

Designing Instrument for Science Classroom
Learning Environment in Francophone Minority Settings: Accounting for Voiced
Concerns among Teachers and Immigrant/Refugee Students

By

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Abstract

This study addressed the educational transition of new immigrant and refugee francophone students and the reflections and practices of their teachers in science classrooms within the Division scolaire franco-manitobaine (DFSM), a school division in central Canada. Based upon an understanding of these experiences, the study focused, ultimately, on developing a Learning Environment instrument that sought to provide an accurate portrait of the cultural, linguistic, social and physical dimensions of classrooms in which new immigrant/refugee francophone students are located. The study used a multi-phase mixed-method research approach to explore the learning experiences of immigrant/refugee students, their teachers, and the influences on student learning and integration into science classrooms within the DSFM. Following the orthodoxy of Learning Environment Research questionnaire development process (Fraser, 1994, 2009; Lewthwaite, 2001), this study was organized into three phases. The first phase was richly qualitative focusing on eliciting 16 new immigrant students' views on factors influencing their engagement, learning and overall transition into science classrooms and eight teachers' views on their teaching effectiveness for supporting the transition of immigrant students. It also included a literature review on influences on students' learning and teachers' teaching practices in such contexts. In the second phase, the data from the qualitative phase were used to develop a learning environment instrument. The development of the instrument involved the use of a focus group, followed by a large-scale statistical validation process involving 84 teachers using principal component,

discriminant and pattern matrix analysis. The final phase of the study involved the application of the instrument in two of the schools wherein teachers and students had previously been involved in the qualitative phase. This phase assisted in determining whether the data obtained from teachers' completion of the instrument corresponded with the data from the initial qualitative phase. The end-result of this three phase process is the *Instrument for Minority Immigrant Science Learning Environment*, an 8-scale, 32-item instrument that when completed by teachers gives a somewhat superficial but overall accurate description of existing conditions in classrooms in which immigrant and refugee students are situated. Through the completion of the instrument and consideration of the data emanating from the completion, teachers are in a position to move responsively, both individually and collectively, towards enacting practices that will support immigrant and refugee students in their transition to Canadian classrooms and the learning of science, especially within francophone minority settings.

Key words: Learning Environment Research, Refugee Students, Immigrant students, Cultural discontinuity, Post-colonialism, Division scolaire franco-manitobaine, Science Education.

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Table of Contents

Abstract	ii
Acknowledgements	iv
1. Introduction to the Study	1
1.1 Introducing the Research	1
1.2 Introducing the Researcher	4
1.3 Rationale for the Study	8
1.4 Research Questions and Intentions	13
1.5 Significance of the Study	15
1.6 Overview of the Thesis	17
2. The Manitoba Francophone School Division	20
2.1 Introduction	20
2.2 The Manitoba Francophone School Division	21
2.3 Science Education Delivery in the DSFM	21
2.4 Student Performance in Science in the DSFM	24
2.5 Science learning and Teaching	25
Lewthwaite: Common Influences on Science Delivery and Compensating for Students' Language Proficiency in	
2.5.1 Francophone-minority Settings	25
Cobern: Student World-View and the Complexities of	
2.5.2 Migration	26
2.5.3 Rivard: Learning and Language in Science Education	33
2.5.4 Bishop: Power relationships in Classrooms	34
2.5.5 Norris and Phillips: Appropriate Literacy Approaches	36
2.5.6 Lee: Instructional Interventions for Language-Minority Students	38
2.5.7 Jegede: Students from Diverse Cultural Backgrounds	41
2.5.8 Summary	43
2.6 Teaching and Teachers That Make a Difference	44
2.7 Chapter Summary	50
3. Theoretical Foundations of the Research	53
3.1 Introduction	53
3.2 Critical Theory	53
3.3 Post-Colonialism	54
3.4 Cultural Aspects of Schooling	56
3.4.1 Cultural Discontinuity	57
3.4.2 Cultural Discontinuities in School	59
3.4.3 Acculturation	63
3.5 Summary	66

	Learning Environment Research: From Western Science to Minority Culture	
4.	Trajectories	67
4.1	The Concept of LER	67
4.2	The Historical Evolution of Learning Environment Research	75
4.3	Applications of LER Instruments	77
4.4	Summary	81
5.	Research Methodology	82
5.1	Introduction	82
5.2	Participants and Settings	83
5.3	Phase I: Epistemological Orientations	87
5.4	Phase I: Qualitative Phase of the Study	87
5.4.1	Students Recruitment and Profiles	91
5.4.2	Teachers Profiles	92
5.4.3	Interviews with Teachers and Stakeholders	93
5.4.4	Interview with Students	95
5.4.5	Focus Group	96
5.4.6	Literature Review	97
5.5	Phase II	99
5.5.1	Development of Initial Instrument	99
5.5.2	Validation and Refinement of the Instrument	101
5.5.3	Application	103
5.6	Context-related Issues	104
5.7	Procedures	105
5.8	Summary	106
6.	Qualitative Data from Teachers and Students Interviews	108
6.1	Introduction	108
6.2	Teachers' Voices	109
6.2.1	Environmental Factors Influencing Transition	113
6.2.2	Teacher Attributes Influencing Successful Transition	121
6.3	Students' Voices	140
6.4	Summary	153
	Development of the Instrument for Minority Immigrant Science Learning	
7.	Environment (I_MISLE)	156
7.1	Introduction	156
7.2	Item List Compilations	156
7.3	Focus Group	159
7.4	Developing the Instrument	161
7.5	Summary	164
8.	Validation of the I_MISLE	165
8.1	Introduction	165
8.2	Participant Schools	165
8.3	Validation of the I_MISLE Scales - Alpha Reliability	166

8.3.1	Resource Adequacy	167
8.3.2	Time and Its Limitations	169
8.3.3	Knowledge of Students' Backgrounds	171
8.3.4	Professional Support Now and Before	173
8.3.5	Professional Adequacy Influenced by the Milieu	175
8.3.6	Professional Science Knowledge for Integration versus Time	176
8.3.7	Professional Attitude and Efforts to Address Studnets' Needs	178
8.3.8	Equity and Fairness to Others and Integrity	179
8.3.9	Summary	181
8.4	Discriminant Validity and Factor Loadings	181
8.5	Chapter Summary	186
9.	Application of the I_MISLE	187
9.1	Introduction	187
9.2	Quantitative Results of the Application of the I_MISLE	188
9.3	Comparison of I_MISLE Data with the Results of Teachers' Interviews	189
9.4	Summary	194
10.	Conclusions and Implications	195
10.1	Introduction	195
10.2	Review of the Study	195
10.3	Major Findings	197
10.4	Recommendations	201
10.5	Limitations and Further Research	203
10.6	Significance	207
10.7	Final Remarks	209
	References	212
	Appendices	226

List of Appendices

Appendix A: Interview guidelines	p. 226
Appendix B: I_MISLE long form	p. 234
Appendix C: I_MISLE short form	p. 254
Appendix D: Letters, Consent Forms and Approval Certificates	p. 269

List of Tables

Table 1.1 Immigrant Students in DSFM 2004-2010	p. 2
Table 6.1 Teachers' Years of Experiences	p. 111
Table 6.2.a Student Demographics	p. 142
Table 6.2b Students' Country of Origin	p. 143
Table 7.1 Scales and Sample Items from the I_MISLE	p. 163
Table 8.1 Alpha Reliability, Mean and Standard Deviation for I_MISLE	p. 167
Table 8.2 I_MISLE Correlation 4-Item Scale with the Other Seven Scales	p.182
Table 8.3 Inter-Scale Table of Correlations	p. 183
Table 8.4 Factor Loadings with Eigenvalue and Cumulative Variance (%)	p. 185
Table 9.1 I_MISLE Implementation	p. 188

Chapter 1: Introduction to the Study

1.1 Introducing the research

The province of Manitoba attracted over 10 000 immigrants last year and projects to receive at least 20 000 by the year 2016 through its Nominee Program and other refugee immigration programs (Manitoba Government, 2007, 2014). The immigration policies that encourage arrival in Manitoba of thousands of immigrants annually from diverse languages and cultures will inescapably have an enormous impact on housing, jobs, and, especially, the education sector (Alper, Ba & Sacko, 2012; Ba, 2007). Providing standard education to immigrant and refugee children who have experienced the hardship of refugee camps and cultural discontinuity through immigration poses serious challenges for the education sector, especially for teachers at the classroom level.

In the context of the Francophone community, the situation is likely complexified because of the scarcity of both human and other instructional resources to support students in their educational transition. In the last ten years, the Division scolaire franco-manitobaine (DSFM) has welcomed numerous immigrant students, mainly from Africa, the Caribbean, and a small minority from Europe (Piquemal & Bolivar, 2009). The number of Francophone immigrants and refugees from Africa has increased from 16% of the entire immigrant population in 1990 to 85% at the beginning of 2000 in Manitoba (Ka, 2007). Table 1.1 below shows an overview of the stable

increase of the number of newcomer students who have more recently registered with the French School Division (Antagané-Abé & Ka, 2013).

Table 1.1
Immigrant students in DSFM 2004-2010

School year	Students	Schools	Number Countries of origin
2004-2005	60	5	13
2005-2006	92	6	17
2006-2007	131	8	26
2007-2008	186	9	35
2008-2009	172	11	26
2009-2010	179	13	32

The main challenge for the DSFM administrators remains that of inclusion, especially in supporting underschooled immigrant/refugee students. More specifically, the core issue is: What are the most effective ways to integrate and accommodate immigrant students into regular classrooms given the issues of their limited experience in formal education (under-schooling), language barriers, cultural discontinuities between home culture and school culture, and the inconsistencies in curriculum these students experience between their home country and Canada. As well, these students come to Canada with a plethora of other languages and dialects from their home country. As reported in Table 1.1, in 2007-2008, the 186 immigrant/refugee students who attended the DSFM came from 35 different countries.

To respond to these issues, notably cultural, social and linguistic discontinuities, the DSFM has had to consider the effective teaching practices that mitigate these issues

and foster improved learning experiences for immigrant students. Pedagogical actions must go beyond vague and popular slogans and international folklore (Piquemal, Bahi, & Bolivar, 2010). While some ethnographic research (Piquemal et al., 2009; Piquemal et al., 2010) has explored the student immigration and integration phenomenon, there is still little specificity of what assists in influencing new immigrant/refugee learning and overall transition at the classroom, especially science classroom, level. Further, there is no detailed account from immigrant students and their teachers' perspectives of what these influences, both negative and positive, are. Finally, there is to date no method available for supporting teachers in systematically gathering information that might assist them individually and collectively in identifying actions they might enact at the classroom and school level to facilitate immigrant/refugee students' transition in their learning, especially in science where Manitoba schools, especially the DSFM are underperforming (PISA 2006, 2011). Science classrooms as shown in the next section may adequately represent other classes as it factored both literacy and numeracy skills of the newcomer students. Considering the value the wide array of learning environment instruments have had internationally in informing teachers' in adjusting their practice (Fraser, 1998) and the imperative for every Manitoban school division to comply with Bill 13 (Manitoba Government, 2007) which pleads for the provision of quality education for every student, the development of an instrument to support teachers' systematic analysis of practice is essential for assisting teachers in addressing this imperative.

The study to be described herewith purposely responds to the experiences of new immigrant and refugee francophone students and their teachers in science classrooms within the Division scolaire franco-manitobaine (DFSM). Based upon an understanding of these experiences, the study aimed, ultimately, in developing a learning environment instrument that would provide an accurate portrait of what is happening in these particular classrooms as perceived by both teachers of science and their students. By accurately capturing the existing situation in classrooms through the items contained in the instrument, teachers are in a position to move responsively, individually and collectively, towards enacting practices that will support immigrant and refugee students in their transition into science classrooms and the learning of science. Although this research was carried out with regard to these stated objectives, the study addresses a long time personal goal of the author as teacher and researcher to help provide quality education for all, especially those likely least able to advocate for changes to adjusted pedagogy to support their learning.

1.2 Introducing the researcher

Coming to a decision to pursue doctoral research using a Learning Environment Research (LER) paradigm within the Division scolaire franco-manitobaine (DSFM) goes back as far as my first days in the classroom as a high school biology teacher in Haiti. At that time, I was 19 years old and a recent graduate from high school. The resignation of my former biology teacher because of unresolved salary negotiations with the principal created this life changing opportunity for me to start teaching without any

teaching experience, or an education degree. In Haiti, in the mid-90s, one could start a teaching career with a high school diploma, especially if one had attended a private school, had excellent grades and maintained friendship with the Catholic priests who managed the boys' high school.

The school to which I was appointed, Notre Dame High School, is perched on one of the southern hills that dominate the city of Cap-Haitien. A phone call from my former principal to join the teaching staff was a kind of calling to a sacerdotal duty. Therefore, I was compelled not to refuse this offer. Indeed, I was notably concerned about choosing a career in education when I also could have become a physician, a lawyer or an engineer. Those careers were at that time considered as the best career choices in Haiti's collective imagination for preferred professions. Thus, even without the prior experience of teaching adolescents, I was quite aware that I had been afforded a mission. As I commenced my teaching career in the sciences, I also took classes at the undergraduate level from the Faculty of Education in Haiti to foster my professional insight into classroom practices that influence student engagement and learning. I knew at an early stage in my professional career I was intrigued to understand what impacted student learning and, therefore, their success as learners. I was also deeply aware that there was a need to advocate for the socially and educationally marginalized and I wanted to be such an advocate. It was through this experience I became acutely aware that learning for these students was problematic and, equally, teaching for learning and creating a classroom environment that fostered learning was, for teachers, a complex rather than simple action. I realized at an early stage of my professional career that a

variety of factors influenced learning and student success in mainstream schools, and that some students were less inclined to succeed. This was not a weakness of students, but more likely a weakness of schools to cater to the nature of such students. I realized early that some students were privileged in their success and others were not, and this was primarily because of the differences between students' home culture and the culture school represented, or more importantly privileged and rewarded.

Although I continued to teach both in Haiti and subsequently in Canada, it was not until I was studying towards a Master in Education I began to think seriously of the influences on the learning of students, especially immigrant students, in my case, in the Canadian context. In 2009, I was given the opportunity to work as a research assistant under Professor Piquemal for “Les Identités Francophones de l’Ouest”, one of the programs of the Alliance de Recherche Universités-communautés. As well as being engaged in my own research to earn my PhD in Education, it was the first time I was involved in doing research that was ultimately published in peer-review journals. These works primarily addressed the mechanisms fostering integration of new Francophone immigrants to Canada, and, more important to me as a teacher, understanding the challenges and successes associated with the influence of cultural and linguistic discontinuities on student educational success. I benefitted greatly by actively participating in these studies and interviewing, analyzing data and co-authoring three articles that are widely used today by the task force on Inclusive Education at the DSFM school division. It was an extremely valuable experience to listen and read of the experiences associated with the integration of francophone immigrants in Manitoba in

general, and that of immigrant students specifically in the DSFM classrooms. From this research, I became critically aware of the experiences of immigrant students and the complexity of the many personal and environmental influences on their educational transition and learning success.

While conducting this research, the Learning Environment Research course I took in 2009 as part of my doctoral studies was an epiphany as I was exposed to the significant influences a teacher may have on both student's perceptions of their abilities as learners and their educational outcomes. Teachers could either cause or impede learning. I knew this as a teacher, but I was not aware of the magnitude of a teacher's influence on students' learning. Barry Fraser, a pioneer in the field of LER, states:

I've come to a frightening conclusion that I am the decisive element in a classroom. It's my personal approach that creates the climate. It's my daily mood that makes the weather. As a teacher, I have a tremendous power to make a child's life miserable or joyous. I can be a tool of torture or an instrument of inspiration. I can humiliate or humour, hurt or heal. In all situations, it is my response that decides whether a crisis will be escalated or de-escalated and a child humanized or dehumanized (Fraser in Ginott 1971, p.13).

I perceived in this central idea a focus for my doctoral dissertation. I wanted to focus on classroom influences on students' learning success with attention to the physical and psycho-social-cultural-linguistic-political dimensions of classrooms, especially the student-teacher relationship, from a refugee/immigrant student's perspective, and understand how what happens in classrooms influenced their transition and success. I wanted to understand the complexity of these influences and assist in systematically informing teachers of immigrant students' experiences so they could understand the necessary adjustments they should make for these students in negotiating

the complexities of the Canadian science classroom environments, an unfamiliar environment for most immigrant/refugee students.

The classroom environment is the most appropriate place to investigate these experiences, and LER is posed as a research methodology to analyze the experiences of students and teachers within this milieu. As common to most Learning Environment Research, this mixed-method study took place in science classrooms in the DSFM of Manitoba; classrooms that are becoming increasingly populated by immigrant/refugee students. The study further works to develop a learning environment instrument based upon these experiences that might systematically capture the complex nature of schooling experiences of new immigrant/refugee students. Now that I have introduced the study focus and myself as the researcher, in the remainder of this chapter, I will present the rationale for the study, the research questions, and the significance of the study as well as an overview of the dissertation.

1.3 Rationale for the study

Manitoba teachers and science educators within the DSFM are experiencing diverse challenges. For example, relative to other Canadian mainstream jurisdictions, students in minority-language contexts are obtaining especially poor results in international scale science, mathematics and reading exams (PISA, 2011). Associated with this performance is the disturbing low engagement of francophone-minority students with science and mathematics (PISA, 2011). These results have brought attention to the perceived need for science curriculum reform and improvement in pre-

service and in-service teacher education to address students' interest and performance in mathematics and science in the minority-language context (Manitoba Education, 2011). These results have also brought attention to the previously identified broad and complex factors impacting the learning and delivery of science in a minority language, especially when the language of instruction is not the student's first language (Lewthwaite, Stroeber & Renaud, 2007a, 2007b). In addition to these challenges, it has been identified that francophone schools in Manitoba have to cope with their own unique concerns such as lack of French resources in science and mathematics, teacher education development issues, and students' lack of ability in French language within the context of francophone minority settings (Manitoba Government, 2011). Although these factors will be explored in more detail in Chapter 3, it is evident that the state of science education in francophone-minority contexts is in a critical state.

In Lewthwaite's (2001) dissertation, he asserts the value of Learning Environment instruments for assisting teachers in identifying and establishing processes for moving ahead to address curriculum based dilemmas, especially at the classroom level. In his case, the development of the Science Curriculum Implementation Questionnaire (2001) has assisted several hundreds of schools, school divisions, provinces, states and nations in identifying their current state and then enacting processes for improvement (Lewthwaite, 2005). Consequently, designing a suitable and similar instrument that will contribute to a systematic understanding of the complexity of the issues challenging effective science delivery for immigrant students addresses a pressing need. This study is justified for the following specific reasons:

- 1) The delivery of science programs in the DSFM is regarded as an exceptionally challenging area as stated by recent studies such as Lewthwaite et al. (2007a, 2007b). Not only are teachers identifying concerns with delivering science programs in French, students are indicating concerns with learning science in French. The recent PISA test results (2011) corroborate the situational issues associated with science learning in francophone-minority schools.
- 2) The DSFM has founded a Committee on Inclusion to work on the issues specific to the inclusion of new-immigrant students in DSFM classrooms; therefore, the Division is likely ready to reflect on empirically based studies focused on the classroom experiences provided for immigrant/refugee students. In association with this, it is imperative to develop an instrument designed specifically for and within DSFM classrooms where refugee/minority students are located that through their voiced concerns might prompt teacher reconsideration of pedagogical practice and inform individual teacher and school-wide teacher professional development, their policies on inclusion, and a more culturally relevant science curriculum.
- 3) Since LER questionnaires are internationally accepted as economical and effective evaluative tools to use at the classroom, school or divisional level by both teachers and science educators for their development and pedagogical adjustment (Fraser, 1998), the proposed research and instrument is likely to be of practical benefit for the DSFM and other school- divisions based in French-minority settings. LER instruments can provide a significant source of

information for fostering teacher change. For example, as reported by Aldridge and Fraser (2008), LER has contributed to understanding the many influences on student performance and program delivery and has provided identification of courses of action to reverse mediocre results in school performance. In their case, a school situated in a lower socioeconomic area in Perth, Australia is now ranked among the top ten public schools in Western Australia because of the information the LER instrument provided as a foundation for school- and state-wide change. LER, with its focus on data collection, analysis and collective staff discussion and implementation of courses of action, has been credited for this success by identifying actions to move towards a positive classroom within participating schools. In analyzing large databases, Walberg, Fraser and Welch (1986) found classroom and school environments to be strong predictors of achievement and attitudes even when other factors remained constant. Thus, using LER instruments as a foundation for decision-making and change is commonly identified as a valuable way forward for schools committed to moving ahead in adjusting practices for their students.

- 4) The multiple efforts made to cross-validate and translate many of the existing LER instruments into Indonesian, Korean, Mandarin, Arabic, and other minority languages provides indication of the determination of the LER community to reach out to minority cultures that are usually ignored in mainstream studies (Aldridge, Fraser, & Haung, 1999; Aldridge, Fraser, & Laugksch, in press; Aldridge, Laugksch, Fraser, & Seopa, 2006a; Aldridge, Laugksch, Fraser, &

Seopa, 2006b; Dorman, 2003; Wolfe, 2007a, 2007b). Aldridge has provided the research community with an overview of studies that are entirely devoted to students from non-dominant cultural backgrounds, meaning students who are not members of the mainstream cultures - especially those living in South Africa. Along with Aldridge, Fraser et al. (1999) there are other researchers who have focused their attention on minority-student educational performance. Among them, I highlight the works of Anderson (2005), Bong (2005) and Chandra (2004) who have addressed girls' motivation in science and mathematics; Park (2001) studying learning preferences of Armenian, African, Hispanic, Korean, Mexican and Anglo students in American secondary schools; and Dhindsa & Fraser (2004) and Dhindsa (2005) addressing cultural-sensitive factors in teacher training. It is pertinent to mention Lewthwaite, Stoeber, and Renaud (2007a, 2007b) who designed a Science Curriculum Delivery Evaluation Questionnaire for Francophone-Minority settings; Lewthwaite & McMillan (2007) who researched three Inuit communities in Qikiqtani, Nunavut and developed a Science Curriculum Delivery Evaluation Questionnaire for Inuit settings; and, among others, Lillis (1999) who worked on ethnic minority science student issues in New Zealand.

These references are far from exhaustive. Despite this imperative, there is a noticeable literature gap in conducting LER studies amongst the immigrant population in North America, especially in science education. By so doing, LER gives recognition for ensuring classrooms are not treated as 'homogenous' and, consequently, minority

cultures are no longer marginalized in LE research agendas. Such considerations can challenge the orthodoxy of a science education learning environment and by so doing provide the impetus for change to accommodate rather than eliminate diversity. Current LER publications show that researchers are cognizant of the classroom experiences of minority students. This is evident in the increased research in this area and the diversification of instruments developed in recent years. It is heartening to see “a variety of economical, valid and widely-applicable questionnaires that have been developed in more recent year and used for assessing students’ perceptions of classroom environment.” (Fraser, 1998, pp. 7-8). Although this comment has a positive tone, the classroom environment for science education is likely predominantly oriented towards an orthodoxy of practice that limits the participation of many students, in particular students as immigrants or refugees.

1.4 Research Questions and Intentions

The purposes of this study were twofold. It aimed to both design and validate a LER questionnaire. Following the LER questionnaire development process often observed in LER research (Fraser, 1998), this study was organized into three phases. The first phase was richly qualitative focusing on eliciting student and teacher views on the learning area under focus. In the second phase, the data from the qualitative phase were used to develop a quantitative instrument. In the third phase, this instrument was created through statistical validation and then applied to science classroom settings to determine its level of correspondence with the initial qualitative phase. In all, these

three phases constituted the research process for the dissertation. In brief, the study sought to advance understanding of the influences on learning at the classroom level through new immigrant students' and their teachers' perceptions of effective science teaching for accommodating immigrant and refugee students in Francophone minority settings. It then used these voiced experiences, both from students and teachers, as the foundation for the development of a LE instrument and then applied the instrument within a school context to test its accuracy. In all, the study addressed the following research questions:

- 1) What, if any, characteristics of effective science teaching are identified by new immigrant/refugee students and their teachers in Franco-Manitoban learning environments? What teacher specific and environmental conditions contribute to effective teaching and transitions for new immigrant/refugee students?
- 2) How can the characteristics of effective teaching and the conditions leading to effective teaching of science as voiced by students and their teachers be used to development an instrument that can inform an improvement in teaching practice for new immigrant/refugee students?
- 3) When validated, can the instrument provide an accurate description of the teaching and learning conditions experienced by teachers of immigrant and refugee students and be utilized to initiate critical reflection among teachers of science towards the improvement of their teaching practices in accommodating refugee and immigrant students?

