs cours de Sciences 10e année?

What equipment do you use to teach your Grade 10 Science lessons? Whiteboard? Overhead projector? Interactive whiteboard technology?
Quel équipment est-ce que tu utilises pour enseigner tes leçons en Sciences 10e année? Le tableau? Le rétro? Le tableau blanc intéractif?

Why do you use this (these) equipment?/What do you like about using this (these) equipment?
Pourquoi utilises-tu cet (ces) équipement?/Qu'est-ce que tu aimes au sujet d'utiliser cet (ces) équipement?

How confident are you in using interactive whiteboard technology?
Comment à l'aise es-tu avec l'utilisation du tableau blanc intéractif?

How or why do you use the Internet in the context of your Grade 10 Science course?
Comment ou pourquoi est-ce que tu utilises l'Internet dans le context de ton cours de Sciences 10e année?

Do you and your colleagues ever use the Internet to share resources? How?
Est-ce que tes collègues et toi utilisez l'Internet pour partager les ressources? Comment?

What challenges associated with resource-sharing have you faced, if any?
Quels défis liés au partage de ressources est-ce que tu as affrontés?

Now, I would like to get your thoughts on the idea of a collection of resources available online to Grade 10 French Immersion Science teachers in Manitoba.
Maintenant, j'aimerais demander ton avis au sujet de l'idée d'une collection de ressources disponible en ligne pour les enseignants du cours de Sciences 10e année en immersion française au Manitoba.

If there were a collection of resources available online to support Grade 10 French Immersion Science teachers, a resource database, how do you picture this resource database?
S'il y avait une collection de ressources disponible en ligne pour appuyer les enseignants des sciences au niveau de la 10e année en immersion française, comment est-ce que tu imagines cette collection de ressources en ligne?

What do you think would be the characteristics or features of an ideal online resource database?
Que penses-tu seraient les charactéristiques d'une collection de ressources en ligne idéale?

What types of resources do you think would be the most useful or valuable to include in an online resource database developed for Grade 10 French Immersion Science teachers?
Quelles sortes de ressources est-ce que tu penses seraient les plus utiles à inclure dans une collection de ressources en ligne développée pour les enseignants du cours de Sciences 10e année en immersion française?

Do you think that you would use this kind of online resource database?
Penses-tu que tu utiliserais une telle collection de ressources en ligne?

How do you think you would use this kind of online resource database?
Comment prévois-tu utiliser une telle collection de ressources en ligne?

How do you think having access to this kind of online resource database would impact your teaching?
Comment penses-tu qu'avoir accès à une telle collection de ressources en ligne affecterait ton enseignement?

Do you think that there would be any challenges to using this kind of online resource database?
Penses-tu qu'il y aurait des défis associés à l'utilisation d'une telle collection de ressources en ligne?

That was the last question! Thank you very much for your responses.
Do you have any information that you would like to add?
Cela était la dernière question! Merci beaucoup de tes réponses.
Est-ce qu'il y a de l'information que tu aimerais ajouter?

Thank you very much again for taking the time to speak with me today. I greatly appreciate your time, and learning about your experiences was very interesting for me. Thank you for sharing your valuable insight.
Merci beaucoup encore d'avoir pris le temps de parler avec moi aujourd'hui. J'apprécie énormément ton temps, et apprendre au sujet de tes expériences était très intéressant pour moi. Merci beaucoup de partager ton aperçu important.

You will receive an e-mail from me within one week of today that will contain the transcript of this interview, with your name and identifiers removed, for you to review if you wish. You are kindly asked to return your feedback within one week of being sent the transcript. Six days from when you receive the transcript, I will e-mail you to remind you that you are welcome to provide feedback if you wish by the next day. If no feedback is received within one week of being sent the transcript, it will be used as written.
Tu vas recevoir un courriel de moi à l'intérieur d'une semaine qui va contenir la transcription de cette entrevue, avec ton nom et mots identifieurs enlevés, pour que tu puisse la revoir si tu veux. Je te demande chaleureusement de m'envoyer ta rétroaction à l'intérieur d'une semaine après que je t'ai envoyé la transcription. Six jours après que tu as reçu la transcription, je vais t'envoyer un courriel pour te rappeler que tu es bienvenu de donner ta rétroaction si tu veux par le jour suivant. Si aucune rétroaction est reçue à l'intérieur d'une semaine après avoir reçu la transcription, elle sera utilisée comme écrite.