1.5 Significance of the study

First, this study will help shed light on the likely reasons contributing to the transition of immigrant and refugee students into DSFM science classrooms and the mediocre performance of these students. Several studies report on the factors for the underperformance of francophone minority students in core subject areas such as mathematics and science (Lewthwaite et al., 2007; Rivard, 2009) but there is no research based on the experiences of immigrant and refugee students themselves as to the identified issues influencing their transition and success into Canadian francophone minority classrooms.

Further, this study will benefit the DSFM and similar jurisdictions across Canada. These settings lack detailed studies illustrating immigrant students' experiences as they adjust to new social settings including Manitoba classrooms. The findings of this study are likely able to better inform adjustment to policies and course of actions, especially at the classroom level, to support the process of accommodation of immigrant students, first and foremost in the DSFM, and in by extension to other minority contexts in Canada or elsewhere.

This study is also significant in terms of adding further voice to the influences on immigrant student integration. It will be of great interest to compare the voiced concerns of new immigrant students in science classrooms in Manitoba to those of other regions both nationally and internationally. While the experiences and solutions may be different, there may be some common epistemologically based influences that are shared between the French communities in Western Canada and other communities

internationally. The phenomenon of immigrant integration in classrooms may be different in various regions but, it is possible, the voiced experience of students and teachers may elucidate some unique influences upon their integration (Lee et al., 2005).

Finally, the instrument that emerges from this study, once validated, will be of use in other Learning Environment studies, especially those considering the need for improving the educational experience of minority students in contexts other than those experienced within the DSFM. The instrument developed in this study is context specific, meaning it is only valid for use within the francophone minority settings in Manitoba. Although it is context specific, the process employed in the study and the findings can be used to inform research initiatives in other minority contexts. The engagement of students in science is an international imperative, and it is commonly acknowledged that such engagement can only come through eliminating the 'pipeline' mentality and the enculturating practice that dictates the practice of science education (Aikenhead, 2006). With modification, this instrument might help other educational researchers conceptualize and implement studies based upon the findings of this study for understanding how science classroom practice must adjust and be accommodating of diversity (Lee, 2005). It is a common practice to extrapolate instruments and to modify them to fit other learning environment settings for a divergent student population (Fraser, 1997), not just immigrant and refugee students in francophone-minority settings.

For all these reasons noted above, this study carries some significance both in terms of fostering my own professional and academic journey, but also, and more

importantly, serving better the most vulnerable student populations who are likely restricted from science inclusion because of the orthodoxy of classroom practice and its resistance to change.

1.6 Overview of the thesis

This study consists of ten chapters and several appendices. The first chapter has presented the background to the study, the research questions and the potential impact of the study.

Chapter 2 that follows describes the context of the study, the Manitoba francophone school division where the study was conducted. A thorough portrait of this school division will be sketched through the qualitative and quantitative components of this study. The study will illuminate teachers' experiences with initial teacher training and on-going professional development as well as students' stories of their experiences. Further, it will detail student demographics and the curriculum and educational policies within the DSFM. The chapter will provide a fair understanding of the science curriculum delivery at DSFM. The chapter will also present the latest findings pertained to science teaching and learning in minority settings using models proposed by various science educators.

Chapter 3 poses the theoretical foundations of the study in defining and contextualizing the core constructs used. Some concepts like acculturation, alienation and others will be operationalized to avoid any confusion in interpreting the results later in the study. This chapter also lays the foundation for the methods section.

Chapter 4 is essentially a literature review focusing on Learning Environment Research as a field of study. Historical perspectives, exemplar studies, noteworthy instruments, and the efficacy of this methodological approach will be discussed, especially in outlining the contributions and characteristics of LER and its methodological tradition which will be applied to this study.

Chapter 5 outlines the methodology section. The epistemological stand for the research methodology is presented. Methods to be used in the qualitative and quantitative stages of the study are described. Instruments and approaches used to collect and report findings are reviewed.

Chapter 6 presents the qualitative data collected in phase one of the study. Interview data from interviews with teachers and immigrant and refugee students and outcomes of the literature review are presented in this section.

Chapter 7 deals with the second phase of the research which describes the processes involved in the design of the instrument and using the factors that are identified through the first phase of the study, including the literature review as influences on the effective teaching of science to immigrant/refugee students in the Francophone minority context.

Chapter 8 extends the second phase of the research and describes the statistical validation processes used in developing the instrument.

Chapter 9 focuses on the third phase of the research where the outcomes of the application of the instrument are presented. In this chapter, the quantitative data from

the application phase are compared to the Chapter 6 interview data from teachers and students' interviews.

Chapter 10 presents the conclusions of the study. Relevant suggestions based on the findings are made. As well, recommendations are presented for supporting the integration of refugee students in classrooms within the DSFM school division. The limitations of the study are also addressed as well as suggestions for further research.

Chapter 2: The Manitoba Francophone School Division

2.1 Introduction

In this chapter information that informs the study is presented. In Section 2.2, a description is provided of the DSFM, especially its social imperative to provide education for francophone minority students in Manitoba in their preferred language. In Section 2.3, an overview is provided of the science education context in the DSFM, with special attention to the culture of science that students, in this study's case, immigrant students are expected to transition into. In Section 2.4, some preliminary literature is presented pertaining to this study, especially from the perspective of scholars whose position theoretically aligns with the study's focus on the transition of students into mainstream classrooms, even though these classrooms are within a minority setting. The literature elucidates issues identified as likely problematic in the transition and includes consideration such as pragmatic issues such as resource availability; language barriers; students' worldview; the political nature of classrooms and curriculum; science pedagogy; and students' cultural background. Section 2.5 presents literature on exemplary teaching practice, especially in science education with special emphasis on the characteristics and influences of teacher effectiveness and responsive pedagogy. The chapter ends with a summary of the pragmatic, cultural, linguistic and socio-political influences on effective science teaching, especially as they likely apply to refugee and immigrant students transitioning into the DSFM.

2.2 The Manitoba Francophone School Division (DSFM)

The DSFM is part of a broader national movement created to give full access to the French communities in Canada to basic services in their own language, including health, social, and educational services. In the mid-nineties, Manitoba already possessed the largest French-language network of schools in western Canada, alongside the largest network of Francophone financial institutions, referred to as the “caisses populaires”. Also within the province are other natural institutional allies such as University of Saint-Boniface, the Centre culturel franco-manitobain, Radio Canada, and le Cercle Molière, the oldest French Theatre company in Canada.

The DSFM was founded in 1994 with the mission of providing francophone children of Manitoba with basic education in the francophone language. In its conception, it was viewed as an alternative to mainstream English classrooms, yet a significant contributor to the cultural and linguistic affirmation of the francophone minority in Manitoba. As of September 2012, the DSFM had a total enrollment of 5074 students dispersed through 24 schools. Along with the promotion of values such as equity, excellence and leadership, their strategic 2012-2016 integrates the following components:

- Their mission is to ensure the development of each learner in a perspective of inclusion and respect for the benefit of the Franco-Manitoban community of today and of tomorrow.
- Their vision of the school division is threefold and focused on:

- the academic, identity and community achievement of its learners
- its ability to equip students with 21st century skills
- its contribution to the vitality of Francophone communities in Manitoba
- Their main goals are aligned with their primary mission of educating the Francophone citizen of Manitoba where French is the first language. These goals include emphasizing academic achievement at the same time as reinforcing the use of the French language at home (DSFM, 2012).

In brief, the DSFM was established to serve a minority that was expected, until that time, to be assimilated into mainstream classrooms. This imperative is important for this study because the growing immigrant refugee population in Manitoba now requires a similar accommodating rather than assimilating response within the DSFM for these new citizens. The DSFM is the only province-wide school division in Manitoba. With 24 schools throughout Manitoba, it benefits from a diverse student population ranging from urban, rural and immigrant categories. While diversity constitutes an asset for the French-school division, it also calls for a better management of that diversity including a management model that encompasses inclusive, fair and innovative practices. These diversity issues challenge the DSFM's robustness at both managerial and instructional levels.

2.3 Science Education Delivery in the DSFM

In this section, a description of science education within the DSFM is provided, because it is within the context of the science classroom this study is situated. In this

same section, DSFM students' performance in large-scale science education performance exams will be reported. The science curriculum of the DSFM school division is the same as that in use in the Anglophone school divisions of Manitoba, albeit that the intended curriculum is delivered in French rather than English. The science curriculum in Manitoba emphasizes the nature of science, science methods and the components of technology, society, ecology and math in science learning (Manitoba Education, 2001). Students learn modules in general sciences from Grades One through Ten across the sciences such as ecosystems, fundamentals of electricity, and human anatomy and physiology. After Grade 10, students may enroll in chemistry, physics or biology classes. Recently, completion of a biology class (30S (Grade 11) or 40S (Grade 12)) has become a requirement for all DSFM students considering entrance to a Manitoba university (Manitoba Education, 2011). Although the Manitoba science curriculum encourages sound pedagogical science teaching, science teachers in the French-minority settings tend to emphasize vocabulary development at the expense of inquiry-based learning (Lewthwaite et al., 2007a), which is typically emblematic of science education delivery internationally. Teachers within the DSFM perceive that the curriculum is overloaded leaving little room for inquiry-based, first hand experiences (Lewthwaite et al., 2007a). The reasoning behind this argument may be justified by the emphasis these teachers put on language remediation, especially on vocabulary, rather than the authentic inquiry-based practices one might anticipate in science classrooms. This situation negatively affects the quality of science teaching and learning

(Lewthwaite et al., 2007b) and is likely represented in the relatively low levels of engagement students associated with science education in the DSFM (PISA, 2010).

2.4 Student Performance in Science in DSFM

It is well-known that students in French-minority settings have underperformed in international and national science assessments and develop a less positive attitude towards learning science relative to their Anglophone counterparts in Manitoba and the rest of Canada and francophone students in Quebec (CMEC, 2004; Pruneau, Liboiron, Vrain, Gravel, Bourque & Langis, 2001). In the PISA (2006), results showed that the 15 year-old students nationally performed very well in science and among 57 countries only Finland and Hong Kong-China students outperformed Canadian students. However, average performance can hide significant disparities within a country or province (Statistics Canada, 2008). These results showed that students enrolled in the French-language school systems in Nova Scotia, New Brunswick, Ontario and Manitoba were all out-performed when compared to those in the English-language schools. While in Alberta the performance of immigrant and non-immigrant students was similar, significant disparities were observed between non-immigrant youth and their second-generation immigrant counterparts, with the non-immigrant students showing significantly higher engagement and achievement. What is not available or reported is data that describes the performance of immigrant and refugee students enrolled in French-minority settings such as those of Manitoba.

Although this data is not available, a more detailed analysis addressing French-minority issues is available for the PISA (2009). Statistics Canada (2011) offers a variety of parameters to provide some comparison between minority and majority schools in regard of the PISA. In Canada, nine out of ten students enrolled in a majority-language school were using that language at home. In minority language schools, such as those represented by the DSFM, three out of ten students were using the minority language at home. Minority students are below their majority-language peers on this indicator both in Canada and in the OECD. Manitoba also shares differential results in the scores of minority and majority students in PISA reading scores. This fact is of great importance knowing the relationship between succeeding in science and mastering the elements of reading. Rivard, Cormier, Lee, Laplante, Jegede, Philip and Norris (all to be discussed later in this chapter) are but a few science educators and scholars who have established that there are direct statistical relationships between language, culture and learning in science. In the sections that follow, I will examine some of this research and apply the significance of the research to this particular study, especially in consideration of pedagogical influences on student achievement and learning.

2.5 Science Learning and Teaching

It is apparent from the previous section that there are many challenges facing teachers in francophone-minority settings in improving the quality of learning in science. In addressing these issues, I now draw from the scholarship, especially in science education to identify best practices that French-minority science education

might be more cognizant of and apply to the francophone-minority school system to address the diverse needs of its students, especially immigrant and refugee students. The sections that follow outline research efforts and theoretical positions that inform this study, especially in regards to the pedagogy and its implications for immigrant students. The scholarship that informs this study draws from research efforts both within the DSFM and applicable to the DSFM and the conditions students and teachers are likely to experience, especially those students likely to be experiencing a significant transition from their prior social and educational experiences to those of the DSFM classroom. Each section draws from a particular dimension that is likely of influence in students' transition and these dimensions will be elucidated to make evident how each is potentially of consequence for immigrant and refugee students.

2.5.1 Lewthwaite: Common Influences on Science Delivery and Compensating for Students' Language Proficiency in Francophone-minority Settings

The first dimension to be investigated concerns *pragmatic* matters associated with science delivery within the DSFM. Of significance to this study is research conducted by Lewthwaite, Stoeber and Renaud (2007) on science education delivery within the DSFM, albeit not with reference to immigrant students. This line of research is one of two science education projects reported that have been undertaken in the DSFM. Although this research is not specific to immigrant students, the methodological approach taken in the research and findings from the research is relevant. "*L'offre des sciences dans les milieux francophones minoritaires*" is a qualitative study that aimed at

understanding the phenomenon of science education delivery in the francophone-minority settings in central Canada, specifically the DSFM (Lewthwaite et al., 2007). More specifically, this study presented the factors impacting the K-9 science curriculum delivery in these milieus. Because of its focus on factors influencing science program delivery, the outcomes of the study are predominantly *pragmatic* in nature and illustrate how such pragmatic factors can be of consequence, directly or indirectly, in influencing students' transition. The data originating from an investigation into issues influencing science education delivery in francophone-minority in the provinces of Manitoba and Saskatchewan were presented in this inquiry. Special emphasis was placed on understanding through qualitative interviews teachers' perceptions of influences on science teaching in the DSFM and its equivalent school division in Saskatchewan. The study included an analysis of teachers' personal factors and school and community environmental factors influencing science program delivery. Bronfenbrenner's bio-ecological model (2005) was used to analyse these data contributed by 74 participants including science teachers, parents, administrators, science education professors and science education consultants associated within the DSFM.

Teachers identified many influences on science teaching effectiveness, most of these factors commonly identified in the literature. For example, external (also referred to as environmental or extrinsic) factors such as resource availability, professional support, time demands and the priority placed upon science in the DSFM all negatively influenced science delivery (Lewthwaite et al., 2007). It was claimed in this study that these pragmatic factors carried more negative consequences in the DSFM francophone-

minority settings than in the English mainstream settings of Manitoba. As well, personal attribute (referred to as intrinsic) factors such as teachers' perceptions of their own adequacy, knowledge and interest also negatively impacted science delivery (Lewthwaite et al., 2007). The fact that this study was conducted in a francophone milieu helps us understand the differences between this milieu and its anglophone counterpart. This article identified more than one similarity between these two milieus. To illustrate, Grade 1-9 teachers from both francophone and Anglophone settings shared similar challenges such as their perceived low professional interest in the teaching of science, their limited background content knowledge in science and inadequate understanding of effective science teaching pedagogies. As well, factors such as physical resources, collegial and professional support and time constraints were often cited as impediments to effectively plan and teach science within both francophone-minority and Anglophone majority settings (Lewthwaite, 2001). In the DSFM some conditions were different from the Anglophone milieu. Especially evident were the pressures that teachers experienced in francophone-minority settings. In contrast to their Anglophone counterparts, teachers taught a greater diversity of classes, often multi-grade and were expected to carry out a wide variety of extra-curricular activities. All of these aspects were perceived to be associated with the relatively small school enrolment but wide curricular provision within the DSFM. Further, within the francophone-minority situation, students' French language proficiency was identified as an impediment to students' success in science and, subsequently, influenced the pedagogical approach used in science teaching. Because teachers perceived students as

possessing limited French language skills, largely because they tended not to practice French outside of the classroom, teachers pedagogically over-emphasized language acquisition and compromised on students' science skill acquisition. Although this study did not seek to explain this phenomenon, it is likely that the socio-historical context of the DSFM might partially explain these priorities. Language acquisition and promotion of francophone identity are at the core of the mandate of this school division and its *raison d'être*, and, thus, science education as a skills-based investigative activity is compromised. In summary, the research indicated teachers in the DSFM were delivering science curriculum with emphasis on language acquisition in a setting where most students, because their first language is not French, were lacking of French language skills. Teachers perceived their teaching workloads were extraordinarily high and they performed substantially more extracurricular duties. It is also important that in this setting students typically held more negative attitude towards science because of the language-based nature of the teaching (Lewthwaite et al, 2007; Pruneau et al., 2001). To re-emphasize, the findings of this study primarily illuminated *pragmatic* influences on science program delivery in the DSFM; influences both intrinsic (teacher personal attribute) and extrinsic (environmental).

2.5.2 Cobern: Student World View and the Complexities of Migration

The study described in this dissertation quite evidently involved immigrant students transitioning a cultural bridge from the educational experiences in their home countries to the schools, and specifically, the science classrooms of the DSFM. For this

reason, the issues influencing science program delivery and students' transition are also likely to be informed by *epistemological* understandings. Of importance to this study and this dimension is the scholarly work of Bill Cobern, a pioneer in challenging the dominant Eurocentric worldviews commonly evidenced in science education. Although Cobern does not allude to the francophone-minority setting, he transgresses the borders of mainstream science education by expanding his research to migrant populations. He attempts to understand how worldviews migrate from, what he refers, naïve countries to so-called civilized ones and the complexities students experience as they make these geographical moves. He presents the concept of worldview as a non-rational foundation for thought, emotion and behaviour. Worldview describes an individual's presuppositions about what the world is really like and what constitutes valid and important knowledge about the world. According to Cobern (1991), worldviews are "culturally organized macro thought: those dynamically inter-related basic assumptions [i.e., presuppositions] of a people that determine much of their behavior and decision making, as well as organizing much of their body of symbolic creations and ethno philosophy" (p. 19). It is to be noted that Cobern pioneered the use of worldview in empirical science education research using Pepper's (1942) root metaphor approach and adapted logico-structuralism from cultural anthropology for use in science education research (Cobern, 1991). Cobern refers to the power of the logico-structural model of worldview consisted of interrelated, universal categories: Self, Non-Self, Classification, Relationship, Causality, Time and Space as elaborated by Kearny (1984). Each of these categories is composed of logically related presuppositions. This composite nature of

the logico-structural model draws the researcher's attention to the complexity of the construct of worldview, and yet the categories themselves provide access to that complexity. While the composite nature of the model makes it less likely that the researcher will oversimplify the notion of worldview, one can still speak of worldview unity based on salient presuppositions within the seven universal categories. Worldview is an exhaustive concept that far exceeds the commentary that exists today in the advocacy for “science for all”. A scientifically compatible worldview is a more modest and useful construction. For example, the American Association for the Advancement of Science (AAAS, 1989) calls for a scientific worldview that would be more accurately called a metaphysic for science.

For Cobern, a worldview cannot be reduced to a set of scientific conceptions and alternative conceptions about physical phenomena. To be rational, for example, worldview simply means to think and act with reason, to have a reasoned explanation or justification for thought and action. Such explanations and justifications ultimately rest upon one's worldview presuppositions. Thus, worldview is about metaphysical levels antecedent to specific views that a person holds about natural phenomena, whether one calls those views commonsense theories, alternative frameworks, misconceptions, or valid science.

A worldview is the set of fundamental non-rational presuppositions on which conceptions of reality are grounded. Moreover, it is no use trying to see behind these worldview presuppositions except with the intention of trying to understand the socio-cultural environment that leads to a worldview. It is simply no use trying to see through

first principles. If you see through everything, then everything is transparent. But, a wholly transparent world is an invisible world. To see through all things is the same as not to see. This is a difficult concept for the scientifically inclined to grasp because science, by its nature, is always seeking the next level of explanation. This unsettled scientific quest, however, is ad-infinitum. All thinking presupposes a foundation which, itself, is unprovable. This is the case even in mathematics where all consistent axiomatic formulations of number theory must also include unprovable presuppositions. There is nothing left to see if one refuses to recognize presuppositions.

How people see the world is of much interest to scientists and science educators. In this study, science educators should be concerned with how refugee students cope with conflicting worldviews when they begin living in dominant cultures and attending schools based upon the societal assumptions of the dominant culture. Science education policy documents such as the American Association for the Advancement of Science (AAAS) Project 2061 call for education to foster a scientific worldview, or in other words, to bring about change so that students embrace a more scientific worldview. Cobern suggests that this encouraged change is particularly problematic for minority students that possess a worldview significantly different from that represented by the majority in the classroom. His assertions about conflicting worldviews are particularly important for immigrant students who may hold worldviews significantly different from non-immigrant students. His assertions challenge the fundamental *epistemological* foundations of the how and why of the science education experience immigrant students

are likely to be provided. He asserts the need for this *epistemological* concern to be considered in the science education experience provided for students of science.

2.5.3 Rivard: Learning and Language in Science Education

In addition to Lewthwaite et al. (2007b), Leonard Rivard, along with colleague Marianne Cormier, has contributed significantly to an understanding of how language influences learning in science, with particular reference to the DSFM context. His efforts go beyond Lewthwaite et al.'s pragmatic assertions illuminating the *linguistic* dilemmas likely to emerge as immigrant/ refugee students' transition into DSFM classrooms. He proposes a model for teaching to improve the science education experience provided for students in minority language settings (Council of Ministers of Education of Canada, 1999). Rivard examines national and international data (Programme for International Student Assessment, 2001), and concludes that students belonging to minority francophone communities of Canada have obtained lower marks in science than those of the majority English-speaking environment. He seeks an understanding of the reasons behind this underperformance. Given the importance of science in contemporary society, Rivard highlights the difficulties students from francophone-minority settings face and uses this understanding to inform Franco-Manitoban educators and policy makers about a set of pedagogical actions that can assist students in minority language settings.

Of particular importance to these scholars are the difficulties francophone-minority students have in intellectually engaging with the discourse of science,

especially in argumentation. Based upon this limitation of students, Rivard has developed approaches that foster learning in science through specific reading and writing to learn approaches. His research program investigates what should be done in classrooms to improve the quality of learning and, subsequently, improve Francophone minority students' performances in standardized tests. Despite the less than adequate performances of Francophone students in those tests, Rivard believes that a science education that is supportive of students' developmental language competencies can still ensure a quality science education experience for all students. Cormier et al. (2004) and others push for a French-minority science education that should start with students' home language to introduce students to the language of science. In relation to this study, Rivard would assert that teacher's pedagogy in the minority-language context is a significant influence on student learning including those from immigrant backgrounds. Similar to Lewthwaite et al (2007) and Cobern (1991), he sees the pedagogical demands placed on teachers working within the cross-cultural and cross-language setting as particularly complex; that is the pedagogical demands are increased in such settings requiring a broader pedagogical capability than in settings that are linguistically and culturally homogenous.

2.5.4 Bishop: Power Relationships in Classrooms

Although not focused upon science education or the francophone context, Russell Bishop, a New Zealand scholar, presents a scholarly argument for understanding the power dynamic that unconsciously operates in classrooms, especially

as experienced by minority students, such as immigrant students in the DSFM. Bishop's assertions illuminate the *socio-political* dimensions likely at work in immigrant and refugee students' transition into DSFM classrooms and schools and how these dimensions can be addressed *pedagogically* through responsive pedagogy. Bishop argues that in the New Zealand context, the reassertion of Māori cultural aspirations and practices has provided the means to address unspoken issues of power and control within the classroom in ways that will benefit both Māori and non-Māori students (Bishop, 2003, 2010). Bishop claims that the outcomes of his research in the *Te Kotahitanga* research and development project involving New Zealand's Indigenous Maori students in mainstream secondary schools can be applied to minoritized students and are thus applicable to refugee/immigrant students.

Learning relationships must promote the knowledge held by Māori learners as acceptable and legitimate, and new knowledge/understandings must be reached through collaborative interaction between students and teachers. From a Kaupapa Māori philosophical perspective, the facilitation of self-determination for Māori students is likely to occur in sociocultural contexts where cultural backgrounds count; where what Māori students know, who they are, and how they know what they know, underpins and characterizes the very dynamics of the classroom (Bishop, 2003, 2010a, 2010b).

Above all, Bishop (2012) is promoting a sense of equity for minority students. Equity in this context means access to all levels of education from primary to post-secondary, as well as academic equity both at a macrosystem level but also, and more importantly at the student-teacher interaction level. This notion embraces interactions

such as modes of communication, the content we teach, the methods used to teach them and the ways minority students are assessed. Therefore, he strongly recommends a culturally responsive approach to teaching that supports students in their learning and affirms the cultural premise of their background in all dimensions, not just language. These characteristics surveyed from the Maori students perceptions of effective teachers are:

- Caring for Maori students
- Caring for the performance of Maori students
- Creating a secure, well-managed learning environment
- Engaging in effective learning interactions with Maori students
- Using a range of teaching strategies
- Using students' progress to inform future teaching practices

Those categories may be the same aspirations of immigrant/refugee students enrolling in science classrooms at the DSFM. Bishop's *socio-political* assertions are particularly important to immigrant students and their teachers as these students are also negotiating cultural divides in Manitoba classrooms and experiencing an unspoken system of the subordination of students' cultural foundations.

2.5.5 Norris & Phillips: Appropriate Literacy Approaches

Complementing the work of Rivard in Manitoba who focuses on *linguistic* issues underpinning immigrant and refugee students' transition, Alberta science education scholars Norris and Phillips give attention to specific *pedagogical linguistic*

strategies for informing student engagement and success in science, especially for those who may experience linguistic and ‘academic and social capital’ disparities. While Norris and Phillips make an important distinction between scientific literacy and its derived sense, they have put forward the importance of teachers using adapted primary literature to help non-mainstream students overcome linguistic barriers. Limitations in language, in addition to the general conceptual difficulties of learning science for students of minority communities could be explained by the lack of exposure of these students to literacy skill development in the majority language. These limits manifest themselves in a lack of vocabulary and especially in the misunderstanding of scientific messages (Norris & Phillips, 2003; Phillips & Norris, 2009).

Indeed, during science lessons, students belonging to minority communities are facing challenges because the language of science instruction is highly academic and contains, for the minority student, a large corpus of previously unexplored and thereby unknown vocabulary. In order to improve science education in minority communities, Norris and Phillips created a pedagogical model for teaching science in this type of environment. In their work, they first discuss some characteristics of teaching in minority communities then go on to propose an approach for conceptual change in science for such a context. Within this framework, they present the various language elements critical to the learning of science. These findings have led the researchers to develop a model to improve learning in science in minority communities.

The oral language activities they purport, such as discussion, writing and reading are part of the definition of learning, exploring, and practicing of science. Scientists in

their daily steps exchange ideas among themselves through discussion, oral argument and by reading the published works of their colleagues. They write their ideas and record their observations. They write reports to communicate their results. The language is an integral, fundamental and constitutive part of science (Norris & Phillips, 2003). For example, the formulation of inferences after reading a scientific text is not as simple as decoding words and their adequate pronunciation. For non-mainstream students, this assertion is quite pertinent and has serious implications for immigrant/refugee students in minority francophone settings that already have limited experience with the orthodoxy of science because of underschooling.

2.5.6 Lee: Instructional Interventions for Language-Minority Students

Lee extends the work of Norris and Rivard to draw attention to specific *science specific linguistic pedagogical* interventions that can be used to support language-minority students. Further, he advances attention to the system requirements to assist such students. In his research, he studied the non-English speaking student population in terms of science education. He revealed that all students, including those identified as English language learners (ELL), can and should have equal opportunity to learn and succeed in science. Teachers play a critical and central role in this process and should receive necessary support. Likewise, he asserts it is important for schools and the school systems to devote time and resources to promote effective professional development for all K–12 teachers of science, including those who teach English language learners. Educational policies and practices at every level of the education system should be in

concert to provide students with equitable learning opportunities (Lee & Fradd, 1998; Lee et al., 2005).

The linguistic diversity of primary and secondary students has been rapidly increasing in every part of North America. More than 5.5 million, or 11%, of public school students in the USA are now categorized as English language learners, and schools, districts, and states are challenged to deliver high-quality instruction to these students. Coupled with the reduction in the amount of classroom time devoted to school science instruction, particularly at the elementary level, many of these students receive inadequate instruction and lack access to quality science programs. It is important that educators who teach science to students identified as English language learners be well versed in science content and pedagogy, and also skilled in constructivist approaches for integrating language acquisition and science learning. Lee's research has shown that effective teacher preparation and professional development results in positive change in teachers' beliefs and practices in integrating science and literacy for English language learners (Lee et al, 2005).

Lee's research on instructional interventions - such as culturally responsive teaching, guided inquiry, and sheltered English instruction - has shown promise for improving achievement outcomes in both science and literacy, as well as narrowing achievement gaps for students identified as English language learners. To ensure all students, including English language learners, have opportunities to learn and excel in science, Lee's article supports the following principles:

- Science lessons, activities, and curriculum for students who are English language learners should be based upon science content and processes outlined in the National Science Education Standards and state science standards, and anchored to science investigations that promote inquiry.
- The use of guided inquiry (beginning with a more structured approach and then gradually developing to a more open-ended approach to learning) that builds on students' prior knowledge and science content provides English language learners with opportunities to learn the practice of science. Through participation in effective science instruction that incorporates literacy skills (reading, writing, speaking, listening, viewing, and representing), all students can develop academic literacy in English.
- Science instruction should recognize and respect the linguistic and cultural experiences, namely the backgrounds that English language learners bring from their home and community environments, articulate these experiences with science knowledge, and offer sufficient educational resources and funding to support science learning (Tyler, Boykin, Miller & Hurley, 2006; Tyler et al., 2010). When this happens, students learn to value their linguistic and cultural identities and develop their identities as science learners. That also leads to bridging cultural and linguistic discontinuities between home, schools and communities of the immigrant and refugee students.

Lee's assertions in the area of *specific linguistic pedagogies* in science education have obvious application to the minority-language context, especially in regards to potential interventions for supporting science learning for immigrant students in the francophone-minority context.

2.5.7 Jegede: Students from Diverse Cultural Backgrounds

Finally, attention is now given to *pedagogical approaches in science education drawing attention to the cultural milieu, especially within the geo-political context.*

Although several science education scholars have made reference to the cultural navigation students need to make in transitioning from home culture to school culture, Jegede is a researcher who has long been committed to searching for evidence of instructional strategies capable of effective conceptual change within a constructivist paradigm for students with diverse cultural backgrounds and gender differences. Through a comprehensive review of the literature on gender differences, his commentary reveals that the factors which have been found responsible for the gender imbalance. Gender inequity in science, mathematics and technology is mostly rampant in non-Western environments in which socio-cultural factors contribute to further drive a wedge between the achievement and differential attitude of boys and girls in the subjects. This study was undertaken, based on an assumption that the use of analogical linkages derived from the socio-cultural environment can successfully act as a psychological bridge for the learning of science concepts.

Although Jegede's research draws attention to pedagogical strategies in science necessary for diverse learners, his contribution to this study is likely more significant because he draws attention to the geopolitical context and its influence on students of science. He problematizes such education, especially in regards to the theoretical systems he believes underscore the hegemonic nature of science education students of diverse cultures experience. His work is founded on / based on / built around theories of decolonization, liberation theology, Marxism, anti-imperialism, and political economy. Critics believe that at times the word "developing" is a misnomer, such as in the case of countries ravaged by European colonialism, where the word "re-developing" may be more accurate since there were successful economic systems prior to colonialism. Allegedly due to ethnocentrism, Western analysts generally deem these prior interactions invalid and do not consider them "developed". The premise is that "to develop" is the same thing as or implies that the goal is "to develop in a western manner".

In his most comprehensive studies, he observed that in Nigeria, a country in which the society is predominantly traditional and the African mode of thought is very prevalent, there were similarities between boys' and girls' perceptions of socio-cultural factors influencing learning and engagement in their science classes. Of importance was ensuring science instruction was grounded in the worldview of students. This is not surprising, considering that boys and girls born and nurtured in similar environments would have socially constructed similar and related experiences of events, and would both bring similar cultural conceptions into the science classroom. Jegede and

Okebukola (1989) found out that learning in the traditional science classroom in Nigeria often does not often relate to students' day-to-day life experiences. He then suggests that there is a need to harness all the beneficial aspects of our culture to make science more accessible to African children. He suggests that human beings tend to resolve puzzles in terms of the meaning available within a particular socio-cultural environment. Locating instruction within such contexts could act as templates, anchors and inhibitors for new learning (Dzama & Osborne, 1999; Jegede et al., 1989). It is quite apparent that Jegede's reference to *pedagogical approaches in science education drawing attention to the cultural milieu, especially within the geo-political context* are likely to be applicable to the immigrant and refugee population transitioning to the DSFM context.

2.5.8 Summary

In this section, I have provided an initial review of the literature that theoretically underscores the research to be undertaken. The DSFM is a complex school environment because most students, whether they are new immigrant or lifetime Manitoba students, are learning science in a language that is not their home language. Further, the situation is complex because the study focuses on immigrant and refugee students who are transitioning from other countries with their likely unique cultural, social, political and linguistic experiences. As well, many of these students might be coming to DSFM classrooms with epistemic worldviews that are incongruent with those that are privileged with the Western mainstream science. These scholars draw attention to

issues which are anticipated to arise as influences on students' transition into DSFM schools and science classrooms. The scholarship provided draws exclusively from schools of thought and scholars, especially in science education who contribute understanding, both methodologically and epistemologically, to the nuance of the francophone minority situation and the likely critical elements influencing immigrant students' transition in this environment. Although only four of the previously cited scholars operate within the francophone- minority setting, all scholars, collectively, draw attention to the complexities of the francophone-minority setting and settings where students are transitioning or being assimilated into the dominant culture. These scholars provide evidence that students' social, linguistic, cultural and epistemological backgrounds are not only important but also become more complex and intertwined influences on immigrant and refugee students in francophone-minority settings. It is obvious, that teachers play a significant role in enabling this transition. As Fraser asserts, "I (as a teacher) am the decisive element in a classroom" (1971). In the section that follows, I now review the general literature that pertains to science teacher effectiveness and its characteristics especially and where possible in the context of minority-settings.

2.6 Teaching and Teachers That Make a Difference

Researchers have increasingly been paying attention to the characteristics of quality science education and its relationship to exemplary science teaching (Goodrum, Rennie & Hackling, 2001; Harlen, 2002; Tytler et al., 2009). They unanimously agree

on the impact of exemplary science teaching on students' outcomes and suggest some common characteristics of quality science teaching. One of the landmark papers on effective teaching in science education comes from the work of respected scholars Kenneth Tobin and Barry Fraser. Tobin and Fraser (1988, 1990) observed directly good practice in classrooms and made four broad assertions on the characteristics of exemplary science teachers. They reported that these science educators:

- Used management strategies that facilitated sustained student engagement in setting goals of independence and autonomy for students who have opportunities to work cooperatively keeping smooth transition between different sections of the lesson;
- Used strategies designed to increase student understanding of science in tackling students' conceptions while providing substantial content knowledge, focusing more on understanding science process, problem solving methods and nature of science than rote memorization by using a variety of verbal strategies while questioning in class or group situations while fostering active engagement of all students;
- Utilized strategies that encouraged students' to participate in learning activities in being aware and addressing the learning needs of all students, designing small group atmosphere, and balancing high level cognitive work with "safety nets" in order to keep students engaged; and,

- Maintained a favourable classroom learning environment in investigating students' perceptions of their own engagement, degree of teacher support, task orientation, order and clarity of rules.

These assertions likely continue to ring true today for all teachers of science and all settings in which science is taught. That is, the indicators of exemplary teachers are likely applicable to all contexts, including the DSFM. The focus of effectiveness is grounded not just in a teacher's knowledge of science, but also in her science specific pedagogical capability and general pedagogical capability as evidenced in the importance of a positive classroom environment, all conditions one would anticipate apply across cultures. Although the teacher education literature is dominated with scholarship on teaching, there is little written pertaining to the pedagogical practices of immigrant students, and none specific to francophone students as immigrants, in particular in Francophone settings. In the context of immigrant/refugee students in the Francophone minority settings, one may argue that Tobin and Fraser's attributes of effective teachers and teaching although implicitly suggesting that teachers need to be adaptive and accommodating, need to give more attention to a more cultural responsive pedagogy. It is the teachers' responsibility to create the necessary conditions in order for nonmainstream students to succeed in classrooms.

The increasingly noted tenets of a culturally responsive teaching approach needs to be emphasized because this approach holds the prerequisite for success for all students, not just mainstream students. While Baskerville (2010) argues that the greatest measure of effectiveness is found in teachers "finding ways to teach across and around

differences” (p. 461), he challenges teachers to adjust and change their pedagogy as a conscious statement to address differences in classrooms. It is not surprising that views such as those expressed by Baskerville give indications that culturally responsive teachers are aware of the power imbalances in classrooms. His assertions indicate that a responsive teacher seeks to accommodate rather than assimilate. As previously stated, Lee (2008) thinks teachers should create culturally inclusive classrooms that involve all members, whatever their identity by adjusting communication, content and interactional elements of classrooms. Alternatively, as Bishop (2012) pleads, the changes need to be more profound; there has to be an adjustment of the power imbalance in classrooms that tends to marginalize and subordinate non-mainstream students. He also suggests that more emphasis must be placed on assisting teachers in developing diverse pedagogies through professional development provision because many teachers are not cognizant at all of culturally relevant pedagogy. He asserts that teachers who are culturally sensitive and attuned to adjusting their practice would be more able to acknowledge and address the learning needs of students from diverse backgrounds.

A cultural relevant pedagogy is almost unanimously recognized and encouraged in the research community, but a fundamental question remains: how can teachers build a culturally responsive learning environment (Aikenhead, 2006; Baskerville, 2010; Bishop, 2010a; Gay, 2000; Kanu, 2006; Piquemal & Nickels, 2005; Rivard & Cormier, 2008)? Baskerville (2010) recommends an immersion of teachers in students’ culture and a sense of open dialogue with students and their contexts through relationship. Rivard and Cormier (2008) and Piquemal and Nickels (2005) call for a congruent model

of teaching that addresses the cultural and linguistic discontinuity students address, both in Francophone minority and Aboriginal settings. Bishop (2010) created the *Te Kotahitanga* professional development series to enable teachers to tackle the educational disparities between Maori students and the non-Maori students. He insisted on addressing the rampant deficit ideology that teachers commonly possessed and displayed in their interactions and expectations for students of color and students with low economic status.

In order to foster cultural relevant teaching among teachers while helping them strengthening their identities, some educators propose alternatives that still need to be validated through empirical research. In a landmark paper on Aboriginal students in Canada, Piquemal (2004) suggests a fourfold framework to address issues on teachers' ethical responsibilities for responsive teaching. Drawing on works of philosophers such as Levinas and Kant, Piquemal (2004) proposes the following core principles for a responsive and affirming pedagogy: commitment to difference, a respect for persons, a commitment for reciprocity and a sense of care. These principles are central for developing culturally sensitive relations with their students. Teachers must be open to equitable practice and affirming difference; develop a learning environment where students' culture has a voice; and foster caring with advocacy. This framework provides the solid ground to build learning environments responsive to the needs of minority students.

The low representation of minority students in science education and science related careers suggest that there is a need for change in practice, especially for teachers

who are culturally sensitive to students' differences and cultural backgrounds. In this sense, it is apparent that there needs to be recommendation and action to foster inclusive practices to promote success for students from minority backgrounds (Piquemal et al., 2009).

It is likely that effective teaching may be easier to characterize than to identify. In an exemplary paper, Waldrip, Fisher & Dorman (2003) put the exercise of identifying exemplary teachers to test and observed that:

Some researchers in science education have tried to achieve this by identifying and describing the behavior of very good or exemplary science teachers believing that, if we can do this, the descriptions of what these teachers do might lead to an overall improvement in student outcomes. However, exemplary teachers have been difficult to identify and researchers have found it difficult to describe what exemplary teaching actually is. A teacher might be able to display a variety of competencies, but may lack the skills necessary to put these components together, and different teachers might put them together in quite different ways. Unfortunately, studies of exemplary teachers have tended to be mainly small case studies (p.120).

Despite this claim, the research literature does identify characteristics of effective teachers of science and teachers of consequence for minority students, in particular immigrant and refugee students. Although there is considerable research in the area of effective teaching, especially identified through a meta-analysis of over 800 international studies focusing on identifying what influences and causes learning (Hattie, Jaeger & Bond, 1999), there is little empirical based research on effective teaching practices for minority students. Conspicuously absent is research that is informed by what minority students themselves have to say about effective teaching practices. As stated by Price and Hughes there is no systematic research providing any

conclusive indication of ‘what works’ in influencing minority students’ learning (Price & Hughes, 2009).

2.7 Chapter Summary

In this chapter, the literature focused on providing some preliminary insight into influences on science teaching and learning, especially for immigrant students from diverse cultural backgrounds. In considering the complexity of the issues challenging effective teaching for learning, it is likely that DSFM science teachers lack the complex training that may empower them to foster quality science learning in a French-minority setting, especially for their immigrant students. The challenges go beyond the commonly cited pragmatic factors such as resource availability and time constraints. In addition to these factors, students’ language unpreparedness, under-experiences with schooling and the hegemonic nature of mainstream science education specifically and teachers’ limited knowledge of students’ worldviews, social and cultural backgrounds (Gilbert et al., 2004, 2007; Rivard, 2009; Rocque, 2009) are likely to be major impediments for effective science teaching and learning.

In the context of the French-minority setting and because of the increasing number of refugee students who enroll at the DSFM, there is an urgent call to foster a science education experience that is pragmatically aware, epistemologically informed, culturally responsive, linguistically congruent, and pedagogically relevant.

At this point, it is important to keep in mind that there is a further increasingly intrusive influence affecting immigrant student achievement in science. Although

research indicates that the science learning in the French-minority settings is hampered by factors such as French-language limitations and lack of exposure to a science-inquiry based (Cormier & Rivard, 2004; Lewthwaite et al., 2007), it is important to echo other research that argues that the increasing emphasis on large scale testing disadvantages immigrant students. Tests are linguistically complex, culturally dependent and socially linked to students' background (Luykx et al., 2007; Seigel, 2007; Solano-Flores & Nelson-Barber, 2001). These studies state unanimously that making minority students take large-scale science tests with only mainstream students in mind is both unfair and irrelevant. These authors are voicing concerns of the relevance of these tests, as cultural objects, because they found evidence that language levels, beliefs, implicit assumptions from students' homes or communities can clash with the accuracy of the measurement of these tests. These studies assert that it is an 'inaccuracy' and 'violation' to make minority students pass the same tests loaded with a heavy academic linguistic patterns dissimilar to their first language. Is it pertinent to expand this reflection to the immigrant and refugee students who transition into the French-minority setting where they also are taking PISA in a French language that might be somewhat different from their country's home language? Do uniform assessment practices work against immigrant and refugee students' success? Does a uniform pedagogical approach work against immigrant and refugee students' success? Are immigrant and refugee students well-served under a French-minority pedagogy paradigm? In the next section, the theoretical foundations that will support the study are examined giving attention to

exploring the paradigms of culture, post-colonialism and teacher's efficacy in the context of the French-minority settings.

Chapter 3 Theoretical Foundations to the Research

3.1 Introduction

In this chapter, the theoretical frameworks undergirding this study are presented. Although some literature specific to science education, minority students and the DSFM were presented in the previous chapter, this chapter focuses on theoretical aspects that underpin much of the scholarship presented in that chapter. The study draws into question the existing orthodoxies of practice in DSFM schools and is thus grounded in the constructs of critical pedagogy that encompasses post-colonialism and its derivative corollary of cultural relevant teaching which draws attention to cultural, linguistic and pedagogical continuities and acculturation. All of these elements are central to this study and underscore the identified research objectives. As well, similar to the literature provided in Chapter 2, they provide the foundation for the analysis of the Phase One data that will be presented in Chapter 6. In this chapter, Section 3.2 explores Critical Theory, Section 3.3 Post-Colonialism, Section 3.4 Cultural Aspects of Schooling, Section 3.5 Cultural Discontinuities, Section 3.6 Cultural Discontinuities in Schools, and Section 3.7 Acculturation. Finally, Section 3.8 provides a summary of the chapter.

3.2 Critical Theory

The main theoretical framework underpinning this study is Critical Theory (Darder, Baltodano & Torres, 2009). According to Giroux (2009), Critical Theory refers to the nature of self-conscious critique and to the need to develop a discourse of social transformation and emancipation. He further adds that Critical Theory points to a body

of thought pertinent to the works of several educational theorists. In brief, the critical framework “demonstrates and calls for the necessity of ongoing critique, one in which the claims of any theory must be confronted with the distinction between the world it examines and portrays, and the world as is actually exists” (Giroux in Darder et al., 2009, p. 27). Critical pedagogy tends to be useful to examine cultural discontinuity and post-colonial manifestations within educational communities. Although critical pedagogy is as diverse as its many adherents, some common themes are part of the critical pedagogy corpus. Among these themes are culture and its corollary sub-themes such as cultural hegemony, class, prejudices, ideology and hidden curriculum. Those themes are part of the continuum of cultural discontinuity and post-colonial theory that emphasizes that the culture of minorities is silenced and negated in classrooms in favor of the dominant culture. Specifically, critical theory seeks to expose the hegemony of Western culture, in this study’s case to make evident the likely discontinuity and subordination experienced by students coming from Africa and the Caribbean within the Franco-Manitoban learning environment. In contrast, it may also expose the efforts made by those exceptional teachers who adjust their practices to provide every opportunity for success for immigrant/refugee students.

3.3 Post-colonialism

Before sketching an operational definition of post-colonialism, I will first conceptualize colonization. Said (1993) sees colonization as a “fate with lasting, indeed grotesquely unfair results”. (p. 207). On the other hand, Nandy (1983) talked about the

“intimate enemy” of the colonial condition and distinguished two forms of colonialism. The first, more militaristic, focuses on the physical conquest of territories; whereas the second, more subtle, aims at the conquest and occupation of minds, selves and cultures. Elaborating on the latter form, Nandy (1983) wrote: “This colonialism colonizes minds in addition to bodies and it releases forces within colonized societies to alter their cultural priorities and once for all.” (p. xi). Moreover, Ghandi (1998) eloquently added: “Colonialism, to put it simply, marks the historical process whereby the West attempts systematically to cancel or negate the cultural difference and value of the Non-West.” (p. 16).

According to studies conducted under the postcolonial education paradigm, this negation of cultural difference has significantly hindered students’ self and perceptions. Consequently, it has negatively impacted their academic performance (Aikenhead 2001; Cobern, 1993; Kanu 2006; Ogbu, 1987). Particularly in science education where immigrant/refugee students are trying to transition into a dominant culture, the challenges can be tougher. This is particularly true for those students who are newcomers carrying “triple” minority status, as immigrants, francophone and visible minorities (Alper & al., 2012). Because of the cultural violence that these students are likely routinely exposed to it is critical for the DSFM to develop comprehensive policies based on reliable LE research. Too often, the school division has to rely on American studies that are obviously not representative of the francophone minority conditions in Manitoba (DSFM, 2010).

Post-colonial theories, through their Marxist and post-modernist roots, may provide an adequate platform to analyze the traumatic past of those migrant students and the new yet significant challenges they are facing along with their parents. They usually experience culture destruction through the assimilation of their children into North American customs and belief systems, academic and professional demotion, and a high rate of unemployment (Alper & al., 2012). Bridging those gaps constitutes significant and pressing challenges within the realm of modern science education.

3.4 Cultural Aspects of Schooling

Culture is usually defined as the unique values, symbols, lifestyles, institutions, and other human-made components that distinguish one group from another (Geertz, 1973; Honderich, 1995). Although it is widely recognized that varying degrees of heterogeneity may occur within ethnic groups, it is commonly acknowledged that regularities in values and behaviors may be shaped by individual and group participation in cultural experiences and practices (Zeichner, 1999). Each culture includes a peculiar way of seeing the world. Schultz and Lavenda (1997) point out that:

Anthropologists often say that people of different cultures live in different worlds. [...] The world one lives in depends on culture, particularly on the referential perspective that one's culture embodies. Every culture contains subcultures, each of which teaches us what the world is like from a different point of view. (pp. 193-194).

One cultural context that significantly influences cognitive development is the public school. Far from being culture-free, classes in mainstream schools represent specific cultural values and beliefs, particularly those of the dominant culture (Boykin,

1986; Ogbu, 1987). Moreover, because families are considered to contribute most directly to the early socialization and education of children, these mainstream values may not reflect the cultural values of various racial/ethnic minority students (Tyler et al., 2010). Finally, the research on culturally relevant pedagogy suggests that many racial/ethnic minority students prefer culturally relevant learning environments that in turn improve their participation in school. In addition, numerous studies indicate that academic performance is enhanced for racial/ethnic minority students who are exposed to their home cultural values at school (Aikenhead, 2001; Bishop, 2010b; Bishop & Berryman, 2010; Tyler & al., 2010). However, regardless of these findings, the majority of public school teachers even those in minority settings continue to utilize mainstream cultural values in their classrooms (Piquemal & Bolivar, 2009). Therefore, in order to increase academic performance, researchers have called for the use of culturally compatible instructional practices for minority students in schools and for classroom instruction that reflects a student out-of-school, or home, cultural values and behaviors (Rivard & Cormier, 2008).