Do you have any questions?
Est-ce que tu as des questions?

If you have any questions after we leave today, please do not hesitate to contact me. You have my e-mail and phone number on the Informed Consent form, which I sent to you by e-mail, but here is a printed copy for you as well.
Si tu as des questions après que nous partons aujourd'hui, s'il te plaît n'hésite pas de me contacter. Tu as mon courriel et mon numéro sur le formulaire de consentement, que je t'ai envoyé par courriel, mais voici une copie imprimée pour toi aussi.

Thank you very much again for your time today.
Merci beaucoup encore de ton temps aujourd'hui.

Appendix G: Detailed Results Tables

Table 8: How do FI science teachers describe their practices associated with obtaining and developing instructional resources for the Grade 10 Science course?

Categories and codes	Participants
A.01: Teachers use a variety of types of instructional resources.	
A.01.01: Notes (*Microsoft Word* or *PowerPoint* documents)	Mike Sophie Renée Paul John Michelle
A.01.02: Textbooks (mainly *Omnisciences 10*)	Mike Sophie Renée Paul John Michelle
A.01.03: Websites (NOT including videos) (e.g., simulations/virtual experiments, animations, Google Earth)	Sophie Renée John Michelle
A.01.04: Videos (including videos on websites and videos not obtained on websites [e.g., DVD]).	Mike Sophie Renée John Michelle
A.01.05: Assessments (e.g., assignments, quizzes, tests, projects) *Note: While "activities" and "experiments" could also be considered forms of "assessment," they are given their own category.*	Mike Sophie Renée Paul John Michelle
A.01.06: Activities or experiments	Mike Sophie Renée Paul John Michelle
A.01.07: Articles (including magazine articles or articles available online)	Sophie Paul
A.02: Teachers obtain instructional resources from a variety of sources.	
A.02.01: Teachers develop their own resources	Mike

	Sophie Renée Paul John Michelle
A.02.02: Colleagues	Mike Sophie Renée Paul John Michelle
A.02.03: Textbooks (mainly *Omnisciences 10*) or teachers' guides (accompanying textbooks)	Mike Sophie Renée Paul John Michelle
A.02.04: Websites	Mike Sophie Renée Paul John Michelle
A.02.05: Government curriculum support documents (mainly the *Senior 2 Science: A Foundation for Implementation* document)	Mike Sophie Renée Paul Michelle
A.02.06 Magazines or newspapers	Sophie
A.03: Teachers use a variety of software programs in the context of their Grade 10 Science course.	
A.03.01: *Microsoft Word*	Mike Sophie Renée John Michelle
A.03.02: *Microsoft PowerPoint*	Mike Sophie Renée Paul Michelle
A.03.03: *Microsoft Excel*	Renée
A.03.04: *Notebook* software (the SMART Technologies software)	Mike Renée Sophie

A.03.05: Motion sensor program	Michelle
A.03.06: Movie maker program	Michelle
A.04: Teachers use a variety of lesson delivery equipment.	
A.4.01: *SMART Board*	Mike Renée Michelle
A.4.02: Whiteboard	Sophie Renée John Michelle
A.4.03: *SMART Podium*	Sophie
A.4.04 Video (computer) projector	Sophie John
A.05: Teachers will often modify the resources that they obtain from various sources.	
A.05.01: Teachers will modify a resource because it needs be translated from English to French.	Sophie Renée Paul John Michelle
A.05.02: Teachers will modify a resource because they feel that the language used in the resource needs to be simplified.	Mike Sophie John
A.05.03: Teachers will modify a resource in order for it to suit their students or their teaching style.	Sophie Renée Paul John
A.05.04: Teachers will modify a resource in order it to match with what they taught (or to match with the curriculum).	John
A.05.05: Teachers will modify a resource in order for it to align with the school division's priorities.	Sophie
A.05.06: Teachers will modify a resource in order for it to suit their particular situation (e.g., equipment available, preparation time that they have, class size).	Renée Paul
A.05.07: Teachers will modify a resource to make corrections to the French language.	Renée
A.05.08: Teachers stated that they modify resources, but no reason provided for the example given.	Mike Renée
A.06: Teachers spend a substantial amount of time outside of the school day obtaining or developing resources, especially early in their career or when teaching a course for the first time.	Mike Sophie John Michelle