3.4.1 Cultural Discontinuity

Cultural discontinuity is defined as a school-based behavioral process where the cultural value-based learning preferences and practices of many ethnic minority students - those typically originating from home or parental socialization activities - are discontinued at school (Ogbu, 1987; Piquemal, Bahi & Bolivar, 2010). Cultural discontinuity has also been termed as cultural misalignment, cultural incongruence,

cultural dissonance, cultural conflict, cultural mismatch, and cultural collision (Piquemal & Nickels, 2005; Rivard & Cormier, 2008). Researchers have utilized the concept of cultural discontinuity to explain the dynamics behind minority student success or failure. They have been hypothesizing that students who feel more culturally aligned with the school systems of which they are a part will feel more motivated and be more academically successful, while cultural discontinuity may contribute to poor academic and psychological outcomes in culturally diverse student population (Walker & Roberts, 1997).

Although there may be discontinuities between the home and school lives of any student, home-school discontinuities are assumed to be more pronounced for visible minority and non-mainstream students (Aikenhead, 2001; Cobern, 1996). For example, the specific cultural themes that are found to be present and preferred in the home socialization activities of Aboriginal and minority students and their parents include collectivism or a sense of community, and spatiotemporal fluidity. Within the body of literature on Latina/o high school students and cultural discontinuity, studies have attempted to address secondary school curriculum and student achievement, variables associated with Latina/o student success, cultural discontinuity in schools, and culturally relevant teaching. In general, research has shown that instructional and cultural practices prevalent in secondary schools inhibit the achievement of non-mainstream students (Aikenhead, 2006; Bishop, 2010).

3.4.2 Cultural Discontinuity in Schools

The following section provides an overview of the theoretical work that has laid the foundation for the concept of cultural discontinuity. It describes ideas considered to be keys to the view that there is a dominant culture that pervades Canadian schools and this culture is incongruent with the home cultures of many minority students. To begin, ethnocentric monoculturalism is the belief in the superiority of one group's cultural heritage over that of another cultural group, as well as the power to impose those standards (Geertz, 1973; Giroux, 2009). Although belief in the superiority of one's own cultural group is not unique to Western culture, no other culture has had the power to impose its cultural values and assumptions so widely. Ethnocentric monoculturalism includes a belief in the inferiority of another cultural group's customs, values, traditions, worldviews and language, as well as its manifestation in institutions such as schools, and more specifically their learning styles and preferences (Cobern, 1996; Kanu, 2008).

Ethnocentric monoculturalism also includes what Sue and Sue (2000) call the invisible veil, or the assumption of universality in a group's belief in the superiority. Ethnocentric monoculturalism is comparable to cultural racism, which encompasses the idea that the determination of the inferiority of an ethnic group is based on White, or Eurocentric, cultural standards as norms of comparison; therefore, White culture is seen as the standard or correct way to live and to learn (Gay, 2000; Piquemal et al., 2010).

This approach excludes possible differences in the cognitive and behavioral development and traits of ethnic groups outside of the mainstream, thereby promoting norms that may be fundamentally antagonistic to the indigenous cultural modes of

expression which derive from the other's own culture. Ethnocentrism is prevalent in the structure, practices, and curriculum our public schools where the behaviors and expectations that are considered to be superior and appropriate are reflective of Western, mainstream, Eurocentric cultural values. In turn, the display of non-Eurocentric cultural values in schools is considered to be inferior and inappropriate; therefore, racial/ethnic minority students are expected to adopt Eurocentric norms and behaviors, as their own norms and behaviors are seen as incompatible with academic success (Ferguson, 2003; Gay, 2000; Kumar, 2006; Noguera, 2003). This ethnocentric monoculturalism is a conceptual precursor to the cultural discontinuity experienced by many ethnic minority students, as it provides a rationale for the actual discontinuance of the cultural value-based practices brought to the public school by ethnic minority students (Ogbu, 1982).

When success in this society is based on Eurocentric values, the minority cultures are expected to give up their own cultural heritage to enjoy it. Although differences in cultures are perceived, the differences of the other are perceived as deficits in comparison to Eurocentric cultural norms and minority/immigrant children are perceived to be at a disadvantage in schools because their homes do not provide them with the types of learning tools and routines needed to succeed academically in mainstream classrooms. In order to counteract the idea of the cultural deficiency of minority students, other theorists discount culture as a deficit and instead consider it to be an advantage for students (Foster, 1995). Cultural difference theorists, then, also

perceive differences in the cultural styles of minority students, but reject that these differences are deficits.

While Appleton (1983) recognizes the assimilationist ideology that pervades the American public school, Noguera (2003) reminds us:

Explanations of academic performance that emphasize the importance of culture generally ignore the fact that what we think of as culture — customs, beliefs, and practices associated with particular groups — is constantly subject to change. . . . The idea that culture could be treated as a static independent variable is very misleading and results in misconceptions. (pp. 45–46)

Moreover, Ogbu (1987) indicates that the current discourse on minority education promotes a distorted meaning of culture and the cultural role of schooling, in the sense that the purpose of the curriculum is not to replace ethnic minority cultures and languages with those of mainstream White Americans. However, while he does recognize the prevalent discriminative practices in American schools, he argues those parameters cannot be the sole factor when examining the American Black students' underperformance.

Cultural difference theorists believe that ethnic minority students come from cultures that consist of languages, values, behavioral styles, and perspectives that can enrich mainstream culture and fail to achieve in schools not because they have deprived cultures but because their cultures are different from the school culture (Rivard et al., 2008). They believe that the school, foremost, is responsible for minority students' academic achievement, and that the school must change in ways that reflect the cultures and cultural characteristics of its students. In that perspective, and more specifically in math and science education, Aikenhead (2006) and Bishop (2010) plead for a more

indigenous science curriculum with emphasis on relevancy. Rivard et al. (2008) promote the concept of congruence in teaching science in minority settings. Mason in Kanu (2006) similarly encourages a 'kinder' mathematics for Nunavut and Cobern (1991, 2000) for a science more reflective of minority students' worldview. The discontinuity between students' home cultures and the culture of the school alienates students from their own cultural values and is considered to contribute to their academic difficulties. Because most teachers and educational administrators are not trained to work with anyone other than mainstream groups, their belief in the superiority or universality of mainstream teaching methods and learning styles is rampant (Piquemal et al., 2010).

However, the current and increasing failure reflected in minority student populations calls for enhanced and differentiated teaching methods and policies that reflect the cultures of the students, otherwise known as culturally relevant teaching. Culturally relevant teaching came about in opposition to the Eurocentric ideology that is rampant in most mainstream schools (Baskerville, 2010; Bishop, 2010). Therefore, teachers have a responsibility to use cultural knowledge, prior experiences, frames of reference, and performance styles of ethnically diverse students to make learning encounters more relevant and effective for them (Gay, 2000). Culturally relevant teaching must provide a mechanism for students to maintain their cultural integrity while succeeding academically. Culturally relevant teaching is an approach that might help reduce cultural discontinuities between the home and school experiences of

minority students, thereby closing the gap between mainstream and nonmainstream students' academic achievement.

Discontinuity between the dominant Eurocentric culture of mainstream schools and the specific cultural values and behaviors of minority students has been identified in the literature. The literature focuses more generally on African American students and neglects other minority groups such as immigrant/refugee students. Additionally, prolific work with African American elementary school-age students has shown that although African American students prefer learning in ways that are congruent with their cultural values, otherwise termed Afro cultural values, their teachers prefer and practice Eurocentric cultural values and behaviors in the classroom and reject Afro cultural behaviors (Tyler & al., 2010). Ethnographic research undertaken in the Francophone-minority settings in Manitoba highlights significant discrepancies between the school culture and that of immigrant and refugee students usually coming from Africa (Piquemal et al., 2009).

3.4.3 Acculturation

In a seminal memorandum, prominent anthropologists conceptualized the term acculturation as followed: "Acculturation comprehends those phenomena which result when groups of individuals having different cultures come into continuous first-hand contact, with subsequent changes in the original patterns of either or both groups" (Redfield, Linton & Herskovits, 1936, p 149). They also differentiate culture-change as it encompasses acculturation, assimilation as a phase in acculturation and diffusion that

is a common tenet of acculturation. In addition, they provide a three-fold framework to study the outcomes of the acculturation process which include:

Acceptance: When there is a great taking over of the greater portion of another culture and the loss of most the older cultural heritage. Examples of this characteristic is the slave that is forced to abandon his own culture to embrace that of the master, the Aboriginal students in residential schools who were alienated from their culture by the dominant Catholic education, the immigrant who is forced to integrate behavior patterns and even inner values of the host society against the socio-economic status. That stage is equivalent to that of the assimilation process.

Adaptation: where both original and foreign cultural traits rework their patterns in a harmonious and meaningful way.

Reaction: where because of oppression alternative cultural movements arise. These movements are to compensate an imposed or assumed inferiority.

As ancient as this framework can be, it provides an insightful tool to examine the notion of acculturation.

An obvious manifestation of acculturation can be the immigrant's adoption of the dominant society's attitudes, values, and behaviors and consumer acculturation as a subset of this process comprised of those attitudes and values. A variety of factors influences the length of time that the acculturation process takes for different individuals. Included in this list are length of time in the host country (the strength of native values appears to decline for an individual after he/she has lived in this country for 10 - 20 years), ability to accept change, education, and income level (Redfield & al.,

1936). Also, a concentration of Hispanics in the same area affects the acculturation process.

Traditional values tend to be more resilient among a growing number of recent immigrants. Some early work on acculturation indicates that immigrants, over time, adopt the consumption patterns of other American consumers. Some immigrants may downplay their own culture in trying to decrease differences between their native and adopted cultures and to fit in (Vence & Knerr, 2005).

Similarly, some researchers found that most immigrant respondents in their study want to hold onto immigrant culture, while at the same time express the desire to become a part of the society in which they live. This latter evidence reinforces the notion that the process of acculturation is, indeed, complex (Piquemal et al., 2009). Others have identified differences within the Immigrant population with regard to the extent to which immigrant students and parents have adopted the host culture. These studies have discussed the concept of acculturative stress, the psychological impact of adapting to a new culture.

A review of this literature indicates that immigrants may go through a series of stages in the acculturation process. Initial hope for a better life may be followed by questioning the wisdom of leaving home, especially when dealing with the challenges of adjusting to a new country, new language, and different cultural values. To the degree that one is capable of overcoming acculturation stress, one eventually remakes his/her life, successfully coping in the new culture. The continual influx of new immigrants, ease of travel, and enhanced communication with their native home

mentioned earlier, however, may foster acculturation stress. The literature suggests that higher levels of cultural adaptation, or acculturation, may be reflected in higher levels of life satisfaction (Wong, 2010).

Immigrant students reflect a middle ground between the values of their ancestral culture and their adopted homeland. These students appear to be in the process of acculturation, partially adopting the values of the country in which they live, yet maintaining the core values of their family's native culture. The potential for stress associated with the acculturation process discussed in the literature review suggests that perhaps immigrant students would be less satisfied with their lives than non-Immigrant students who may be rooted more solidly in one culture (Museus, 2008; Museus & Jayakumar, 2012; Piquemal et al., 2009).

3.5 Summary

In this chapter, an overview of the theoretical foundations of the study has been presented. It is these theoretical frames that are anticipated to provide insight into the many influences on immigrant students' experiences in science education. As well, it is anticipated they will help inform the perspectives of teachers' orientations to teaching and will thus inform the analysis of the conversational data emanating from the interviews with participants. In the next chapter, the research methodology is introduced giving significant attention to the methodology orientation this study is grounded in: Learning Environment Research.

Chapter 4 Learning Environment Research: From Western Science to Minority Culture Trajectories

4.1 Introducing Learning Environment Research

This study focuses on understanding a ‘learning environment’, that is the classroom environment experienced by both teachers and immigrant and refugee students in the DSFM. It follows by developing an instrument that captures the nature of that milieu for developmental purposes, in particular in informing adjustments at the classroom level to teaching practice to accommodate immigrant and refugee students. LER, Learning Environment Research, is an acronym that infers different meanings depending on the semantics of the phrase: “learning environment” which is a polysemy; that is, it encompasses a number of meanings, interpretations and understandings. Rieber (2001) proposes a definition that comprises a variety of learning environmental tenets.

A learning environment is a space where the resources, time, and reasons are available to a group of people to nurture, support, and value their learning of a limited set of information and ideas. Learning environments are social places even where only one person can be found. The center of a learning environment is sharp, clear, and focused, but the edges are very fuzzy. There are limits to each learning environment, both in what can be learned there and whose learning will be supported most. It is most common to describe a learning environment by the types of resources to be found there, but while the resources are crucial to a learning environment’s effectiveness, resources are only as good as the conditions under which one has access to them. Learning environments are places where diverse people have different access to limited resources. The goal, of course, is to provide a person all the resources he or she needs in a suitable climate for learning. But we know this is never possible. The complexity of human learning makes even the identification of which resources are appropriate for which people very difficult. One of the most precious resources for learning - time - is usually in short supply (p. 3-4).

This initial definition emphasizes pragmatic elements associated with the learning environment. It highlights the intentions, resources, limitations and more tangible specifics of the learning environment. This definition is elaborated on by pioneers in the field, such as those of Fraser and Tobin (1998) who, from a social constructivist perspective, have pointed out the following:

Learning environments are constructed by individuals in a given setting and consist of socially-mediated beliefs about opportunities to learn and the extent to which those opportunities are constrained by the social and physical milieu. Although individuals have their own experienced and preferred learning environments, those constructions are constrained by interactions with others and characteristics of the culture in which learning is situated. [...] From this perspective learning occurs within constantly evolving communities in which the practices of participants are shaped by social structures, relations of power and the nature of the activities in which learners engage. (p. 626).

This view adds more the subjective nature of the learning environment recognizing that how each person experiences a learning environment is quite phenomenological, rather than normative. As well, what occurs within a learning environment is likely influenced by a variety of social structures that impinge on the classroom environment. Although these descriptions provide reference to constraining factors on learning such as the nature of learning interactions and resources available such as time, they encourage consideration beyond pragmatic matters to more epistemological points of view that are likely to be evidenced in the context of the study where immigrant and refugee students are transitioning.

Notwithstanding the complex nature of the learning environment, Hannafin et al. (1999) suggest at least four components or attributes to depict learning environments: an

enabling context, resources, a set of tools and scaffolds. They explain those four components as followed.

Enabling context: This helps student connect to prior learning, choose appropriate strategies, and design relevant processes to solve or generate case problems.

Resources: Extensive resources such as print-based books and articles, static or dynamic online data, human resources such as experts in the field, an open inquiry or teacher-controlled formats may be provided to learners.

Set of tools: Tools may support higher thinking even if this ability is not automatically induced. Some scaffolding may be required for that level of understanding to be reached. Four types of tools are mentioned: information, manipulation, communication and scaffolding.

Scaffolds: This process may be nourished by tools, teachers, experts or peers. They distinguish procedural, conceptual and metacognitive scaffolds.

This fourfold framework conveys a sense of the very complex attributes of “learning environments”, a phrase that generates many competing claims. Therefore, Moos (1976), a pioneer in LER, was probably right in carefully choosing phrases like *classroom climate*, or *classroom ethos* over the widespread concept of *learning environments* to purposely describe the many attributes that inform a description of the learning environment. Although LER involves a range of activity in several areas of education, the broadness of the phrase can to some extent be misleading. LER first and foremost seeks to understand the operative conditions of the learning environment and

what influences learning. If these environments can be conceptualized, then improvement can then be considering.

LER has a sustained and broad research agenda and has provided a powerful framework for inquiring about different areas in education research; most notably in science education research. I refer to likely the most prominent current and unofficial voice of the field that provides a broad and, yet, clear definition of the field of LE and its corollary, LER, per se. On its website, the *Learning Environments Journal*, whose Editor-in-Chief is Barry Fraser, adroitly states their mission:

Learning Environments Research builds our understanding of pre-primary, primary, high school, college and university, and lifelong learning environments irrespective of subject area. Apart from classroom and school environments, the journal devotes special attention to out-of-school learning environments such as the home, science centers, and television. New learning environments created by information technology are also explored.”

It equally provides an adequate definition of learning environments:

This journal interprets "learning environment" as the social, physical, psychological, and pedagogical contexts in which learning occurs and which affect student achievement and attitudes. Original academic studies include theoretical reflections, quantitative and qualitative research, critical and integrative literature reviews and meta-analyses, methodological issues, and development and validation of assessment instruments. In addition, the journal features reviews of books and evaluation instruments.

It is interesting that LE is considered as a ‘context’ in the latter definition because context involves a milieu and people who are trying to act upon it. I would state the LE is a ‘space’ purposely designed to host pedagogical intentions, interactions and students’ outcomes. Learning can happen anywhere, any time and is always continuous; however, I understand learning environments as those milieus where the pedagogical intentions and instructional endeavors are not always explicitly stated and pursued. As

Fraser and Tobin asserted, there can be unspoken social processes at work that have significant influence on classroom practice.

As stated in Chapter 3, it is only more recently that LER has given attention to classrooms of difference as a result of the heterogeneity rather than uniformity of educational imperatives and participants and, consequently, is becoming increasingly aware of the social structure at influence in and on classrooms. LER has shown that as a research approach it can be used irrespective of the subject area and grade level to conceptualise classroom milieus, and, for this reason, continues to favor the design of new instruments for assessing students' and teachers' perceptions of the learning environment in increasingly divergent settings. If classrooms can be understood, no matter how divergent, they can be improved and LER provides the systematic means to understand and conceptualise classroom operation and structure.

Historically, this trend towards understanding and improving classrooms can be explained by the fact that the very first LE inquiry conducted by Walberg and Anderson (1968) in the context of research and evaluation was related to Harvard Project Physics. This initial inquiry has led to the elaboration of Learning Environment instruments for a variety of contexts beyond the initial Project Physics efforts. The early history for the the use of instruments in gauging and improving science classroom practice has been well-documented (Fraser, 1986, 1994; Fraser & Walberg, 1991).

What is typical of these instruments can LER instruments? How can they be described or characterized? The learning environment instrument tries to capture dimensions of the classroom such as the physical, pedagogical and psycho-social nature

of a classroom environment. The instrument will contain several scales, each identified through statistical validation, each with a number of items that try to capture each aspect or dimension of the environment. For example, one scale may pertain to student-teacher interactions and student-student interactions, and another scale may pertain to the curriculum resources used and another the teacher's teaching practices. In all, through the different factors and associated items it contains, the instrument tries to capture all features of that environment deemed important by curriculum developers, teachers and students within the particular context. Thus, an instrument developed for science education in a mainstream context might be quite different in composition and content to an instrument developed for an Indigenous context where alternative epistemological and pedagogical orientation might be encouraged. This aspect is central to this study because what is deemed important is context and participant dependent. The utilization of an instrument for one context cannot be uncritically applied to another context. For example, an immigrant student's perceptions of influences on her successful transition are likely to be different from those of a teacher raised within that context, especially if they have little awareness of the linguistic, pedagogical and worldview differences students and teachers identify as significant in influencing positively their transition. Students and teachers representing the dominant or mainstream culture will likely possess a cultural capital for success in such a classroom whereas immigrant students are likely to voice a need for support in transitioning to this culture or accommodating practices that allow this transition.

Typically, the items on the instrument need to be comprehensive; that is, they capture all of the attributes seen as important. The totality of the items, ideally, must capture the whole. At the same time, the instrument must be economical ensuring that there are not too many items and, consequently, time required of teachers for completion. If there are, the teacher response to completing the questionnaire diminishes. As well, the instrument typically occurs in two forms: the actual and the preferred. The former requires participants to portray the learning environment being scrutinized as it is, whereas the latter deals with the aspirations, intentions and perceptions of participants about the learning milieu they actually would like to see manifest, thus the terms actual and preferred are commonly used to describe these instruments (Fraser et al., 1991). As an illustration, an item like “I am supported by the administration to teach science” from the actual form becomes following the preferred format: “I would like to be supported by the administration to teach science.” The difference between these responses is important as it provides some indication of the improvement the participant deems as necessary. It is important to note for this study that there can be issues with the use of a ‘preferred’ instrument because what teachers might seek as ‘preferred’ might give little consideration to what might be necessary or possible for students. This is especially important in terms of considering what a student might prefer or see as necessary, especially a student seeking a classroom experience that accommodates socially, pedagogically and epistemologically rather than assimilates.

The data collected and analysis procedures associated with instrument use need to be considered. In the application of instrument, decisions should be made by

researchers as to whether analysis will entail scores obtained from individual students or teachers (private press) or whether these scores will be merged to construct the average of the environment scores of all students and/or teachers in the same school or class. In most cases, literature has shown preference for the choice of unit of statistical analysis and multilevel analysis (Bock, Bryk, & Raudenbach cited in Fraser, 1998) to be commensurate with the intended use of the data. For example, if an individual teacher is seeking to adjust practice based upon student response, the classroom becomes the unit of analysis. If a country is seeking an understanding of variability in preferred pedagogical practice, then school level analysis is likely more appropriate.

The instrument items are assigned a scale 1 to 5, with 1 for Strongly Disagree and 5 for Strongly Agree. When all students and/or teachers complete the instrument, the average of the scores can be manually calculated or computed using statistical packages such as SPSS, SAS or R. By completing both actual and preferred form, gaps in the average scores are used to help foster dialogue amongst teaching staff or teachers and students about issues on the specific learning environment studied (Fraser, 1991). Fraser also suggests that teachers be involved in an iterative process of reflection, adjustment and re-evaluation until discrepancies between actual and preferred averages are addressed; that is, teachers can begin to work from the actual to the preferred and ideal. The less the discrepancies, the 'better' or more appropriate the learning environment. Feedback toward remediation and effective follow-ups are crucial in using LER instrument as enhancer tool to improve learning milieus (Stewart & Prebble, 1985). Again, it is important to note that actual and preferred scales are not always used.

Preferred scales tend to be limited to environments where an ideal environment has been both conceptualized and is understood by teacher participants.

4.2 The Historical Evolution of Learning Environment Research

According to Fraser (2009), the field of classroom learning environments offers a set of tools and ontology for conceptualizing, assessing, investigating and improving what goes on in classrooms. Fraser, as portrayed by his fellow professor, Jill Aldridge (2011), is a “Father” in the field and his major works are central to the evolution of LER. Consequently, his Alma Mater, Curtin University in Australia, has to be acknowledged for the landmark studies, research programs and research degrees that it has provided in this area of research. As a historian and a scientist of LER, Fraser (2009) has crafted an insightful book chapter on Australian contributions to LER which provides, from the perspective of an Australian author, the scope and the influences of LER around the world.

Fraser reminds us that the first works in LER are rooted in the works of two pioneers: Herbert Walberg and Rudolf Moos. Walberg and Anderson (1968) designed one of the first Learning Environment instruments, the Learning Environment Inventory (LEI) during the implementation of the Harvard Project Physics. Moos (1974a, 1974b), on his side, developed the Classroom Environment Scale (CES) classifying human environments into three dimensions (relationship, personal development, and system maintenance and chance). Other instruments designed by Fraser and others are use

worldwide to assess student and teacher perceptions of the actual and preferred learning environments.

In that perspective, three LER instruments are worth mentioning among the landmark tools that enrich the methodologies of LER. These questionnaires comprise the Constructivist Learning Environment Survey (CLES) (Taylor, Fraser and Fisher, 1997); the Science Laboratory Environment Inventory (SLEI) (Fraser, Giddings and McRobbie, 1995); and the What Is Happening In this Class. (WIHIC) (Aldridge, Fraser, and Huang, 1999). Describing these instruments, Aldridge (2011) points out: “Findings from these instruments have not only formed the basis for improving teaching practice but also helped researchers in a variety of ways, including evaluating educational innovations and examining the impact of the learning environment on a range of student outcomes.” (p. 767). In all cases, those instruments have shown robust factorial validity and internal consistency reliability in different countries such as Australia, South Africa, Canada, India, Singapore, Korea and languages (Indonesian, Taiwanese, Sepedi, Arabic and other Australian Aboriginal indigenous languages) in which they were implemented (Aldridge, Dorman & Fraser, 2004; Aldridge & Fraser, 2008; Fraser, 2009).

Also, Fraser has established one of the most important doctoral programs in Mathematics and Science Education and has opened doors of research doctorates to non-traditional students around the world – namely USA, Indonesia, Fiji, Canada, South Africa and Nigeria making explorations in math and science inquiry a more inclusive adventure (Aldridge, 2011). These doctoral programs were implemented at Curtin University where Fraser spent 27 years as Director of the Mathematics and Science

Education Center at this university. Having mentored more than 70 doctoral students to completion, Fraser supervised a range of scholars in the field, who continue to make contributions to LER through the ongoing development of conceptualizing learning environment contexts internationally.

Two other, yet significant, breakthroughs in the LER field give indication of the ongoing development and extension of Learning Environment Research: An International Journal by Fraser whose first edition was published in 1998 at Springer and the establishing of the Special Interest Group (SIG) on Learning Environments in 1984 under the umbrella of the American Educational Research Association (AERA). The journal benefits from a panel of astonishing researchers around the globe. European, Australasian and North American scholars constitute the diverse editorial boards. Moreover, the recent launch of a book series, *Advances in Learning Environment Research*, ten years after the first publication of LER journal, by Sense Publishers, forms another landmark in the evolution of this field of knowledge (Fraser, 2009). It is because of these ongoing developments, especially with attention to student contexts and environments beyond the mainstream that motivates the study described here.

4.3 Applications of LER instruments

Kose, Bag and Gezer (2007) elaborate in a research bibliography the more than 300 hundred references in the field of LER in the last 20 years. The work comprises articles, monographs, conference presentations, and dissertations using LER

methodologies. Despite the tremendous contributions of LER to improving science learning in classrooms (Frazer, 1994), it has been criticized as being focused on normalization of classroom practice emphasizing practices most favourable to the dominant culture and orthodox Western science vehicle (Michie, 2011). Drawing on this bibliography and other landmark studies, I will address the relevance of Michie's critical statement as described above versus that of Fraser (1998) that stipulates:

“The field of learning environments has undergone remarkable growth, diversification and internalization. [...] Few fields in education can boast the existence of such a rich array of validated and robust instruments which have been used in so many research applications.” (p. 7-8).

Using a simple content analysis based on means and frequencies, I will determine how far the current research addresses the issue of mainstream communities in science education. Kose et al. (2007) inventoried 212 journal articles, conference papers, 83 PhD and Masters Theses. Of the 212 articles, 179 (84%) can be categorized as mainstream culture whereas 13%, namely 11 of the 83 theses, address nonmainstream issues.

Consequently, those statistics support the argument by Michie that describes LER as largely a Western Science vehicle. Western Science should be understood as a field of knowledge that favors “methods and curricula that give voices to the dominant culture group and disadvantage and silence the minority cultures” (Matthews, 1994, p. 20). Since major studies have been conducted within the majority culture, notably in Australia, North America and Europe, and address the main foci of Western science such as science methods, nature of science, positivistic views of science, Michie's (2011) claim is both accurate and poignant. However, when referring to the history and

evolution of LER, there is a genuine warming trend and willingness of integrating and accommodating minority cultures within LER studies.

Tobin and Fraser (1998) have acknowledged the cultural aspect, the diversity of population per se during their investigations. Inspired by the epistemological stance pioneered by Bourdieu (1992), they noticed:

Cultural diversity can be a challenge for teachers, especially when students have different native languages, but significant even when a common language is employed. There is an understandable tendency for many teachers to regard differences as in patterns of interaction and sense making as deficiencies to be corrected rather than as forms of capital to be invested in learning. In terms of learning environments, the extent to which cultural variation within a class is regarded as capital or deficiency is significant. (p. 626).

They referred to Bourdieu's "symbolic violence" to describe the situation whereby students from minority cultures (peripheral participants) are trying to participate in a community where their cultural capital is countless, as a foundation of learning. While they acknowledged science as a potential source of symbolic violence for all students, it is more a frequent issue for the peripheral participants, who have a different language from the majority. Those considerations emphasize the care by which LER pioneers treat the question of cultural diversity, making it a cornerstone for effective science learning in any learning environment.

This concern for the perpetuation of orthodoxy and the need to challenge the normalization of science education practice has been evident in the multiple efforts to adjust instruments for non-western contexts. The effort to cross-validate and translate many of the LER instruments into Indonesian, Korean, Mandarin, Arabic, and other

minority languages provides testimony of the LER community to more recently reach out to minority cultures that are usually left behind in mainstream studies (Aldridge, Fraser, & Haung, 1999; Aldridge, Fraser, & Laugksch, in press; Aldridge, Laugksch, Fraser, & Seopa, 2006a; Aldridge, Laugksch, Fraser, & Seopa, 2006b; Dorman, 1999, 2003). Aldridge has provided the research community with a few studies that are entirely devoted to students from non-dominant backgrounds, especially those living in South Africa.

Along with Aldridge, Fraser et al. (1999), there are other social scientists who drawn attention for the need to ensure instruments are context dependent. Among them I highlight the works of Anderson (2005), Bong (2005) and Chandra (2004) addressing girls' motivation in science and mathematics; Koul & Fisher (2005) addressing issues in Indian schools; Hirata & Sako (1999) addressing issues in Japanese schools; Li (2004) and Thomas & Mee (2005) inquiring on LE in Hong Kong kindergarten and primary classrooms; Park (2001) studying learning preferences of Armenian, African, Hispanic, Korean, Mexican & Anglo students in American secondary schools; Dhindsa & Fraser et al. (2005) and Dhindsa (2005) addressing cultural-sensitive factors in teacher training. For the sake of this study, it is worth mentioning the following: Lewthwaite, Stoeber, & Renaud (2007a, 2007b) who designed a Science Curriculum Delivery Evaluation Questionnaire for Francophone-Minority settings; Lewthwaite & McMillan (2007) who researched three Inuit communities in Qikiqtani, Nunavut, Canada and developed a LE instrument for this context; and Wood and Lewthwaite (2008) who have developed a LE instrument for Maori schools in New Zealand.

This list gives testament for the need to develop instruments for the contexts in which classroom improvement are identified as necessary. The list of instruments is never complete nor exhausted, and for this study, there is a clear gap in LER research for representing the concerns of minority students, including immigrant and refugee students who are increasingly resident in francophone-minority students in Canadian classrooms. Even though these scholarly references show how minority cultures are no longer marginalized in LE research programs, there are still identified groups where such research is necessary. Currently, there is evidence through the LER publications that research is increasingly cognizant of minority cultures and their unique educational needs. This study is aligned to respond to this consideration in terms of assessing learning environment of immigrant/refugee students within the Francophone minority settings.

4.4 Summary

This chapter has provided an introduction to Learning Environment Research which serves as the methodological foundation of this study. In this chapter, the nature of Learning Environment instruments has been discussed. As well, the history and contributions of LER have been considered and opportunities for new exploration have been described, including justifying the imperative for an instrument that responds to the context of immigrant/refugee students in francophone-minority classrooms. In the chapter that follows, the methodology for this study will be described.

Chapter 5 Research Methodology

5.1 Introduction

This LER study followed a mixed method approach drawing from other landmark studies in the field (Fraser, 1998; Lewthwaite, 2001; Lewthwaite, Stoeber, Renaud, 2007a, 2007b). As previously stated, the study, typical of most LER agendas, uses a mixed-method three-stage approach using an initial *qualitative* stage followed by a *quantitative* stage and, finally, an *application* stage. The application stage, which blends both qualitative and quantitative methods, closes off the study. Traditionally, LER has benefited from the robustness of mixed method research wherein scales of instruments are developed from insights and constructs salient to the study context (Moos, 1974; Fraser & Tobin, 1998; Roth, 2009; Tobin & Roth, 2009). In this study's case, the context of the study is likely to give evidence from students' of the acculturation processes of cultural discontinuity and, potentially, symbolic violence (Karsenti & Savoie-Zajc, 2004) they experience in their transition. The threefold phase method, qualitative, quantitative and application of the instrument, was adopted to ensure the quality of the current study in accordance with LER practice. In the sections that follow, the methods used in the study are described. Section 5.2 describes the context of the study, including the participating school teachers and students. Section 5.3 explores the methodological theoretical underpinnings of the study. In this section, interpretivist, positivist and transformative theories will be examined that inform the analysis of the data and the discussion. Section 5.4 describes the qualitative methods of the study that encompasses interviews with teachers and students. Section 5.5 describes

the quantitative aspects of the study. Section 5.6 describes the third phase of the study, the methods for the application phase. Section 5.7 describes procedures associated with ensuring quality of the study; credibility, transferability, dependability and validity. Section 5.8 describes the ethics procedures associated with the study. Finally, Section 5.9 draws the chapter to an end summarizing what has been presented and introducing.

5.2 Participants and settings

This section presents the settings in which the study was conducted. This includes the DSFM profile along with information about the participants, especially the countries of the origin of the participant refugee students and a brief description of the education system of these countries. Lastly, students and teachers' profiles are detailed.

Settings

This research took place, primarily, in two urban secondary schools of the Division scolaire franco-manitobaine, the Francophone school division that is located in the province of Manitoba. Although the quantitative component of the study included a broader participation of schools in jurisdictions similar to the DSFM, the study, overall, is located exclusively within the context of the DSFM. Founded in 1994, DSFM is mandated to providing French public education to the sons and daughters of the *ayant-droit* (entitled) students according to Bill 21 that legitimates the *raison d'être* of this province-wide school division, as stated in the Manitoba School Act (2009):

“In this Part,

"Charter" means the *Canadian Charter of Rights and Freedoms*; (« Charte »)

"entitled person" means

- (a) a resident of Manitoba whose first language learned and still understood is French,
- (b) a Canadian citizen resident in Manitoba who has received at least four years of primary school instruction in a francophone program in Canada, or
- (c) a Canadian citizen resident in Manitoba who is the parent of a child who is receiving primary or secondary school instruction in a francophone program in Canada or who has received not less than four years of such instruction; (« ayant droit »)

With the changes to immigration policies by Manitoba Immigration during the early 1990s, a substantial increase of Francophone immigrant/refugees was recorded. In response to this, the DSFM schools opened its doors to immigrant and refugee coming from countries in war or political unrest. A report issued by Accueil Francophone (2014), the organization working at Immigrant settlement, and sponsored by SFM (Société Franco-manitobaine), delineated the issues that have prevailed in the original countries from which where the immigrant and refugee students arrive from. The report emphasizes that a large proportion of the new immigrants comes from refugee families. Few Manitobans know these students' socio-economic and cultural background and, especially, the educational experiences they have encountered in their home countries prior to their move to Canada. These experiences, including a lack of experience with

more formal schooling, are likely significant influences on immigrant/refugee positive transition in DSFM schools.

In Africa, four main Francophone countries are identified as 'producers' of refugees: the Democratic Republic of Congo, Rwanda, Burundi and, most recently, the Ivory Coast. Some historical references may help to understand the root causes of refugee status, but the Accueil Francophone (2013) report adds that living conditions in the refugee camps are very precarious.

The inhuman conditions that prevail in the refugee camps are as follows. With the arrival of more refugees each week, toilets and tents have become completely dilapidated and inadequate. Some refugees sleep in buildings constructed to serve as schools for children, but most sleep outside on the ground. There are women who give birth in open space without any medical assistance. There is also a lot of old people who are alone and sick. Rescue teams are distributing food, like corn flour and vegetable oil, but it is still insufficient and famine spreads quickly in these camps.

The children, who are the most vulnerable population, are exposed to all sorts of epidemics (cholera and malaria in particular) despite the efforts of well-known international organizations such as Doctors without Borders and the Red Cross. Nurseries are often created to allow toddlers to flourish so they can forget the atrocities experienced in their country. The refugees are often coming under attacks by armed groups which neither the origin nor the affiliation is known. Some villages saw their classrooms occupied by refugees who could not get proper housing and shelter. Thus, many schools are closed, and students cannot study, resulting in a phenomenon called underschooling. This relatively limited experience with formal schooling may be problematic for immigrant/refugee students' transition to DSFM schools.

Educational systems of the home countries

Most countries where immigrant and refugee students are coming from have their educational system derived from France and Belgium. The Belgium educational system comprises a pre-school phase that lasts three years and it is not mandatory. By the age of six, children start school at primary level where they will spend six years. Afterwards, they will move to secondary level, as a twofold phase, where they will stay for six years. They are then admitted to tertiary level to attend post-secondary institutes and universities. Similarly, France shares the same characteristics with a small difference; children start elementary school at seven and leave after six years. Then, they will move to middle school and secondary school; both will last seven years in total. That will lead to post-secondary institutions. Most of the African countries, such as Ivory Coast, Senegal, Togo, Cameroun, Benin, Morocco, Tunis, Alger and the Democratic Republic of Congo, from which the new students are coming, have embraced the France educational system. These former colonies are still under the influences of the colonial systems of France and Belgium. After the series of independencies of African countries in the sixties from France and Belgium, particularly; there has been a huge demand for education services in these countries. However, these local governments are not able to respond to this social demand.

The Francophone African school systems face major issues that affect the quality of education provided. Low pass rates, lack of instructional materials, scarcity of qualified teachers, poor structure and infrastructure, fair access to education and big class sizes are among the main issues that hamper these educational systems (Ngub'

Usim, 2007). Teachers act as an authoritative figure where students have to listen during teachers' exposition and rote memory is highly valued. Students are supposed to render through memory exactly what has been taught in class; therefore, there is no room for creative endeavor such as open-ended science investigations. As noted by (Ngub' Usim, 2007), the fear of giving the wrong answer, the high value allocated to book knowledge and teachers writing on the board while students are primarily passive and limited to constantly taking notes constitute a clear picture that portrays what is happening in African classrooms where the refugee and immigrant students emigrate from. It is possible that the DSFM classroom, which encourage an inquiry-based approach and, subsequently, students' active participation, may be problematic for immigrant/refugee students. Further, it is likely the social and linguistic experiences of students are to be different from that in practice in DSFM schools. Further, it is possible that the cultural practices of classrooms in the DSFM are considerably different from what students have previously experienced. All of these differences are likely collectively of significance in influencing students' successful transition.

5.3 Phase I: Epistemological Orientations

This study draws from a three-fold epistemological base. Similar to most LER agenda's it combines interpretivist and positivist foundations because it employs a mixed-method approach drawing from qualitative and quantitative orientations. In the first phase of the phase, it draws from an interpretivist paradigm. The researcher uses qualitative methodologies that are directed toward understanding through the voices of

refugee/immigrant participants their educational experiences in mainstream science classrooms. In the second phase, the methodological stance is positivist because quantitative methodologies are used to extract the most understanding from statistical data using a commonly prescribed approach (Fraser, 1988, Lewthwaite, 2001). Finally, the methodology is embedded within a transformative paradigm because in the final application phase, the data collected provides opportunity for teachers to reflect and make critical decisions about their own teaching practices in working with and instructing immigrants/refugee students in science. This final phase, potentially, draws teachers' attention to the existing structures of classrooms and schools and how these might need to be changed to support immigrant students.

The interpretive phase gives voice to stakeholders, both science teachers and particularly their immigrant/refugee students. Also, the author is framing these voices, collected through semi-structured interviews, into meaningful vignettes with regard to the research questions being scrutinized. This clearly presents this study as an effort to capture the personal experiences of teachers working within the French minority setting in Manitoba and their Francophone student immigrants who are integrating the system. Studies crafted by Piquemal et al. (2008; 2009), Lewthwaite et al. (2009) and Rivard et al. (2010) are part of this literature canon when it comes to understanding the current francophone educational learning environment in Manitoba, especially from the perspectives of students and teachers.

The positivist quantitative phase that follows inquires about the statistical relationships between the learning environment of science instruction and the

perceptions of immigrant/refugee students, which ultimately leads to the elaboration and development of the research instrument.

Once developed and when applied, the research also belongs to the transformative methodology tradition because it encompasses a critical framework. The data collected from the instrument's application can likely cause reconsideration of unquestioned pedagogical practice that discriminate and promotes change in how the classroom learning environment and its practices can be adjusted to support immigrant and refugee students in their transition.

Each of the three phases will be explained in the sections that follow.

5. 4 Phase I: Qualitative Phase of the Study

The first phase of the study was qualitatively oriented and sought to gain an understanding of the experience of immigrant students and their teachers of science within the Manitoba francophone-minority settings. It also drew from other stakeholders at the school level who were likely to have had a first-hand experience with immigrant/refugee students and the likely influences on their successful transition, especially at the classroom level and in science education. The focus of this section sought to understand the experiences of both and what they each perceived as positive contributors and impediments to the transition of immigrant/refugee students. In line with the focus of LER, it sought to understand from participant's perspectives the social, physical, linguistic, pedagogical and epistemological influences on their learning. It also sought to understand from teachers' points of view what adjustments

and changes were necessary to assist them in fostering students' transitions. As well, the qualitative phase in LER instrument development typically includes a review of the literature. The review sought to augment through the scholarly research, teacher and student perceptions of influences on their successful transition, especially those transitioning as a minority. Although the literature review in Chapter 3 drew attention to these influences and dimensions, the literature review for this component sought to identify specific teacher personal attribute and environmental factors that could be included in the instrument to be subsequently developed in phase two of the study. Specifically, the first phase of the research sought to understand the practices and actions of teachers influencing immigrant/refugee students' learning experiences, both positively and negatively, in science education. Further, this phase also included the participation of a focus group that assisted in identifying potential gaps in the preliminary findings and suggested further inclusions of factors of influence on the successful transition of refugee/immigrant students in DSFM science classrooms. Ultimately, and similar to the orthodoxy of LER instrument development, the findings from this phase of the study were used as the foundation for the inclusion of items in the LER instrument to be developed in phase two. In summary, the data collection for this phase arises from interviews with teachers and students, a focus group with both teachers and students and a literature review.

5.4.1 Student recruitment and profiles

Recruitment of students to participate in this study was conducted using a two-step process. The 16 students who consented to participate in this study were newcomers (Élève Nouvel Arrivant or ENA) who have joined the DSFM within the last five years, as stipulated by the School Division policy on immigrants and refugees. These students came from six different countries including Haiti, Ivory Coast, Congo RDC, Congo Brazzaville, Guinea Conakry, and Egypt (DSFM, 2010). (See table 6.2b). Criteria such as less than five years arriving in Manitoba and registering in a science class in the DSFM were the selection criteria for student eligibility (Locke et al., 2007). They were aged between 15 and 18 and were enrolled in general science classes in which students learned about science topics such as ecology, electricity, basic chemistry, mechanics, and astronomy and reproduction modules. These classes are mandatory at the Grade 10 level.

Students were recruited using a snowball sampling technique, meaning as they were interviewed, they suggested other students that may have an interest to participate in these interviews. This chain-referral method allowed the researcher to start with a small group of recruits who became informants to reach out more participants. As suggested by Brackertz & Meredyth (nd) and Noy (2008), this sampling method is especially useful when recruiting hard-to-reach groups that include minorities and marginalized groups. This form of sampling is very useful in a qualitative study because it uses participants' social networks and personal contacts to access other prospects for the study. As Noy (2008) noted snowball sampling is primarily “social” using friends,

friends of friends of friends, acquaintances, acquaintances of acquaintances, contacts, contacts of contacts as a social spiral and neural networks. The students involved in the study were mostly attending general science classes instead of advanced science classes as a result of the academic deficit they had accumulated preceding their arrival to Canada.

The process to recruit students for the study was done as follows. First, the DSFM administrators were contacted through emails that presented a thorough description and intentions of the research. Then the DSFM Superintendent granted permission to contact local school administrators, principals or special education teachers, the latter because they were typically involved in supporting the procedural accommodation of immigrant and refugee students during their enrolment process. In turn, school principals agreed that I could contact parents whose children's profile suited the participants "persona" I wanted to interview. School databases were also used to identify the parents and students who ultimately participated in the project. Parents who agreed for their children to participate returned the consent form to the researcher using the school office facility. Interviews were conducted on school premises or at parents' depending on their preferences (See Appendix A).

5.4.2 Teachers' Profiles

The teachers who were interviewed in this study were employed by the DSFM. A letter was sent to the Superintendent to access school venues to do the study. Upon the DSFM administrators' approval, letters describing the study and informed consents

were emailed to teachers whose profiles met the study recruitment criteria. Those who consented then shared their experiences and perceptions of teaching science to newcomer students. These interviews took place on school premises after school hours or were conducted over the phone according to the interviewees' preferences. Digital files of the interviews were shared with participants as an opportunity to re-evaluate their informed consent right on publicizing some collected data. The interview protocol is presented in Appendix D and largely seeks to understand teachers' experience in teaching immigrant and refugee students within the science classroom and their perception of the influences on students' transition.

5.4.3 Interview with Teachers and Stakeholders

First-hand data needed to be collected primarily from students and teachers. Thus, the purpose of this phase of the study was to gather data on the perceptions from science teachers of their experiences with the immigrant/refugee students' academic and social integration in three urban schools of the DSFM. Although teachers participated in this process, the researcher also sought input through an informal process from counsellors, student service specialists and other school personnel who were able to share their perceptions on how these students have experienced schooling and science in Manitoba classrooms. Interviews took place either face-to-face or over the phone. The format of the questions was broad rather than specific in order to get rich data to build a clear picture of these young immigrants/refugees' experiences from a teacher's perspective. Therefore, the use of open-ended questions was implemented (See

Appendix A). Two non-exclusive criteria were used to select teachers' interviewees: experiences in science teaching and experiences with immigrant/refugee students (Locke, Spirduso & Silverman, 2007).

Interviews with teachers were processed according to the guide provided for data reduction and analysis by LeComte, Millroy and Preissle (1992). Initially, each interview was analyzed and common data categories were developed for each interview with special attention to teacher specific and environmental factors that influenced teachers' perceptions of influences on student transition to science classrooms within the DSFM. It was anticipated that many of these factors would be typical of what influences student success in science classrooms as outlined by, for example, Hoy (1998) in the Collective Efficacy Scale. These themes are commonly associated with factors such as school ethos, professional support and development, resources and time. It was also expected that comments would surface that were associated with less commonly identified factors such as linguistic and social aspects that might be influencing student transition. Finally, it was also possible that teachers might show some indication of issues associated with philosophical, cultural and even epistemological aspects influencing student transition. Congruent data emerging from the interviews determined whether these categories were to be retained or rejected. This iterative process continued until the data saturation was evident; that is no further emerging themes were evident in the teacher and stakeholder conversations regarding immigrant/refugee transition into mainstream classrooms.

5.4.4 Interview with Students

To fully comprehend the experiences of the immigrant/refugee students in the DSFM, I engaged with a group of 16 immigrant/refugee students in in-depth individual conversations about their science learning experiences. I asked students to share their science experiences and perceived influences on their transition and their performance in science classes (See the interview guidelines at the Appendix A). With the permission of parents, these interviews were able to shed light on the peculiarities of being an immigrant/refugee science student in the context of the French community settings in Manitoba. Pedagogical practices and social interaction processes drawn from students' socio-cultural experiences were considered in the interviews. As well, assessment practices and outcomes were also explored, since evidence shows that students who have the opportunity to engage in more authentic assessments, those aligned with the contexts of their social-cultural backgrounds, are more motivated to do science (Garcia & Pearson, 1994; Lacelle-Peterson & Rivera, 1994). These interviews also provided insights into students' self-perceived level of integration and social networking within the classroom.

Interviews with students followed the same iterative process as that of teachers. However, in contrast to the teacher interviews, primary data were not able to be compared to the literature base because there was a lack of data in the current literature that gave voice to newcomer students' experiences in science within the Francophone minority settings, other than some inferences arising from Lewthwaite et al. (2007) and Piquemal et al (2009).

Overall interviews with students lasted around 20 minutes on average and took place either at schools or at students' according to parents' preferences, whereas these with teachers the interviews lasted 50 minutes on average and took place either at school or over the phone. All interviews were transcribed, hand-coded using color-coding for each theme, and analyzed using Texalyser-online text mining software-giving the frequencies of terms and occurrences of pre-defined concepts. The results were re-examined by the focus group to further decide which themes and items would help design the first draft of the learning environment instrument, the Minority Immigrant Science Learning Environment Questionnaire.

5.4.5 Focus group

A focus group was formed for two purposes. First, the group assisted in identifying any influences on student transition that may not have surfaced through the student, teacher and stakeholder interviews or the literature review. Second, and as will be discussed in Section 5.4.3, the focus group had a role associated with the second phase of the research leading to the development of the instrument. In the development of the instrument, it was important to identify all of the perceived influences on students' transitions, as suggested by the participants and literature. It was assumed that some of these influences would appear more than once in the categorization process that would lead to the initial questionnaire. For that reason, a group of six participants, coming from different areas of education, was selected to participate in a focus group in order to work together to analyze, categorize and rank a list of items that they were

given. The process was guided by a Task Completion List that delineated the role of each member of the group before they started reviewing the Item list. The procedure followed Knight and Meyer's (1998) suggestion that a focus group would help identify gaps in the interviews and assist in identifying trends and patterns in the data.

Furthermore, the focus group was deemed as useful to corroborate on the researcher's decisions (Merriam, 1988; Fowler, 2009) leading to the development of the instrument in the second phase of the study.