A.07.: Teachers are not currently integrating Aboriginal perspectives throughout their Grade 10 French Immersion Science course.	
A.07.01: Teachers are not currently integrating Aboriginal perspectives because they do not know how or resources to do so are not something that they "hear of" or "see."	Mike Renée John
A.07.02: Teachers have attended professional development about integrating Aboriginal perspectives, but have not yet integrated the perspective into their French Immersion science course (either they have not been able to or have not looked for resources yet).	Mike Sophie John
A.07.03 Teachers do not feel that integrating Aboriginal perspectives has a "place" in all the units.	Paul
A.07.04: Teachers express interest in integrating Aboriginal perspectives into their Grade 10 Science course.	Mike Sophie Renée Paul John Michelle
A.08: Teachers work with colleagues on course development.	
A.08.01: Teachers in this study seek support from colleagues for course development.	Mike Sophie Renée Paul John Michelle
A.08.02: Teachers in this study share, or are open to sharing, their resources with colleagues.	Mike Sophie Renée Paul John
A.08.03: Teachers in this study discuss, or are open to discussing, with their colleagues to share their course development ideas and strategies.	Mike Sophie Renée Paul Michelle
A.08.04: Teachers in this study try to have some consistency within their courses among colleagues in their school or collaborate in course development.	Sophie Renée Paul Michelle
A.09: Teachers' course development practices evolve over time.	
A.09.01: Teachers express interest in expanding or modifying their course development practices.	Mike Sophie Renée Paul Michelle

	John
A.09.02: Teachers have expanded or modified their course development practices or beliefs.	Mike Sophie Renée Paul Michelle John
A.10: Not all teachers teach all four clusters in the Grade 10 Science curriculum (or place equal importance on all four clusters).	
A.10.01: Teachers emphasize the importance of the *Chemistry in Action* and *In Motion* clusters.	Sophie John Michelle
A.10:02: Teachers do not teach (all of) the *Weather Dynamics* cluster due to class time constraints.	Sophie Renée John Michelle
A.11: Teachers consider various student-related factors in course development.	
A.11.01: Teachers consider students' needs and abilities in course development.	Mike Sophie Renée Paul Michelle
A.11.02: Teachers consider the size of the class in course development.	Sophie Renée

Table 9: How do FI science teachers describe their challenges associated with obtaining and developing instructional resources for the Grade 10 Science course?

Categories and codes	Participants
B.01: Lack of instructional resources	
B.01.01 Lack of resources or classroom-ready resources (stated generally)	Mike Sophie Renée Michelle
B.01.02: Lack of resources in French (or less resources available in French compared to in English)	Mike Sophie Renée Paul John Michelle
B.01.03: Lack of (readily-available) resources at the appropriate French level	Sophie Renée

	Paul
B.01.04: Lack of resources that align with the Manitoba curriculum	Mike Sophie Renée
B.01.05: Lack of (readily-available) resources that incorporate different perspectives (e.g., Aboriginal perspectives)	Renée
B.01.06: Lack of updated textbook that aligns with the Manitoba curriculum	Renée
B.01.07: Lack of resources that support distance learning	Michelle
B.02: Time constraints and commitments	
B.02.01 Lack of time (stated generally)	Mike Sophie Renée Paul Michelle
B.02.02: Time to go through the resources that are available (spending time searching for resources)	Mike Sophie Renée Paul Michelle
B.02.03: Time to develop resources (time-consuming nature of developing resources)	Mike Sophie Renée Paul John Michelle
B.02.04: Time to translate resources and/or to ensure quality of French while developing resources	Mike Sophie Renée Paul Michelle
B.02.05: Time constraints due to course load (lack of consistency in course load, challenging course load, time needed to prepare for other courses)	Renée Paul John Michelle
B.02.06: Time constraints due to other demands of teaching (e.g., marking, helping students at lunch, mentoring new teachers, coaching)	Paul Michelle
B.02.07: Time constraints due to family/personal commitments	Renée Michelle
B.03: Challenges related to collaboration and professional development	
B.03.01: Lack of professional development opportunities	Sophie Renée