The focus group was composed of two science educators, a graduate student in science education, a retired secondary school teacher in the DSFM, a science consultant, and a science education professor knowledgeable in instrument design. The focus group was divided into three subgroups to perform the task of first identifying any potential omissions from the perceived list of factors influencing students' transition and teachers' teaching to foster a successful transition. As well, and as will be discussed, they were asked to identify logical groupings for these perceived factors and allocate the items to the appropriate emerging factors. They were also asked to prioritize these factors according to the level of influence they believed the item carried in influencing students' successful transition. These rankings would ultimately serve as the main criteria for the selection of items that would assist in structuring the initial instrument.

5.4.6 Literature Review

As mentioned, the qualitative phase in LER instrument development typically includes a review of the literature. The review seeks to augment through the scholarly

research teacher and student perceptions of influences on successful student transition. Although the literature review in Chapter 3 drew attention to these influences, the literature review for this component sought to identify specific teacher personal attribute and environmental factors that could be included in the instrument to be developed in phase two of the study. The literature review for this study was completed and has been partially presented in Chapter's 2 through 4. Scholarly papers pertaining to commonly identified issues associated with the delivery of science education were analyzed to identify impediments and contributors to influences on student transition to the DSFM environment and ultimately engagement and learning in science. Although influences on student success are commonly identified in the science education literature, especially in regards to effective teaching practices, important for this study were the context-specific influences identified in the scholarly literature on immigrant/refugee student integration. Studies were gleaned that focused on issues such as the integration of students (Piquemal et al., 2009, 2010); science education pedagogical models in minority settings (Cormier et al., 2004); minority education pedagogy in general (Gilbert et al., 2004); and studies pertaining to French-minority education addressing more epistemological considerations such as post-colonialism, cultural discontinuity, and teacher efficacy (Pruneau et al., 2001). Ultimately, all of these studies were used to identify the many influences on student engagement and learning in learning in science education and highlighted teachers' perception of these influences on the effectiveness of their teaching. These studies not only informed the items that would be contained in the instrument being developed but also served as a background to analyze the results of

the qualitative aspects of the study. It is noteworthy that although there was literature pertaining to these topics and the minority context, there was little literature that specifically pertaining to the pedagogical practice of classrooms.

5.5 Phase II

This phase was quantitatively oriented and comprised the draft instrument development and statistical validation process. The phase one data served to identify items that could be included in the Learning Environment instrument. Interviews, focus groups and literature findings underpinned this phase of the study with the ultimate main goal of designing a statically robust and comprehensive instrument that could capture the many influences on the effective transition, teaching and learning of science for refugee/immigrant students in minority settings. Thus said, here is the detailed process of the development of the *Instrument for Minority Immigrant Science Learning Environment (I_MISLE)*

5.5.1 Development of Initial Instrument

The development of this instrument followed the traditional pattern of development of other LER instruments (Lewthwaite, 2001; Lewthwaite et al, 2007). The phase one data collected from a literature review, interviews with students, teachers and other stakeholders and focus group participation allowed the researcher to identify the influences on immigrant/refugee students' successful transition into DSFM science classrooms. These influences became the substance for the individual items that were

included in the instrument. After the focus group had categorized these items and the repeating items and low prioritized items were eliminated, a final list of items for the instrument was secured. The items were then organized into a provisional instrument following the typical orthodoxies of practice in LER instrument development. These processes included:

1. Consistency with existing instruments. The Instrument for Minority Immigrant Science Learning Environment (I_MISLE) that was developed is aligned in a structural format with existing instruments like the School Level Environment Questionnaire (SLEQ), the What is Happening in the Classroom Questionnaire (WIHIQ), the Science Curriculum Implementation Questionnaire (SCIQ) the Science Delivery Evaluation Instrument for Francophone-minority Settings (SDEIFMS) developed by Lewthwaite et al. (2007).
2. Coverage of Moos, general categories. The SCMIQ integrates the three general categories pioneered by Moos (1976) to examine all learning environments. They are as follows: Relationship Dimensions, Personal Development Dimensions and Maintenance, and System Change Dimensions. These categories are coherent with internal and external parameters that may affect science delivery curriculum in a minority setting.
3. Acknowledgement of Levin's and Murray's models as critical descriptors for analyzing human behavior patterns. Lewin (1936) considered factors such as personality and the environment and their interactions as a dynamic process

to model human interactions and behavior. Murray's need-press model and environmental press are crucial to analyzing human behavior patterns. Contemporary science education scholars such as Fraser (1998, 2010), Lewthwaite (2007) and Fisher (2008) adhere to the need-press model.

4. Economy of use. One of the parameters influencing LE instrument development is ensuring that the instrument is not so lengthy that it becomes a source of frustration for teachers to complete. The LER instrument needs to be able to be deployed on a large scale without costing a fortune, both in terms of time and finance. For these reasons the researcher decided to develop a provisional instrument that contained 10 items for each of the factor scales identified by the focus group. By allowing for 10 items in the provisional instrument, there was flexibility to reduce the numbers of items in the final instrument after the statistical validation process.

5.5.2 Validation and Refinement of Instrument

Ultimately, the instrument needed to have several scales each with several items that would capture the influences on students' successful transition. Statistically, the items would be resident within particular factors, each of which would have limited overlap with other factors. Statistical validation of instruments requires a large participant base and the participants need to be teaching within the context for which the instrument is being developed. For this reason, the provisional I_MISLE was distributed to as many schools within the DSFM and similar school divisions across Canada as

possible. Typically, numerous teachers are needed to answer each item of the questionnaire to provide statistical validity to the process (Fraser, 1998). This means a large participation of teachers' participation was required for statistical validation. Letters of intent were sent to principals and administrators of DSFM and other francophone school divisions throughout Canada where teachers of science in high schools were likely teaching immigrant/refugee students. The primary intent was to survey French-Manitoba, other Western Canadian French schools and perhaps some schools in Toronto to get enough participants to validate the instrument. Unfortunately, because of circumstances beyond the author's control, only 80 teachers across these schools completed the online questionnaire despite an anticipated participation of 150. Construct validity analysis and internal consistency statistical data were generated to ensure the generalizability of the instrument within, of course, the similar environments in which it was developed.

A Component Principal Analysis (PCA) was run in order to identify the main factors that influenced students' transitions to the teaching of science in mainstream classrooms. This process would assist in designing the final questionnaire reducing the data while retaining the key factors that explained the latent factor being studied (Field, 2009). This method was used to frame the I_MISLE questionnaire design in pointing out the main factors that affected the latent variable, in this case, the perceptions of teachers and students of the influences positive transition and accommodation into DSFM science classes. Also the Cronbach-Alpha was also implemented to examine the correlation among items so the researcher could measure the internal consistency of

each factor (Field, 2009). Systematic statistical analyses through SPSS package were performed and contributed to refine the selection of both scales and items that were, ultimately, retained in the final instrument.

5.5.3 Application

Once the instrument was statistically validated in phase two of the study, the third and final stage of the study involved the application of the SCMIQ the schools from which teachers and students had been interviewed. The intent of the application was to gauge whether the results from the qualitative phase corresponded to what was measured by the instrument through its completion by teachers. It is important to note that because of Ethics requirements, the participants were required to complete this anonymously and the school was not allowed to be identified, thus resulting in this data being aggregated in this final application analysis. Consequently, the aggregated would not allow the researcher to get a detailed quantitative description of each school. In essence, did the data collected from the instrument completion by these teachers correspond to what they perceived was happening in science classrooms that were influencing teaching and learning with immigrant/refugee students at the DSFM school division? The quantitative data collected from the Likert-type scale questionnaire were compared to those collected from the interviews with teachers and students. Following these methodological steps, are issues very specific to the context of French-minority settings wherein the study was conducted.

5.6 Context-related issues

While this study was conducted with the methodological rigor required to build an instrument according to the LER orthodoxy, the findings of this study are restricted to and because of:

- 1) Minority contexts in education. Minority educational settings such as these of Maori in Australia (Bishop, 2012) and those in Canada (Gilbert et al., 2004; Rivard et al., 2008) have their own set of social dynamics and issues, especially these of linguistic oppression, acculturation and neocolonial concerns. Because of these specific characteristics, one should be cautious when applying the instrument to contexts dissimilar to wherein it was originally generated.
- 2) Small number statistics. The fact that this research was dealing with very small numbers, less than what is usually deemed necessary as per the ratio participants per item (as the rule of thumb of 5 participants per item), the data should be cautiously taken into consideration for any potential transferability to other studies (Brinkman, 2009; Prentice & Miller, 1992)
- 3) Position of the researcher. One should be reminded that the researcher himself is an immigrant, a visible minority teacher working for the school division where the study was done. Therefore, the data that were collected during interviews with fellow teachers and students for which he was an authoritative figure might influence their answers and considerations (Hinkin, 1995). This double aspect (ethnicity and insider from the milieu) might also transpire during the process of data interpretation and the conclusions made from the study.

That being said, all effort was made to follow the orthodoxy of valid mix-method research such as content validity, criterion-related validity, construct validity, and internal consistency. As stated by Hinkin (1995, p. 968):

Content validity refers to the adequacy with which a measure assesses the domain of interest. Criterion-related validity pertains to the relationship between a measure and another independent measure. Construct validity is concerned with the relationship of the measure to the underlying attributes it is attempting to assess. Internal consistency refers to the homogeneity of the items in the measure or the extent to which item responses correlate with the total test score.

These well-accepted parameters were followed to assure that the instrument met the criteria of validity and reliability. Overall, if there were instances where statistical significance might be a problematic issue; content significance was a reliable compensation in such occurrences.

5.7 Procedures

In summary, the following procedures were followed in the research process to design the questionnaire that is intended to gauge the perceptions from teachers of the teacher personal attribute and environmental influences on the successful transition of refugee/immigrant students in science classrooms:

- 1) Interviewing current DSFM science teachers about effective classroom teaching practices that influence immigrant/refugee students' transition into DSFM classrooms;
- 2) Interviewing current DSFM students in Grades 10-12 immigrant/refugee students about classroom teaching practices that influence their transition into DSFM classrooms;

- 3) Reviewing the literature on science program delivery and influences on teaching and learning in mainstream contexts;
- 4) Reviewing the literature pertaining to the influences on student, especially minority students and their engagement with and transition into mainstream science classrooms;
- 5) Using a focus group to identify categories of classroom factors and prioritizing factors influencing immigrant/refugee transition;
- 6) Designing the provisional questionnaire;
- 7) Implementing the questionnaire amongst teachers in Francophone-minority settings in Manitoba and locations across Western Canada and Ontario;
- 8) Statistically validating the instrument;
- 9) Modification of the instrument based upon the statistical validation process;
- 10) Application of the instrument in one of the phase one schools to determine the congruence between the quantitative data and the phase one qualitative component of the study.

5.7 Summary

The focus of this chapter has been to describe the methods used in the development, validation and implementation of an instrument to help to assess the current conditions in DSFM science classrooms that may be of influence to immigrant/refugee students' successful transition. The methodologies used in Phase I of this study (teachers and students' interviews, systematic literature review) were

qualitatively based and embedded within an interpretivist theoretical framework. Phase II of this study mainly dealt with the development and validation of the Instrument for Minority Immigrant Science Learning Environment (I_MISLE) (focus group, development of the questionnaire, validation and modification) and employed essentially quantitative tools with pattern discovery and statistical analysis using the software package SPSS. This phase of the research with its pre-determined quantitative procedural emphasis was embedded within a positivist theoretical paradigm. Phase II of the study applied the instrument in one of the original Phase I schools and used this data to determine how well the quantitative data described the Phase I school and also asked teachers to reconsider their practice in light of the emerging data patterns. This phase of the research was aligned with a transformative paradigm. Chapter 6 which follows presents the findings of Phase I of this research that encompassed interviews with teachers and students and a systematic review of the literature, both of which inform the content inclusion of the learning environment instrument.

Chapter 6 Qualitative Data from Teacher and Student Interviews

6.1 Introduction

This chapter provides a summary and interpretation of findings from interviews with teachers and students. These results are thematically organized into extrinsic and intrinsic factors perceived by teachers and students to be influencing immigrant/refugee students' transition in francophone-minority science classrooms within the DSFM. The data first examines teachers' perceptions of influences on the transition. Thereafter, the chapter illustrates factors that immigrant/refugee students themselves identified as influences on their transition. Subsequent to these analyses, this chapter discusses the commonalities and differences between students' and teachers' discourses and offers some reflections on best practices for influencing the minority student transitions in francophone-minority settings.

This chapter is structured as follows. Section 6.2 presents an analysis of data from interviews with eight science teachers that explored intrinsic (personal attribute factors) factors such as professional adequacy, professional knowledge, teacher efficacy, and equity, and extrinsic (environmental) factors such as time, professional support, school ethos, and students' interests; all factors teachers believed were influencing immigrant/refugee students' integration into the science classroom. It seeks to identify if teachers are aware of the nuance of students' transitions, especially in regards to the epistemological, socio-political and linguistic issues raised in Chapter 2 likely to influence students' transition. It scrutinizes dimensions of teachers' backgrounds and perceptions of their level of readiness and professional science

adequacy as educators of immigrant and refugee students. Section 6.3 presents data collected from 16 immigrant/refugee students on their perceptions on influences on their transition including personal attribute factors such as language competency and performance effort and environmental factors such as social networks within the science classrooms of DSFM schools. Finally, section 6.4 summarizes the information collected from both teacher and student interviews as presented throughout the chapter, and concludes by introducing the intentions of Chapter 7.

6.2 Teachers' voices

The science teachers interviewed, came from two schools, had three to nine years of experience working with immigrant/refugee students. The eight teachers interviewed, all with science and science education backgrounds, mostly received their initial training from the Faculty of Education of the Collège universitaire de Saint-Boniface, a French-language university in Winnipeg, Manitoba. The familiarity with such contexts is important for this study because it indicated because of their prior experience they were likely themselves well-adjusted to the nuance of such settings, and potentially conscious of the influences on students' transition.

Six of the participant teachers were male of which two were visible minorities, with an African background, and two Caucasian females. At the time of the study, they were teaching science in Grades 9 to 12 and held relevant academic competencies in the subjects taught. It is worth re-emphasising, as identified by Lewthwaite et al., (2007a, 2007b) that these teachers were delivering science curriculum in the DSFM in a setting

where most students, because their first language is not French, lacked proficient language skills and subsequently emphasized language acquisition in the teaching of science. As well, research has identified that science teachers in the DSFM perceived (1) their teaching workloads as being extraordinarily high, (2) they performed substantially more extracurricular duties and (3) they were under-resourced in both physical teaching and human resource support (Lewthwaite et al., 2007). It is also important that in this setting students typically have more negative attitudes towards science because of the language-based nature of the teaching (Lewthwaite et al., 2007; Pruneau et al., 2001). These previously identified issues are potentially factors that can influence teachers' abilities to support students in their transition, especially if students do not possess the 'academic and social capital' that is necessary to transition successfully.

As indicated in Table 6.1, the teachers had on average 5.25 years of experience working with immigrant/refugee students. Table 6.1 also shows their gender and whether they belonged to a visible minority group. In general, science teachers ($n = 8$) working at the two DSFM schools who voluntarily participated in this study demonstrated positive attitudes toward teaching science to immigrant/refugee students who were becoming new members of the Francophone minority community in Manitoba. Nevertheless, and as will be evidenced later in this chapter, they acknowledged that they were challenged in differentiating their practices because of the adequacy of their professional knowledge of students and of their sociocultural backgrounds, and as a result their professional level of teaching efficacy for assisting

students in their transition. The diversity in the science teaching personnel may be beneficial to minority students, because as seen in other studies, a teacher's background may positively influence the way immigrant/refugee students develop their self-esteem, as these teachers can act as role models for them (Lee, 1998; Piquemal et al., 2009).

Table 6.1
Teachers' Years of Experiences in Teaching Immigrant/Refugee Students

Number	Years of experience	Gender	Visible minorities
1	5	M	Y
2	4	F	
3	3	M	
4	4	F	
5	4	M	Y
6	9	F	
7	4	M	
8	6	M	

M: Male; F: Female Y: Yes

It was apparent from the interviews that a variety of environmental and personal factors were influencing teachers' ability to accommodate and facilitate the transition of such students into their classrooms. Teachers in both schools primarily commented, similar to what Lewthwaite et al. (2007) experienced, on several pragmatic environmental factors, including resource adequacy, professional support, and preparation time that positively or negatively influenced the science curriculum delivery to foster immigrant/refugee students' transition at the classroom level. They also

commonly made reference to the limitations of their professional knowledge in accommodating students' academic and sociocultural background, which they perceived required a specialised professional knowledge for facilitating students' integration. Alongside these aspects, their positive professional attitude and interest was identified as having a significant influence on fostering students' transition. Also evident in the interviews was the discrepancy between teachers' responses regarding external factors influencing their practice in working with immigrant/refugee students in areas such as resource adequacy and administrative support with one school being perceived as much more supportive of teachers in their efforts in working with refugee and immigrant students.

As science educators equipped with a wide scope of experiences ranging from three to nine years of teaching general science, chemistry, biology, and physics to immigrant/refugee students, the participants offered insightful comments on teaching practices they perceived as playing a particular role in student engagement and supportive of student's transition. The following sections list themes that emerged from the narratives, along with quotations from teachers and comments from the interviewer to, at times, elucidate points or parts of original narratives, as needed. Although several quotations could be included for each theme identified, this elaborated documentation is viewed as being of secondary importance to this study because the importance of the first qualitative phase in the research chronology is primarily to identify factors related both to the environment or extrinsic, especially at the classroom, and personal or intrinsic factors influencing immigrant/refugee transition into mainstream classrooms.

6.2.1 Environmental Factors Influencing Transition

A. Teacher perceptions of the necessity of administrative support and resources

Teacher participants identified administrative support (defined as different levels of help, support, and/or collaboration coming from supervisors, such as school principals and other administrative personnel and lead teachers) as a key element in supporting their ability to adequately address the academic and social needs of immigrant/refugee students. Studies in the literature have commonly identified the role of administrative support in fostering new curriculum initiatives, even specific to these of the DSFM (Lewthwaite, 2001; Lewthwaite et al., 2007b). In one school, teachers cited that having complete support from the administration had assisted them as teachers of science to support these new students in their transition. At this school, training, provision of instructional material, and group meetings were identified as tangible aspects of the administration's positive contributions to helping teachers support students in achieving success. In contrast, teachers from the other school cited the absence of administrative support as working against efforts to support students' transitions. As one teacher stated:

I don't think we are 100% equipped to do this job. Anyway, it is a kind of a new phenomenon [working with immigrant students]. We don't have a budget to buy instructional materials. We have to make some adjustments in our practice at the classroom and school level [because of the limited writing and reading ability] of these students. I don't know if there have been studies about these students' performance, but their literacy levels are low. The administration, along with all teachers involved, should elaborate some new tools like resources that can support their transition socially and academically. (T6)

Teachers' comments echoed Lewthwaite et al. (2007), who emphasized that Francophone schools (DSFM) in Manitoba were under-resourced, especially with regard to curriculum resources that teachers can use to engage and foster student learning. Teachers frequently cited that the resource issue was intensified because of the specific needs of refugee/immigrant students. To paraphrase one teacher (T6), there was a perceived need for improvement in the resources on hand to meet the complex needs of teaching science to students with great schooling deficits, especially in their reading and writing ability. Teachers described being under-resourced in general, specifically so for immigrant/refugee students, and saw reallocating and being innovative in managing meager resources as imperative (Kanu, 2008; Piquemal et al., 2009).

In the Francophone minority school setting, the lack of resources in science is often cited as an impediment to effectively teaching the subject. Some teachers pointed out this lack of resources as the main cause of recent poor performances of francophone minority students on international large-scale tests (CMEC, 2004; Lewthwaite et al., 2007; PISA, 2006; Pruneau & Langis, 2001). Therefore, as new immigrant/refugee students, profiled as a minority within other minorities, join the francophone minority student population, teachers have voiced concern that these test scores are likely to worsen because the complexities that influence transition into the system are already under strain. It might be easy to identify and blame the lack of French resources as presenting the greatest interference to the transition of these newcomer students, but

instructional material cannot be the sole blame, as at least a few considerations highlight the narrowness of this argument from several of the participants.

First, material resources were only seen as satisfactory if the teachers perceived their own competence and perception of their ability to work effectively with immigrant and refugee students. As gleaned from the interviews, some teachers who had limited experience with such students commonly attributed the difficulty of their teaching to a lack of resources, whereas more experienced teachers did not attribute such difficulty to resources. This finding suggests that teachers with higher efficacy have creative approaches to adapting resources for differentiated practices. Karsenty (2007) clearly addressed this issue when he differentiated a "tool from an instrument," the latter being a tool mediated by a skilful operator. As recommended by Piquemal et al. (2008, 2010) and Lee (1998), this is why initial teacher training and continuing professional education are key to helping teachers deal with the dynamics and ever-changing landscape of their profession--especially teachers who are instructing immigrant/refugee students. As we will see later in the sections on intrinsic values influencing transition, this training may contribute to teachers' self-efficacy and confidence in teaching science, especially for diversifying practice to accommodate immigrant/refugee students. Therefore, instructional resources, human capital, and human resources are directly related interactional elements that influence teachers in dealing with these resource demand issues.

Second, it is evident that although the development and production of science resources in Manitoba for English classrooms outpaces those in French, there are plenty

of science materials as instructional objects available through agencies external to the DSFM such as the Ministries of Education online portals of France, Quebec, and other French-speaking countries. Moreover, it is common practice nowadays that Anglophone universities, such as Carnegie Mellon University (2014) with the ChemCollective, a chemistry virtual lab software, University of Colorado (2014) with the PHET, interactive simulations in Physics, and MIT (2014) with the SCRATCH, offer online science resources that are open source (therefore free of charge) and in multiple languages. Finally, every well-known science agency or institution such as NASA has its counterparts in the Francophone world, such as l'Agence spatiale européenne. Therefore, arguing that there is a lack of resources in Francophone minority settings is hardly defensible; rather, these documents should be vetted by a local teacher aware of his or her students' cognitive abilities, cultural backgrounds, and milieus.

B. Teacher perceptions of the support available from external sources to support their teaching of immigrant students

Alongside the mention of pragmatic influences such as administrative and resource support, parent involvement in their child's education was another factor that was perceived to influence student success, particularly in science (Piquemal et al., 2010). In the case of the Francophone minority settings, immigrant and refugee parents described having great hope that their children will do well in the DSFM because of the opportunity it afforded them to integrate into a better school system. Therefore, to this population, academic success was highly regarded (Piquemal et al., 2009, 2010). Nevertheless, teacher-interviewees pointed out that parents of immigrant/refugee

students did not seem to understand the school expectations, which was often because of language issues that inhibited parental involvement in the educative process. This behaviour likely constituted a limiting factor to immigrant student's transition and potentially academic achievement in science. One teacher explained, "I had to communicate with one of my immigrant student's family, this year, but I didn't succeed. Her parents do not speak English or French, so we have tried to find better ways to assist and to communicate."(T8)

Sometimes, immigrant/refugee parents simply did not have the right resources or "capital" to help their children in a new school environment. These parents were coming from African school systems in which the schools mostly have the entire responsibility of instructing the students, as parents did not have formal experience with schooling. This problem was compounded by the hard reality that parents were often illiterate and therefore, incapable of helping their children do homework or other science projects (SFM, 2014; UNESCO, 2014). It was, therefore, impractical for teachers to ask for parent involvement in this matter even though most African parents still involved themselves in the self-discipline of their children, thus making the teacher's job more successful.

Moreover, immigrant parents, especially refugee parents, were not aware of the expectations of the Manitoba school system. They were, like their children, in a transition phase made more complex by their own need to acquire a new language, that being English; the endless quest for a decent job, and, for many, the battle for the recognition of prior studies done in their home countries. These issues made new

immigrant and refugee parent involvement in their children's education complicated. Even attending parent-teacher meetings became a luxury that most could not afford (Piquemal et al., 2009).

In one interview, an immigrant father, apparently well-educated, told me of his disappointment at learning at the end of the school year that his son did not pass Biology 40S (Grade 12). He relied on his son's account in his home language (neither English nor French) to know what was happening in the biology class. He was upset when told by his son that he should be given permission by his son, being 18 years old, to gain access to his academic file. A similarly frustrating story was recounted by a father from Congo Brazzaville, where children are still treated as minors under parents' authority, even in their mid-20s. These are but two examples of how a lack of knowledge of a new school system's expectations can impact refugee parents.

The researcher believes that this matter of parents not understanding the cultural orthodoxy of schools should be addressed by community settlement organizations such as The Welcome Place and, particularly, The Accueil Francophone. These organizations should add to their agendas sharing these cultural expectations with new immigrant parents as early as possible and, at the same time, helping them access information about meeting these expectations from the school system. Although parental ability to support students in their transition was identified as an issue influencing the transition, teachers also described being challenged by the lack of time to adequately teach immigrant/refugee students. Time, a scarce educational resource, will be examined in the next section.

C. Teachers identified the time demands that were necessary to support students in their learning.

Prior DSFM studies identified time as an inhibitor to science implementation (Lewthwaite, 2001; Lewthwaite et al., 2007b). Time is a multidimensional parameter, with time necessary for planning the instruction to address the learning needs of students and, more significantly, time necessary to working with such students individually. Teacher narratives highlighted a common tension among teachers in attending to the significant learning needs of newcomer students in their transition to science classrooms, especially needs associated with students limited science learning and linguistic backgrounds, especially in the reading and writing of French and comparative to students from Canadian backgrounds. When queried about this issue, they mentioned the lack of time they had available. As one teacher explained:

I am not 100% aware and ready to teach these students. But, what I have seen as a huge obstacle is the class size. When I was working in a small group with my five immigrants/refugee students, they were experiencing some success. Sometimes, they are shy to ask questions when we are working in a regular lecture format class. When I was assigned a teacher's aide that was from their ethnicity it was then I started seeing some great improvements. However, with a class of 30 kids, it is unrealistic for teachers to find time to work one on one with students, especially with students that need such learning support. (T5)

Piquemal et al. (2009, 2010) have already emphasized the issue of lack of time for individualized instruction within the DSFM regarding teaching refugee/immigrant students. In this ethnographic study, teachers seemed to understand that if they worked collaboratively, especially by involving those at the classroom level who are more familiar with these students' cultural backgrounds, they may be able to compensate for

lack of time. As noted by one teacher, “The teacher’s aide that is referred to in this verbatim surely talks their language and knows better the student’s cultural background than the science teacher and this made a great difference” (T5).

Time also became a factor in accommodating the complex learning needs of students in a fixed term semester. Because the Manitoba school system requires that cohorts move according to age level, and not to skill level, teachers and school counselors were challenged to find creative ways to accommodate what students are supposed to learn in schools within a defined period of time. Moreover, teachers of immigrant/refugee students were often challenged in trying to accommodate children impacted by trauma from war zone countries and consequently operating with huge schooling deficiencies; in some cases, students were performing at a grade 6 reading level at 17 years-old.

As Rivard et al. (2008) have reported, science educators should accommodate students at their cognitive level, especially by having resource people who are familiar with students’ idiolect and culture available to provide the individual support deemed necessary, especially in reading and writing to learn in French. Further, Piquemal et al. (2009, 2010) suggested that the DSFM hire more visible minority teachers to meet the newcomer students’ academic and social needs at the classroom level if the school division wants its threefold model of success (academic-identity-community) to become a reality.

As demonstrated in this section, the right resources advocated by sensitive administrators and science educators and support provided by effective community

leaders ensuring a liaison between school and parents are identified by teachers as key to making a difference in immigrant students' schooling experience. While the lack of resources constituted a key issue in approaching newcomer students' integration into science, teachers are duty-bound to become dedicated lifelong learners in equipping themselves with the proper knowledge, adequate tools, and human capital to support student learning. They must help every student, including refugee students, become achievers despite the multiple constraints, such as lack of time and other resources, and thus pave the route to individual and collective success in science. Even though (and perhaps because) most immigrant parents, who are supposed to be the first advocates of their children, were not able or ready to fully meet the school system's expectations, teacher commitment should be a professional mantra under a transformative pedagogy (Giroux, 2009).

6.2.2 Teacher Personal Attributes Influencing Successful Transition

Teachers identified a variety of personal attributes, that is, teacher-specific (intrinsic) factors that influenced their ability to accommodate such students through their teaching practices. These factors include professional adequacy, professional knowledge and interest, and a disposition towards equity. Far from being insignificant, these factors are key to helping teachers make key professional decisions that can either enhance or compromise newcomer students' engagement in learning science. The diversity of the student body in the DSFM appeared to play a significant role in supporting immigrant students' transition. Of particular importance was that teachers

were welcoming students from different sociocultural backgrounds, different school systems, and a range of science learning trajectories. These learning environments offered a particular niche for investigating newly emerging social interactions, particularly those of student/teacher relationships.

A. Teacher perceptions and knowledge of students' social, cultural, linguistic, emotional, and academic background

Teachers acknowledged how teaching new immigrant/refugee students placed considerable demand on them because of the students' varied socioeconomic, cultural, linguistic, emotional, and academic backgrounds and teacher perceptions of their own lack of ability to respond to such differences. They voiced that they were often confused about how to adequately build their teaching practices around students' backgrounds and worldviews, an issue that has been cited in the literature (Aikenhead, 2006; Cobern, 1996).

Academic backgrounds

This issue represented a challenge that compromised learning in science, as one teacher-interviewee explained issues related to academic background of these newcomer students:

It is so different to teach these kids because we don't know at what levels they are or what are their experience and background [social, academic, and cultural backgrounds]. For example, when a Canadian student enters my class I assume where he is supposed to be and [what he is supposed to be capable of]. I know what to expect in math, science and reading. I have a sense of their backgrounds. But, it is more difficult to know the academic level and background of immigrant/refugee students; because sometimes, they are way behind and so different compared to their Canadian peers. (T1)

Students' limited academic backgrounds were a concern shared by most teachers who were interviewed. As well, teachers commented frequently on students social needs.

Social-cultural backgrounds

As Bishop (2010) has reminded us, teachers' knowledge of their students' background may positively influence their teaching, and is in fact core knowledge for being an effective teacher. In one interview, the teacher admitted her lack of knowledge of students' background, especially their socio-cultural backgrounds as identified influences on students' transition. The frequency of this view among teachers, unfortunately, revealed that the DSFM teachers felt they lacked the necessary knowledge of students themselves that could inform diversified practice, especially in addressing students' linguistic and socio-cultural backgrounds that teachers perceived were 'inadequate' for the demands of DSFM science classroom success.

It became obvious in the interviews that the DSFM teachers were looking for means to 'identify' and 'understand' where students were at linguistically and socially relative to the normative demands of their classrooms. They sought elaboration or adjustment of appropriate data gathering tools to assess and understand newcomer students during their first days in school. Knowing very little of the home country education systems of these students, and not having the proper assessment tool for early remediation in science, led most teachers who were interviewed to cite their limited

skills in helping immigrant/refugee students integrate into science classrooms, academically, socially, and linguistically.

Not only did teachers have a dearth of knowledge about their students' backgrounds, they also identified that newcomer students, like their parents, held a very limited understanding of the normative practice and protocols of the Manitoba school system, notably of the grading system, a subject commented on by one biology teacher:

The student did not understand the result he got on a test. He asked me: Madam what does 60% mean. Is that good? For me, the answer was evident [meaning not so good], but for him it was not so clear . . . He did not know if the grade was Ok or not. I replied: 60% is average. That means you get 60% of the subject. It is not bad, but there's room for improvement. I did know how to handle the question; I was kind of puzzled. (T2)

This teacher was unlikely aware that in the Francophone African School systems, 60% is a good grade, and teachers put their expectation at 50% for a passing grade. This anecdote suggests the importance of the Manitoba school system intervening to help newcomer students understand the expectations of the school system. Such education would help bridge the gaps of academic and cultural discontinuities (Piquemal et al., 2009, 2010) and support teachers in becoming not only academic, but also cultural brokers, a concept developed by Aikenhead (2006).

Teachers' limited knowledge of the various students' cultures and school systems contributed to complications around newcomer students' success in science. Teachers observed that the better they understood the sociocultural background of the immigrant/refugee students, the more efficient they were in accommodating them (Aldridge, 2000; Bishop, 2010; Corbern, 1997; Ogbu, 1987). In this study, the more

teachers shared a cultural background with or even awareness of their students experienced more positive relationships with them. For example, teachers' aides from visible minorities appeared to positively enhance these new students' schooling experiences. As one teacher who had the same background as the majority of the newcomer students described it:

That [working with new immigrant/refugee students] was easy in my case. In fact, they can easily relate to me. I have even received students I am not teaching; they came to me looking for advice. There are a lot of them doing that. A few of them have called me their dad. (T6)

As Bishop (2010) has documented with Maori students, this kind of relationship is advantageous in helping students make an effective transition into a new science class.

Educators in this study noticed different challenges related to students' school performances depending on their political status as either an immigrant or refugee. The latter group had a tendency to have poorer scores due to hardships it has endured and the survival mode it experienced living in unstable refugee camps before moving to Canada. As well, they tended to possess less of the social capital required for successful school transition. As pointed out by Piquemal et al. (2009) and Kanu (2008), major differences exist between immigrants and refugees. As one teacher noted:

I have to differentiate [find out their immigrant status] from the beginning because immigrant students don't have as many hardships as refugee students do. But, I have to emphasize that the curricula are not the same, the cultures are different, and our school system is quite different from the countries where these students [from both groups] come from. (T4)

Immigration status was also linked to how these students presented themselves as students of science, especially their choice of words and levels of vocabulary.

Linguistic backgrounds related to science knowledge

Refugee parents were identified by teachers as facing more language barriers and other integration issues than those immigrating, especially those coming mainly from Europe and the Americas. Issues related to language barriers and culture shock were evident in teachers' narratives about their ability to make a difference in newcomer students' academic lives, especially refugee students. A few teachers voiced concerns that French is sometimes the third, if not fourth, language of these students. This lack of language mastery impacted the understanding and application of science, especially the sophisticated language associated with scientific concepts, especially in biology, where learning biology concepts is similar to acquiring a new language. Language fluency plays a critical role in learning science, as demonstrated in studies led by Lee (2005), Norris and Phillips (2003), Phillips and Norris (2009), and Rivard (2009). When asked about her approach to managing the lack of scientific vocabulary among newcomer students, one teacher pointed out:

I would like to have some time next year to teach the scientific vocabulary specifically, like we do in transitional math [where they provide students with a glossary and vocabulary activities that come with each new chapter]. I would do some pre-teaching of the vocabulary so they can grasp the concepts before they are exposed to them in regular classes. (T2)

As Laplante (2001), Rivard (2009), and others science scholars have emphasized, language is a pillar in learning science. In the case of the DSFM, Lewthwaite et al. (2007) found that sometimes the emphasis on learning French compromised mastery of scientific concepts. However, in the present study, teachers did not make significant

mention of students' oral language levels in influencing teaching and learning. They did though make some reference to students' reading and writing capabilities. Their narratives placed little emphasis on students' linguistic backgrounds in the transition. It would appear that the immigrant/refugee students coming in this study have their language at an adequate oral level for learning science even though they may lag in formal writing and reading.

Summary

In summary, teachers commonly mentioned students' inadequate science education background, not just in content knowledge but more commonly in the skills based aspects of science such as procedural and manipulative skills required in science experiments and hands-on science projects.

Teachers viewed how students are placed in schools as one of the main issues in ensuring the success of immigrant/refugee students in science classrooms. In Manitoba, students are placed according to their age, but participant teachers argued that placing students with substantial academic deficits into a new school system is not, and will not, be efficient in the long run. Teachers' uneasiness was compounded by the fact that science courses are primarily content-oriented, meaning that unprepared students can face insurmountable hardship.

As mentioned previously, a teacher's cultural background was seen to be a positive factor facilitating student/teacher connectedness. Out of eight participant teachers, only two belonged to the immigration population. Having similar immigration

backgrounds provided these teachers a better understanding of the students' background, as they were, in essence, insiders to these immigrant cultures. Research has acknowledged that students seem to relate better to teachers with similar ethnic backgrounds (Jegede, 1989; Ogbu, 1987). This value-added characteristic of the student/teacher relationship may expedite immigrant/refugee students' own academic and social integration into the school environment.

B. Teacher perceptions of their ability and competence to teach science to immigrant/refugee students

Teacher perceptions of their ability and competency in teaching science have been widely addressed in LER research, especially those that took place in the French minority settings in Manitoba (Lewthwaite et al., 2007, 2008). These perceptions were linked to teachers' sense of self-efficacy (Hoy, 1998; Pruneau et al., 2001). Some teachers thought that the requirement to teach science effectively to immigrant and refugee students presented similar challenges to those of teaching the average Canadian student. However, a few highlighted the differences that emerge in teaching this student population, and strongly argued for the respectful integration of this cultural diversity, encouraging more of an attitude of accommodation than of assimilation. As several interviewees explained:

Yes, these [immigrant and refugee students] students have different attitudes and habits, because I had a chance to talk to them about the education system in their respective countries, and there are major differences compared to ours. So we should find a balanced approach to help them [newcomer students] integrate our school system; also, we have to respect their habits and ways of doing things. That is not always easy because, at times, they will be placed in classes that are not at their levels [of ability]. Occasionally, it takes some time [for teachers and school counselors] to know what classes they are supposed to register in. (T5)

I do share similar background with these students, but as for my Canadian colleagues, everything is new. Even in my case, with my African background, I do face some challenges when instructing these students. In fact, the Faculty of Education I went to never talked about immigrant students integration, the phenomenon is quite new. They addressed, however, some aboriginal perspectives on education. (T6).

I remember during my B.Ed.; we talked briefly about it. The idea was to address any kind of students' background with special needs. So we went over immigrant and aboriginal students, everybody was put in the same basket. Therefore, we didn't receive enough instructional resources or strategies to [specifically] assist immigrant/refugee students. (T2)

As reported in these narratives, teachers clearly identified the need to reconsider their teaching approach in an attempt to respond to immigrant/refugee students' background in order to teach more effectively. Their concerns were beyond the pragmatic and linguistic and were drawing attention to epistemological issues. The second teacher pointed out the lack of knowledge about teaching immigrant/refugee students in initial teacher training, whereas the third teacher described trying to transfer general knowledge on differentiation and inclusion to a specific student population and recognising that this general application of one group to another is problematic. These remarks presented evidence of teachers' perceived need for professionally enriching ways of approaching the situation to compensate for teachers' self-identified lack of knowledge and/or competencies for supporting students' transition pedagogically.

Science educators teaching immigrant/refugee students in minority settings identified the complexity of the role and the difficulty in grasping the scope of

complexities they have to negotiate in order to help every student succeed in science. They realised it was not only about knowing science and general science pedagogies but also about responding to each student's cultural norms (Cobern, 1996; Lewthwaite, 2005). As mentioned earlier, teachers' perceived knowledge of teaching science are paramount to their effectiveness to teach immigrant/refugee students. The more knowledgeable they are or they are the more innovative their pedagogical practices may be. And the more students could benefit from their accommodating effort to meet each student with her specific background. This parameter addresses the component of teachers' efficacy as approached by science educators such as Bishop (2010). As the preceding narratives indicate, initial training in instructional practices to help immigrant/refugee children learn science was perceived as very limited.

Teachers also made reference to their own professional learning as science educators. Teachers' continued education was seen as crucial because, as emphasized during the interviews, teaching immigrants/refugee students was still a recent phenomenon in Manitoba, at least for them. Furthermore, they perceived their initial teacher education, as previously mentioned, never prepared them to deal efficiently with this new classroom reality. When asked if her initial training, life experiences, and professional development contributed to helping her students integrate into the Manitoba school system, one teacher answered:

Nope, I got this training on the go. I took a few classes at Masters' level that dealt with immigration and values. I have cumulated a personal toolkit that has proved very valuable to professional growth as I am teaching this new students' population. (T4)

She added that one of the pedagogical practices in her toolkit was knowing how to handle inclusive groups in the science classroom.

Teachers also identified they needed to be skilled at helping newcomer students build their social networks within the science classrooms and were thus expressing awareness of sociological influences on students' transition. Teachers reported a tendency for new students to isolate themselves or to limit their association to other immigrant/refugee students who have been in Canada longer (Piquemal et al., 2010). Students' academic integration was perceived as being associated with their ability to build a nurturing social network, as has been observed among Maori students (Bishop, 2010). In the beginning, as reported by teachers, new immigrant/refugee students tended to join students from the same cultural background when forming groups to work on science projects or other collective assignments. Being aware of this trend, a few teachers started setting precise rules and guidelines to encourage students from all cultural backgrounds to form more culturally inclusive groups. A grade 9 science teacher said:

I put them [new immigrant/refugee students] in groups where they have a chance to work. That makes more sense, according to me. In the past, I was not used to that and these students started isolating themselves. So I said to myself there is an issue there I have to address. I don't know what they are doing in other courses. When they are working alone, that allowed me to identify a few other things. In Universal Design for Learning, we identify students' strength and weaknesses, and build the teams according to these parameters. There are the learning styles identified by Howard Gardner; we asked students to fill a questionnaire. Those who are strong in languages are matched with those strong in math, so the groups can reflect some kind of diversity (T3)

In pairing students according to their strengths and weaknesses, this teacher was able to foster some level of success with his immigrant/refugee students.

Finally, teachers self-identified their limited effort in integrating cultural dimensions into their science teaching, an issue well documented in the science education literature (Aikenhead, 2006; Cobern, 1996; Fraser, 2006). The integration of cultural components of science into the curriculum is not explicitly required in Manitoba science education (Manitoba Education, 2014). All teachers agreed that the current science curricula did not reflect the cultural diversity found among their immigrant/refugee student population. Most teachers interviewed believed that explicit omissions of minority cultural views in science did not affect students' achievement in science; however, a few others argued that it does matter and pleaded for a more culturally responsive integration into the science curriculum. In their words:

I use a variety of visual instructional supports and manipulatives. I gave them a chance to voice their life experiences within the scope of the subject we are studying, and I add the academic components afterwards. I don't see too much cultural aspect in the curriculum; I haven't seen much of that in Grade 9 science, particularly. I have added some of them in my course, however. (T7)

Just changing and replacing people's name here and there to reflect cultural diversity, as for me, doesn't work. And I'm not only talking about science but for other classes too. I don't really think this small change [adding names from other cultures], per se, can carry any diversity awareness among teachers at all. (T2)

The Manitoba science curriculum's insufficient attention to multiculturalism was fiercely criticized by teachers asking for more than designated, token folkloric days dedicated to immigrant/refugee students' countries of origin. Moreover, this deficient cultural responsiveness within the Manitoba science curriculum, as reported by these

two science teachers, was seen as particularly problematic given that the immigrant/refugee student body was growing at a relatively fast pace (Manitoba Immigration, 2014). These teachers perceived the lack of a culturally responsive curriculum as a pressing issue in terms of the persistent cultural discontinuities between students' former education systems and cultures and the Canadian school system and cultural framework into which they are dropped (Piquemal et al., 2009). But culturally responsive pedagogy is neither explicitly part of the teaching agenda nor part of the teaching toolkit of teachers, as noted by other science education scholars (Aikenhead, 2006; Jegede, 1989).

One teacher, however, described a great module on the environment that allowed students to relate to the subject based upon their specific cultural backgrounds. Teachers interviewed assumed that science was a neutral subject and did not see that culture needs to be treated within the scope of science instruction. This view contradicts what has been advocated in science education, in particular in the works of Cobern (1997), Bishop (2010), and Aldridge et al., (2009).

Expanding on this subject, some teachers mentioned that these cultural gaps were not being properly bridged by the official science curriculum and that new culturally inclusive practices were not being reinforced in classrooms by teachers who were already ill-informed about immigrant/refugee students' cultural backgrounds--an issue likely to compromise science learning. Despite these formidable limitations, teachers who participated in this study showed particular interest in teaching

immigrant/refugee students and great curiosity about learning to know their students better.

C. Teacher perceptions of the science attitudes and interest they hold towards learning and teaching science

Teachers expressed positive attitudes toward teaching science to students coming from immigrant/refugee families. Teachers thought that despite the challenges related to the immigrant/refugee students' academic and social integration, this new phenomenon offered rich opportunities to implement innovative pedagogical practices. In science education per se, they had tried, with some success, approaches that varied from small group instruction to peer teaching, as informed by frameworks such as Universal Design Learning (Baskerville, 2010; Bishop, 1999; Cormier et al., 2005). One teacher explained:

I have noticed that they [new immigrant/refugee students] will get together with other immigrant students. Sometimes I let them choose their groups. Usually, I form the groups so I can match them [new immigrant/refugee students] with stronger academic students who are also friendlier. Because, the thing is some very strong academic students don't get along with other students, so helping others who are struggling is not part of their daily interests. Then, I factor in all these parameters to put the groups together. I have always asked for evaluations and auto-evaluation for team members and for the group as a collective entity to have a sense of the group dynamics. Some rules may apply, like you can criticize ideas but not people, and these rules apply to everyone in the groups.
(T2)

It was evident that teachers stayed motivated despite lacking background knowledge about their students, proper initial training, and resources. They were urged to combine different conventional strategies and methods, such as taking professional development classes and inquiring into students' cultural backgrounds, as ways of fostering

effectiveness in teaching newcomer students. Of note, however, is that teachers made no comment about their professional science knowledge. It was evident that these teachers assumed that they knew enough to meet the content criteria; instead, their professional learning was focused more on developing the professional knowledge required to promote the social integration of their newcomer students.

D. Teacher beliefs and disposition towards equitable teaching practices

Teachers' sense of equity was a major contributor to students' academic and social integration. This factor is crucial when dealing with students who have experienced war cruelty and refugee camp subsistence (Alper et al., 2012; Kanu, 2006). Teachers, in general, reported, as highlighted above, that their immigrant/refugee students were timid and less eager to take initiative and take on leadership roles. However, they noted that this pattern changed over time. They observed that students, during the second and third year, started taking ownership of their learning, especially because of how they had been supported in their transition. Did this transformation occur because they better understood teachers' expectations, gained more conceptual understanding of the science subject, or were now able to keep pace with the science curriculum? The relationship between student development and equity treatment is evident in the following remarks:

They [new immigrant/refugee students] are less inclined to participate in classroom discussion. I don't know if this is due to their culture or a lack of knowledge. That [this lack of knowledge] can hinder their participation, too. I have also noticed [that] there is [they have] a strong will to succeed. They are hard-workers, but they don't have the proper strategies. I have also seen the longer they are in Canada, the more they want to take risks and initiatives. But

the new immigrant/refugee students who have been in Canada for one or two years are in a more precarious state of leadership. They are here to learn the subject and are less open to exploring. As for as equity, if two students are having the same problem, I will use the same rules for both of them, that might not be to the advantage of all my students, however. (T1)

I would say that depends on the student; I don't see the differences between the new students and Canadian students in terms of leadership. Since there are Canadian students who are shy, they will never take leadership roles. So, I don't see any differences between the two groups. (T3)

As this study posed questions that helped teachers reflect on their practices, it became evident that teachers treated students equally, as, indeed, students' narratives confirmed. However, teachers' resistance to integrating multicultural aspects of science into their teachings may have compromised this apparent sense of equity as they may be unintentionally fostering cultural alienation. This phenomenon occurs when newcomer students try to accommodate the mainstream cultural science, whose biases have been exposed by a postcolonial perspective (Said, 1993).

Summary

In all, teachers identified a wide variety of linguistic, sociological, epistemological and pragmatic influences on students' transition and their ability to support students' transition. Participant teachers made insightful recommendations, and questioned, by the same token, some pedagogical practices that they perceived needed to change. The first issue teachers criticized was the practice of placing immigrant/refugee students according to age. Others argued for a more inclusive pedagogical approach in which immigrant/refugee students would not be labeled as

such [meaning newcomers], but would be considered as any ordinary Canadian student with “special” and/or "specific needs.” At best, these teachers were looking for better strategies by inquiring into student backgrounds, especially into their linguistic and cultural background that was seen primarily as a deficit in influencing students’ academic trajectories. However, developing responsive strategies to differentiate instruction was impeded because time limitation seemed to play a major role in reducing attention to planning and altered teaching approaches.

In spite of many challenges, teachers maintained the hope that students’ academic integration would improve over time as they acquired the capital necessary for success in the DSFM classroom. One teacher voiced a very personal and genuine comment that could represent the perceptions of most Manitoban teachers:

I come from a small village in Manitoba where there are very few new immigrants. When I came to Winnipeg, working with immigrant students was definitely new to me. I really adore the diversity in our school. Even though it represents a challenge to cope with students from different backgrounds in our school, it is also a factor that enriches the school. That is why, I love seeing the integration of the new immigrant students in our school. (T5)

As a closing observation, it was clear that the epistemological issues associated with students’ transition into the culture of DSFM science classrooms were not perceived as important or valued. Overall, half of the teachers interviewed saw science as a value-neutral subject; therefore, deeming it should be taught the same way regardless of the culture in which it is embedded. In holding this neutrality view of science - a discipline that does in fact inherently or inevitably encompasses cultural components - these teachers may have been unintentionally imposing the mainstream [that is, Eurocentric]

worldview of science on their newcomer students. This worldview has been questioned by many science educators and philosophers (Aikenhead, 2006; Bishop, 2010; Lee et al., 1998; Matthews, 1994; Piquemal et al., 2010) and is well-entrenched in the thinking of the science teachers participating in this study.