B.03.02: Negative experiences with past professional development sessions (hesitant to attend other PD sessions)	Mike
B.03.03: Lack of time to meet with colleagues (other teachers and coordinators)	Mike Sophie Renée
B.03.04: New teachers not wanting to ask (or not feeling comfortable asking) experienced teachers for their resources (or feeling that they need to be independent/trying to be independent)	John Michelle
B.03.05: Lack of French Immersion colleagues	Sophie Michelle
B.03.06: Teachers not wanting to share their resources (or not feeling happy about sharing their resources)	Renée Paul John
B.04: Challenges related to the curriculum and curriculum support documents	
B.04.01: Lack of updated Grade 10 Science provincial curriculum in French	Renée Paul Michelle
B.04.02: Lack of awareness of Grade 10 Science curriculum support documents available from Manitoba Education	Mike Sophie Renée Michelle
B.04.03: Difficulty obtaining documents from Manitoba Education	Sophie
B.04.04: Lack of detail in Grade 10 Science French-language curriculum document (compared to English curriculum document or in general)	Renée Michelle
B.05 Challenges related to addressing all the curricular outcomes and to preparing students for future science courses	
B.05.01: Challenges with course development time management (e.g., knowing how much time to spend on each concept or unit, planning ahead)	Renée John
B.05.02: Challenges associated with having enough to time teach the entire curriculum (or deciding what outcomes to leave out)	Paul Michelle John Sophie Renée
B.05.03: Challenges associated with the desire or the need to do the same activities as colleagues	Michelle
B.05.04: Challenges associated with ensuring students are prepared for future science courses	Sophie Michelle
B.05.05: Challenges associated with ensuring the quality of resources (“making sure that they meet the expectations”)	John

B.06: Other challenges	
B.06.01: Challenges associated with ensuring quality of written French in teacher-developed resources	Mike John Michelle Renée
B.06.02: Challenges related to a lack of content knowledge (including regarding experiments)	Mike Renée John Michelle
B.06.03: Source of stress, teachers feeling "overwhelmed," or teachers get "tired"	Mike Sophie John Michelle
B.06.04: Challenging nature of developing (or translating) resources (stated generally)	Mike Sophie Renée John
B.06.05: Administration not understanding that French Immersion teachers' needs are unique (different than English-program teachers)	Sophie
B.06.06: Challenges associated with organizing resources	Sophie
B.06.07: Challenges associated with making the teacher-developed resources "nice"	Sophie
B.06.08: Challenges associated with uncertainty in course load	John
B.06.09: Cost of books	Paul

Table 10: How do FI science teachers describe their needs associated with obtaining and developing instructional resources for the Grade 10 Science course?

Categories and codes	Participants
C.01: Increased availability of instructional resources	
C.01.01: More classroom-ready resources (stated generally) or more (readily-available) resources in French or more resources that align with the Manitoba curriculum	Mike Sophie Renée Paul Michelle
C.01.02: More (readily-available) resources at the appropriate French level	Sophie Renée
C.01.03: More (readily-available) resources that incorporate different perspectives (e.g., Aboriginal perspectives)	Mike Renée Paul Michelle
C.01.04: (New) textbook that aligns with the Manitoba curriculum	Sophie Renée
C.01.05: A variety of activities that pertain to the same learning outcome (or group of outcomes)	Mike

C.01.06: More articles (current events, world issues) that relate to the curriculum	Mike
C.01.07: More resources at a variety of reading levels	Mike
C.01.08: More resources that support distance learning	Michelle
C.02: Needs related to time constraints and opportunities for collaboration and professional development	
C.02.01: More time to find or develop resources (e.g., increased preparation time)	Mike Sophie Michelle
C.02.02: More time or opportunities to meet with French Immersion colleagues (immediate colleagues and colleagues from other schools, as well as the coordinator – if applicable)	Mike Sophie
C.02.03: More quality professional development opportunities specifically for French Immersion high school teachers	Mike Renée
C.03: Needs related to the accessibility of provincial curriculum documents and curriculum support documents	
C.03.01: Updated provincial curriculum in French (and support documents)	Renée Michelle
C.03.02: Improved means of being informed of resources available from Manitoba Education	Renée
C.04: Other needs	
C.04.1: Money (stated generally or government money to develop resources)	Mike Sophie

Table 11: How do FI science teachers describe their practices associated with integrating language-learning into their Grade 10 Science course?

Categories and codes	Participants
D.01: Teachers model and encourage French-language use in all verbal communication (subject matter related and non-subject matter related).	
D.01.01: Teachers encourage students to speak in French (e.g., with the teacher, amongst each other).	Mike Sophie Renée Paul Michelle
D.01.02: Teachers speak French with their students (e.g., during class time, outside of class time.)	Mike Renée Michelle
D.01.03: Teachers share their personal experiences with the French language with their students, act as models, and/or show their passion for the French language.	Renée Paul Michelle

D.02: Teachers use various language-development strategies.	
D.02.01: Teachers explicitly teach vocabulary.	Mike Sophie Renée Paul John Michelle
D.02.02: Students engage in speaking (discussion) activities in the course.	Mike Sophie Renée Paul John Michelle
D.02.03: Students engage in writing activities in the course.	Mike Sophie Renée Paul John Michelle
D.02.04: Students engage in reading activities in the course.	Mike Sophie Paul John Michelle Renée
D.02.05: Students watch videos in French related to the subject matter (when available).	Mike Sophie Renée Michelle
D.02.06: Teachers will sometimes teach a French grammar lesson during science class.	Mike Sophie Renée
D.02.07: Teachers encourage students to use a dictionary (online or print).	Renée John
D.02.08: Teachers teach reading comprehension strategies.	Mike Paul John
D.02.09: Students answer listening-comprehension questions (while watching a video).	Sophie
D.02.10: Teachers evaluate the students' written French.	Sophie

Table 12: How do FI science teachers describe their challenges associated with integrating language-learning into their Grade 10 Science course?

Categories and codes	Participants
E.01: Challenges associated with integrating language-learning	

experienced during course development	
E.01.01: Lack of (readily-available) instructional resources	Mike Sophie Renée John
E.01.02: Teachers' lack of knowledge of strategies	Mike John
E.01.03: Lack of time for teachers to organize field trips	Renée
E.01.04: Teachers feeling that they "focus more on the content specifically of the course" rather than the French language-learning	John
E.01.05: Teachers feeling that they need to prepare students for future science courses (future courses in general or future courses in English)	John Michelle
E.01.06 Lack of time to plan or to develop resources	Sophie
E.02: Challenges associated with integrating language-learning experienced in the classroom	
E.02.01: Challenges associated with students speaking English (and/or challenges associated with encouraging students to speak in French)	Mike Sophie John
E.02.02: Getting all students involved in class discussions	Mike John
E.02.03: Lack of student motivation or students feeling discouraged (or frustrated) (e.g., if they are having trouble expressing themselves)	Mike Renée Michelle
E.02.04: Level of French knowledge of the teacher (e.g., struggles with vocabulary in French)	Mike
E.02.05: Class time constraints (e.g., having a curriculum to "cover") or the challenge of the time needed to integrate language-learning	Mike Sophie Paul John
E.02.06: Students not viewing language-learning as important (or part of) Science class	Renée
E.02.07: Lack of student resources (e.g., for projects)	Renée Paul
E.02.08: Francophone teachers not fully understanding the language learning struggles of French Immersion students	Sophie
E.03: Challenges associated with integrating language-learning experienced at the school level	
E.03.01: Lack of French use in the school (for dual-track schools)	Sophie Renée
E.03.02: Lack of French course options for students	Sophie
E.03.03: Teachers not being on the same page (in terms of integrating language-learning in the content areas)	Mike

E.04: Challenges associated with integrating language-learning experienced beyond the school-level	
E.04.01: Lack of parental support	Renée
E.04.02: Lack of French use in the community	Sophie
E.04.02: Lack of availability of guest speakers (or outside activities) in French	Renée

Table 13: How do FI science teachers describe their needs associated with integrating language-learning into their Grade 10 Science course?

Categories and codes	Participants
F.01 Teachers' needs associated with integrating language-learning into their Grade 10 Science course	
F.01.01 More (readily-available) instructional resources (or time to prepare resources)	Sophie Renée Paul John Michelle
F.01.02 More knowledge on how to integrate language-learning or professional development opportunities	Mike Paul
F.01.03 Time to meet with French Immersion colleagues in the school about how to integrate language learning	Mike
F.01.04 More guest speakers available who speak French	Renée

Table 14: How do Grade 10 FI Science teachers describe an ideal online instructional resources database (collection of resources) that would support them in course development?

Categories and codes	Participants
G.01: General features of online collection of resources	
G.**0**1.01: Easy-to-use (easy-to-navigate) (user-friendly)	Mike John
G.01.02: Modifiable (editable) resources	Mike Sophie Renée Paul John Michelle
G.01.03: Current resources (updated regularly)	Mike Sophie Renée Michelle
G.01.04: Website platform (dedicated website)	Mike John Michelle
G.01.05: Includes resources that incorporate various perspectives	Sophie Renée

G.01.06: Includes resources that foster language-learning	Mike Sophie
G.01.07: Contains relevant resources (e.g., related to Manitoba and/or Canada)	Renée
G.01.08: Includes a variety of activities for the same outcome (or group of outcomes)	Mike
G.02: Specific types of French-language resources to include in collection	
G.02.01: Videos	Mike Sophie Renée Paul John Michelle
G.02.02: Activities or experiments	Mike Sophie Renée Paul John Michelle
G.02.03: Assessments or assessment tools (e.g., assignments, quizzes, tests, projects, rubrics)	Mike Sophie Renée Paul John Michelle
G.02.04: Student notes	Renée Paul John Michelle
G.02.05: Readings (e.g., articles, world issues)	Mike Renée Paul John Michelle
G.02.06: Websites (including simulations/virtual experiments)	Sophie Renée Michelle
G.02.07:: Teacher notes (teacher background information)	Renée Michelle
G.02.08: Classroom discussion guides	Mike
G.02.09: Ideas for field trips	Mike
G.03: Organization of collection of instructional resources	
G.03.01: Organized by unit and curricular outcome (or group of	Mike

curricular outcomes)	Sophie Renée Michelle
G.03.02: Organized by type of resource (e.g., notes, activities, assessments)	Mike Sophie

Table 15: How do Grade 10 FI Science teachers describe the impacts that an online instructional resources database would have on their teaching and personal lives?

Categories and codes	Participants
H.01: The collection of resources would allow teachers to spend more time on other aspects of teaching (and less time on creating resources).	
H.01.01: More time/save time (stated generally) or make the teacher more efficient	Mike Sophie Renée Paul John Michelle
H.01.02: More time to focus on individual student needs.	John
H.01.03: More time to plan in general or more time to plan the lesson delivery.	Paul Michelle
H.01.04: More time to spend on assessing students' progress (or planning assessment).	Paul John Michelle
H.02: Other positive impacts of the collection of resources on teachers' practices.	
H.02.01: The teacher would learn new ideas.	Sophie Renée John
H.02.02: The collection of resources would help the teacher with organization/help the teacher to ensure that the curricular outcomes have been addressed.	Michelle
H.02.03: The teacher would be more confident at the start of his/her career.	Renée
H.02.04: The collection of resources would help the teacher improve his/her practice.	Paul
H.03: The collection of resources would have a positive impact on teachers' personal lives.	
H.03.01: Improve the teacher's work-life balance (generally stated).	Sophie Michelle
H.03.01.01: More time for family or friends.	Michelle
H.03.01.02: More time to sleep.	Michelle
H.03.01.03: More time to pursue personal interests.	Michelle
H.03.02: Reduce the teacher's stress level (or the teacher would be	Mike

or would have been less overwhelmed).	Renée John Michelle
H.03.03: Teacher would be happier.	Mike
H.03.04: Help out new teachers or teachers who are teaching a course for the first time.	Renée John