From a post-colonial view, this pretended neutrality when teaching more vulnerable students coming from immigration and refugee camps may be harmful since the process of acculturation since these students had to fit in the new culture might be escalating into a mere assimilation. Science teachers should know that teaching science is per se a political and ideological act when choosing worldviews that are already dominant, the scientific events that they choose to share, the scientists they want to promote and the way of approaching science subject per se can be filled of conscious or unconscious discriminatory choices.

Adding to that, teachers seemed to be teaching at a survival level. Meaning, they put their priorities and resources into providing safety and emotional and basic academic support to these refugee students instead of pushing these students toward excellence in science. Such a cautious professional choice might be a good starting point to accommodate these newcomer students, but in the long run, these students need to be offered the same opportunity to thrive as their Canadian peers within the limits of their desire and intrinsic motivation.

Also absent was the eagerness of the participant teachers to dive into the rich repertoire of linguistic tools brought in classrooms by these newcomer students. At a

certain level, their French speaking abilities were more than the average compared to their fellow Canadian students. This was a critical base point where teachers could build very meaningful science conceptual understanding and integration. But this linguistic asset has yet remained unexploited by science teachers who made social integration their top priorities. While in other studies, the same teachers were complaining about the lack of French language command of their Canadian born students but left the language skills of their newcomer students unused.

Equally not mentioned was any emphasis on the use of story to sustain learning in science, as in the African traditions where oral aspects of culture play a major role in passing on knowledge and wisdom. It has been demonstrated the power of stories and narratives to make science interesting and generating interests among students (McMillan, 2007). Despite this, the use of story and narrative to draw from newcomer student' culture was also not put to use.

Teachers also showed no apparent awareness of the resiliency of these immigrant students who dared to start a life in a complete new country and the refugee students who had survived various hardships and atrocities of refugee camps and transition countries. Whereas a few teachers were complaining about the amount of work and resources it took to help these newcomer students get performed at their true potential, little had been done to build on the likely high levels of resilience of these young immigrants.

School counselors are the first to narrate the hardships and traumas some students had been through and how unprepared they are as professionals to support this

new clientele; in the same token students' heavy past is a double-edged sword, while it can hamper them from moving forward in life, it is also a powerful yet symbolic witness of their inner desire to cope and move on. Teachers and other school personnel failed to build on these life skills such as resiliency and determination instead of constructing a victimization discourse around their realities. The latter will not be useful to the full integration of his students neither in schools nor in the host society.

To summarize, while teachers interviewed did care about the well-being of newcomer students, a lot has to be done to operationalise the adequate academic integration of these students; and, by so doing, go beyond responding to the basic academic and emotional support that is actually provided.

6.3 Students' voices

This section presents student voices on their educational experiences and process of social and academic transition into DSFM science classrooms. As discussed in the literature review, postcolonial theory appears to be a pertinent and convenient framework for understanding and interpreting immigrant/refugee students' discourses (Kanu, 2006). Postcolonial analysis and interpretation is appropriate because these students have no choice but to live in a new culture, which is mainstream, whereas key descriptors of their home culture were likely - unconsciously or consciously - being suppressed or ignored. The rampant cultural assimilation prevalent in the new school system could potentially lead to cultural alienation (Gandhi, 1998; Piquemal et al.,

2010; Said, 1993; Rinaldo, 2005). Of the 16 ($n = 16$) students who chose to participate in the study, 31% came from the Democratic Republic of Congo, one of the most unstable African countries. On average, 56% of the African immigrant families and 44% of the African refugee families came from DRC. Tables 6.2.a and 6.2.b offer more specifics on students with regard to numbers of years living in Canada, sex, types of status (R: refugee, I: immigrants), country of origin, and grade levels.

As reported in the teachers' section, immigrant/refugee students were described by their teachers as embodying the following social characteristics: talking less than the average student; showing less eagerness and more reluctance to answer teachers' questions, pose questions, and take risks when learning; and having less likelihood to assume leadership roles. Were they intimidated because of language barriers, cultural discontinuities, and perceptions of teachers as the sole depository of knowledge, as is the case in the school culture of their home countries? Cultural factors weighed significantly on the way social transactions took place between newcomer students and their teachers (Jegede et al., 1989, 1999; Kanu, 2008; Ogbu 1987).

Table 6.2.a

Student Demographics

#	Years in Canada	Country of Origin	Sex	Immigrant status	Grade
1	2	DRC Congo	M	I	9
2	3	DRC Congo	M	R	8
3	3	Ivory Coast	F	I	9
4	3	DRC Congo	F	R	10
5	3	DRC Congo	M	R	8
6	2	DRC Congo	M	R	11
7	1	DRC Congo	M	I	10
8	3	Guinea Conakry	F	I	12
9	2,5	Guinea Conakry	M	I	11
10	3	Guinea Conakry	M	I	11
11	3	Egypt	M	I	9
12	2	DRC Congo	F	I	10
13	2,5	DRC Congo	M	R	12
14	2,5	DRC Congo	F	R	11
15	3	Haïti	M	I	11
16	2	Congo Brazzaville	F	R	12

Table 6.2b

Students' Country of Origin

Country of origin	N	%
Kinshasa	1	6
Congo Brazzaville	3	19
Ivory Coast	1	6
Uganda	1	6
DRC Congo	5	31
Guinea Conakry	3	19
Egypt	1	6
Haiti	1	6
Total	16	100

This section presents students' general perceptions of their new science classroom environment, describes the challenges they faced, and discusses the coping strategies they used to support their transition.

A. General perceptions of newcomer students on studying science in Canadian classrooms

For the most part, new immigrant and refugee students showed positive perceptions and attitudes in their experiences attending the DSFM and in their perceptions of their classroom experiences. Students said school personnel appreciated them and these feelings worked positively to support and sustain their learning in science (Bishop, 2010).

An affirmative school and classroom ethos is one characteristic of a positive and supportive learning environment (Fraser, 1998). Most students thought DSFM teachers treated them better than their teachers had back home. They pointed out that Canadian teachers cared and were willing to go the extra mile, as evidenced in their efforts to make science lessons understood, using more examples at the beginning of the lesson, meeting students at lunchtime for extra explanation, or even responding to their emails after school hours. To the question, “How would you describe science instruction here compared to that of your home country?” they answered:

I think the schools here in Canada are great; we have everything we need, books, computers, etc. But in Africa, particularly in my country, I think it was more intense. We had to do the research on our own without teacher intervention, whereas here, we always go to teachers for this or that. I like it better here. (S11)

I am talking about Congo when teachers are teaching, they tell you what to write and what you will be studying. You cannot change anything. You may change some words, but you can't go too far. (S11)

You are not bored as often. You have a lot of friends, meaning things are going well. (S11)

I would say that my science classes are wonderful. I am learning a lot of things. I have had great experiences with the people. My physics and chemistry modules are just amazing. (S10)

I think Canadian teachers get along better with students. They understand us better. They encourage us to voice our opinions compared to Africa where we are not. In Africa, we are forced to do what teachers tell us; here, teachers understand us. (S8)

Importantly, immigrant/refugee students felt privileged to have access to their Canadian teachers whenever it was needed during the day. Because of this availability, they perceived themselves as valued learners. They reported that in their countries of origin, students were regarded teachers as neither willing to explain more nor disposed to offering time outside regular class hours to contribute to their understanding of the subject matter. The student-interviewees explained:

Here, if we have hardship we talk to teachers, and they will help during lunchtime. But, in Congo, if we have hardship, teachers don't have time to help you. They ask you to go home and study. They ask where we were when they were teaching. But, here, teachers are helping, I like it better, they are available. (S 10)

In Africa, classes are crowded. There are 4 classes of 45 students. Teachers don't have time to work with each student individually. (S 9)

Nonetheless, is the DSFM a friendly learning environment for immigrant/refugee students? Based on their responses, there is no doubt that newcomer students were

quite satisfied with the Canadian school system. That said, this satisfaction did not translate into the same or better academic performance for immigrant/refugee students compared to that of the average native Canadian student. It is worth noting that for three of the students interviewed, there were no huge differences between their home school system and the Canadian ones; in fact, they argued that in their country they had worked on more science content than in Canadian schools. As one put it, "I don't really see the difference between what I have learned in science at my school back home [Conakry] and over here. My former science teachers were even more demanding" (S 11).

Student perceptions of their new teachers referenced their openness, availability, and accessibility, all positive and supportive characteristics of teacher effectiveness (Baskerville, 2010). Frequently, students commented that teachers asked questions about their origins and were curious to know about their culture. Teachers were clearly giving students an opportunity to express and vocalize their needs and interests in the science classroom. To the question that dealt with academic exclusion, they answered:

Teachers gave us many hours of one on one instruction. We got extra hours to go through the homework. If we have questions, they are always available to answer. In classes, they always say if you have questions, we should always ask them. (S 9)

This answer clearly indicated that the teachers' attention was focused not only on quality of instruction, but also on students' academic and social needs. Student responses confirmed that teachers treated them as they treated their Canadian peers--and potentially in even a more supportive nature. This view offers some indication of equal treatment, which has not been the case in studies where students reported issues of

unfair treatment from their peers and, in very rare cases, from teachers (Piquemal et al., 2009). Despite this dynamic with teachers, a few students felt rejected, if not ignored, by their peers, as they described that integrating into groups formed exclusively by native-born Canadian students was very hard; such results have been reported by Piquemal et al. (2009, 2010).

Finally, teachers' keenness to better understand immigrant/refugee students' cultural background was significant in fostering positive human social relations, though such interest did not appear to permeate instructional practice. Therefore, despite continued teacher support, these students faced a few challenges related to their academic trajectories, as they lacked the necessary academic capital to easily adjust to the new school environment. In brief, they experienced the reality of the schooling deficit through different school system curricula as mentioned by Kanu (2008). However, they seemed well aware of all of these obstacles. As one explained:

Yes, I am satisfied with my grades. Before, I took science and math. I took Grade 9 science in the semester before and Grade 10 science with the Grade 10 students. I was like, demoted because all the students took Grade 9 science. I was the only one in the group not knowing what mitosis is. Then I talked to the Vice Principal, she told me that I should go back to Grade 9 science. Once I was in the Grade 9 group, I was more advanced than the average student. I knew all [the concepts] because I did it with the Grade 10 students. It was great. (S 10)

B. Challenges faced by immigrant/refugee students

During the interviews with students, three main issues summarized their concerns towards a successful transition in the DSFM schools. The first one was about placement issue: placement is quite problematic because students are placed according to their age following Manitoba Education standards and not according to their literacy

and numeracy levels. In the case of refugee students who had been out of the school system for years, this has posed a very challenging issue for school counselors. The second issue relates to the acquisition of scientific language and terminology: while most of the immigrant/refugee students interviewed showed a fair command of French language, the scientific discourse still remained a challenge to overcome as it is the case for their Canadian peers. The third issue is about the social integration of the newcomer students: during the first year in Canadian schools, immigrant/refugee students felt isolated and pushed to work with students from the same ethnographic background to complete group assignments and collective projects.

Placement: Why am I taking this class?

Upon their arrival in Manitoba and the DSFM, students were assigned to a class according to their age instead of their academic profile. While they could repeat grades in their home country, in Manitoba they could only repeat the classes they failed. Some of them wanted to try any classes they chose, but this practice was discouraged, and even sometimes denied by school advisors. A few students were not happy with these refusals because they thought they deserved the right to try or to learn just for the sake of it, as this grade 12 student stated:

They [counsellors and administrators] should help people. I didn't take Bio because I was discouraged before even starting. I could do it, but I became discouraged before even trying. There are people who need a diploma to go look for work. But if they see a student who is willing to study just for the sake of it or just to make it up, they should not put him down or refuse to give access to take classes. (S 11)

What emerges from this commentary is that students perceived that school counselors were making decisions about what subjects they should take based on a deficit-model of student abilities. Teachers assumed that they were preventing students' failure by placing them in more convenient courses. However, these students, on their side, saw courses imposed by teachers and counselors as a negation of their right to experience new learning even though they might carry a failed grade for these classes (Piquemal et al., 2009).

In addition, students saw the first few weeks and months as the most significant in determining their probability of success. This period was seen as crucial and the most difficult during their transition:

That was the beginning when the teachers explained things; it was like everything was new. That I had to start from scratch. I didn't understand that at all. And, tests were very difficult. (S 11)

I would talk about the beginning that was not so easy. First of all, I didn't want to talk about my weaknesses. I didn't talk too much to teachers. But later, I got drawn by teachers who were helping me. Here teachers are more open-minded towards students. They take time to help them. They gave us practice tests to make sure we understand. (S 11)

Adding to a less predisposition to verbalize their lack of comprehension, these students were also struggling with the very peculiar aspects of science terminology and discourse.

Scientific language: Another battle field

New immigrant and refugee students faced similar obstacles to those faced by native Canadian students, as documented by Aikenhead (2006) and Rivard et al. (2009).

Issues such as the difficulty of mastering scientific terminology, understanding the complexity of science concepts such as oxidation-reduction in Grade 11 chemistry, and grasping abstract concepts such as electronic orbitals kept coming up during the interviews. Further students identified that success in science required familiarity with the procedural and manipulative skills associated with experimental science. As well, the orthodox practices of test assessment were commonly mentioned. Subsequently, most students admitted that the pace of science instruction fit their rhythm of learning, whereas others complained about starting new chapters without having written the test for the previous ones.

Language acquisition and learning science concepts, especially through reading and writing, which requires high linguistic fluency, remained challenging both for students in their learning and teachers in their teaching in the DSFM (Cormier et al., 2004; Lewthwaite et al., 2007; Rivard, 2010). Insisting that teachers start using a congruence model (Rivard, 2009), meaning using students' everyday language and vocabulary to teach science that would likely support students' transitions.

Unfortunately, teachers indicated they were not knowledgeable in the idiolects of immigrant/refugee students. If Canadian students are using French as their second language and are struggling with mastery of casual language, the acquisition of science concepts and terminology could clearly be more challenging (Lee, 2008). However, oral language issues were not seen by students as a significantly influential factor influencing their transition in the context of this study. A potential explanation for this lesser emphasis on the language issue might be because these students in this study

came from countries where French had a greater status than other local languages and dialects. In their countries, the French language was highly regarded, as speaking French usually confers higher status and social mobility. If content was an issue during students' interviews, as a fluent French researcher, I did not notice any limitation to students' French oral language fluency.

Social issue: How to fit in?

Conversely, newcomer students' interactions with their peers were identified as somewhat problematic. A few students stated that it was difficult for them to be accepted into groups composed of Canadian-born students, especially those in grades 11 and 12. They believed this was so because native Canadian students were more willing to form groups with long-time friends, an issue that has also been documented by Piquemal et al. (2009, 2010). One newcomer student addressed the question of her social network in the science classrooms this way;

Yes and No [when she was asked about the existence of racism in classrooms]. There are always problems when we are working in groups. We don't have partners; there is always some confusion. I said to myself they don't want me. In general, it is not so bad. Everybody understands each other. I work more with African students. I am not saying they [Canadian students] do not want to associate with us, they rather want to work with their friends. I am not talking about racism. Sometimes, people want to work with their friends, with people they share a common view of things. They don't like working with strangers (S 12)

It is important to know how these new immigrant/refugee students handled these challenges. What do they do, and how do they develop coping mechanisms along with managing the complexities of learning science in a whole new learning environment?

C. How did immigrant/refugee students cope?

In the narratives, students referred to teachers as their primary resources for coping with hardship in science classrooms. They mainly talked to teachers when they needed learning support and clarification, a retest, or even postsecondary education advice. Some of them used student services at the school, of which they spoke highly: "When you have homework, you can go there with your stuff. You can ask them questions in any language, even in English and in Swahili" (S 11). As this remark indicates, this particular school hired teachers' aides with the same cultural and linguistic backgrounds as the newcomer students. A very small percentage used home resources, as stated below: "I could get help from the Internet; my brother also could have helped me. He is very good in science" (S 10).

From a pedagogical standpoint, immigrant/refugee students seemed to prioritize one-on-one instruction, small group work, peer-teaching, and inquiry-based science learning (labs, exploration) along with science projects:

I really like it. Every morning, when I know that we have a science class and that I will go to the lab, I am very excited. I like using the science tools and equipment. Later on, I would like to become a dentist. In grade 8, I worked a lot in groups and that was great. It is always cool to share with friends what you have found and especially when they did not know it and vice versa. So everybody is working hard, and that is so great. (S 8)

Most students attributed their lack of good performance in science to themselves, avoided blaming teachers, and believed they should work harder, pay more attention in class, and engage early with class resources in order to improve. Taking conventional science tests remained a challenge for most of them. When asked about next year's

strategies for succeeding in science, this grade 11 student answered: "Concentrate on what I don't know, don't worry about what I master and have the courage to go to teachers and ask questions" (S11).

Reflection on these comments raises the question, what could be the most effective instructional strategies to help these students learn better in science? The approaches the students described as helping them cope in science aligned with other science teaching practices, as documented by Fraser (2010) and Lewthwaite et al. (2007).

6.4 Summary

Student narratives echoed, for the most part, the same factors of influence upon their transition as highlighted by their teachers. Both groups cited the importance of time and professional support as critical influences on the transition. Students, on the other hand, placed more emphasis on the interpersonal aspects such as teachers' attention to equity manifest in teachers' effort toward integration through the tangible support received from teachers evident mainly in teachers' availability. As well, classroom social networks such as enacted through positive group formation within the classroom were seen to be important transitional support mechanisms.

Absent from the student interviews was reference to epistemological or worldview tensions associated with students' transition, something alluded to only by some teachers. It is the researcher's opinion that students had already experienced the imposition of a worldview in their science schooling experience in their home countries

and that what they were experiencing in Canada was a similar imposition. It was they who needed to adjust, and expressing preference for the orthodoxy of science classroom practice to change was not considered, or at least expressed. Further, little mention was made of linguistic adjustment likely because of students well-developed French oral language skills. Students' underschooled experience in science, in both content and skill, was evident in the conversations but also underscored by a perception that teachers were advocates for their transition in this area.

In all, and important to the results that will follow in Chapter 9, the third and final application stage of this study, teachers were, overall, moderately optimistic of a variety of personal attribute and environmental factors influencing their ability to facilitate the transition of newcomer students. Nothing said was extremely negative, the only evident negativity coming from the teachers in one school in reference to professional support measures.

The conversations indicated that there may not be a fail-safe strategy for accommodating and integrating new immigrant/refugee students into science classrooms in Francophone minority settings. However, a few strategies were identified as proving more effective than others, according to both students' and teachers' narratives during these interviews. The following recommendations emerged from both teachers and students' interviews. Although a few of them will be listed in the concluding chapter of this dissertation as recommendations, it is appropriate to list them here as they emerged from stage one, the qualitative stage of the research. These are

presented as a non-exhaustive list of these supportive tenets for supporting teachers and students:

1. Academic placement decisions should be negotiated with the students. As students expressed their concerns for having their opinions counted in the process of their own academic placement.
2. Information on students' academic and sociocultural backgrounds must be shared among science teachers, academic advisors, and special education teachers, as suggested by teachers.
3. Prioritize science-based project learning for science instruction. Labs and hands-on activities should be a regular part of science lessons as suggested especially by immigrant/refugee students.
4. Teachers must be more assertive in forming student groups to make sure they are as varied as possible to maximize interaction between Canadian-born students and new immigrant/refugee students as suggested by teachers.

In all, this chapter has first identified through the voiced perceptions of teachers the influences on transitioning newcomer students into science. Then, students' views on the challenges and coping strategies they have used to handle the new science learning environment were described. As well, it has included identification of strategies that were voiced that were seen to likely support teachers in working with students. All these factors now provide the foundation for the design of the I_MISLE instrument, which will be described explained in Chapter 7.

Chapter 7 Development of the Instrument for Minority Immigrant Science Learning Environment (I_MISLE)

7.1 Introduction

This chapter outlines the procedures used in development of the learning environment instrument, the Instrument for Minority Immigrant Science Learning Environment. Section 7.2 provides a detailed view of the procedures used in the selection and inclusion of items in the initial Instrument List. Section 7.3 outlines the procedures utilized in consultation with a focus group in selecting items for the initial instrument. Section 7.4 follows by explaining the procedures used in the development of the 56-item initial instrument. Finally, section 7.5 summarises the chapter and introduces the purposes of Chapter 8, which relate to the validation and modification of the initial I_MISLE.

7.2 Item List Compilation

Insight into the various factors immigrant students experience during the transition into science classrooms was provided through the analysis of the data collected from the student and teacher interviews as well as the literature review. In the initial stages, it was clearly evident that a variety of teacher specific and environmental influences impacted on students' transition. In reference to the Phase One study suggestions, the factors influencing student transition included external factors such as time availability for teachers to attend to students' needs, the culture of support or school ethos that supports the transition and the attention made to adjusting curriculum

through curriculum leadership and support, and teacher specific characteristics such as their professional interest and adequacy in providing specific support for immigrant/refugee students. Under the supervision of his advisor, the researcher carried out the next phase of the research. In this phase the focus was on procedures that would support the development of an instrument that would capture the wide and complex nature of the factors influencing the immigrant/refugee student transition, both from a student and teacher perspective. In response to this imperative, each of the factors identified in the initial study phase were placed on an ‘instrument items’ list. The list was neither categorised nor ranked; it simply outlined all the specific factors that had surfaced in the first phase as influences on the transition. In addition, the factors that influenced transition were identified and adjusted so as to be appropriate for a learning environment questionnaire (Fraser, 1995).

As an example, a teacher mentioned during an interview that:

Even though it is a challenge to cope with students from different backgrounds in our school, it is also a factor that enriches the school. That is why, I am motivated to see the inclusion of new immigrant students in our school and I see it as really important in my practice. (T5)

In order to transform this teacher dispositional characteristic into an item appropriate to the intent of the questionnaire, it was changed to:

I am motivated to teach science to immigrant and refugee students.

In all, 80 items identified in the phase one of the study were developed. Cognizant of the above procedure, the following steps were then taken to generate the list after translating the interview and literature review data into the full item list. In light of this,

the process was structured into three stages namely; cutting, clustering and refining stages.

The 80 items were cut into individual paper strips and sorted according to common themes that surfaced. The items belonged to one of several general clusters, themes, groupings or categories of factors identified in Chapter 6 as influences on the immigrant student transition. Several of these categories, namely resource adequacy, provision of professional support, staff interest in the area of concern (in this research's case, teaching science to immigrant/refugee students), teachers' time availability and administrative leadership and commitment are commonly cited as influences on curriculum innovations (Fullan, 1992).

Most of these categories were essentially part of school culture or environmental attributes and failed to address the more nuanced nature of the challenge associated with supporting such students in their transition; these being teachers' personal attributes such as the professional knowledge and professional adequacy seen as necessary for supporting students in their transition because of their linguistic, social, and science specific 'difference' and consistently featured in phase one of the study. For this reason, other categories not specifically mentioned by Fullan surfaced. Although, Fullan identifies teachers' capability in dealing with the task at hand as a factor influencing curriculum implementation, he does not specifically address the professional knowledge, professional adequacy and self-efficacy as individual teacher critical conditions contributing to or inhibiting the effective transition and teaching of immigrant students in a minority setting.

The next step in the development of the I_MISLE item list was to refine the instrument by doing away with some of the repetitive statements in an interactive process. For example; Item 50 indicated that teachers at this school are well prepared to adequately teach science to immigrant students while item 70 illustrates that teachers at this school have been adequately prepared to teach science to immigrant students. This is clearly a repetitive item. Cancellation of repetitive items led to the reduction of the number of items on the item list to 56 items. In light of this, sorting was completed when the broad categories had been identified and the repetitive items had been eliminated. The culling of repetitive items, verification of the identification of these groupings and classification and ranking of items was seen as the next critical stage of the instrument development.

7.3 Focus Group Consultation

Representing the diverse sectors of secondary education, the six member focus group namely; two science educators, a graduate student in science education, a retired secondary school teacher in the DSFM, a science consultant, a science education professor and a physics teacher were primarily given the task of identifying clusters of items according to patterns and trends in the data and any gaps in the factors influencing science program delivery (Knight and Meyer, 1996). The focus group was further separated into three pairs and each pair was given the item list. In light of this, the list

was cut into individual items so as to aid the panellists' identify common groupings of factors. Each pair was also given a task completion sheet that clearly stated their role as focus group members. Towards this end, the task sheet also provided the focus group members with a description of the aggregate of factors orienting curriculum delivery as identified in Chapter 4 that outlined the tenets of learning environment research.

Using this information as a guide the focus group pairs identified clusters of items according to patterns and trends in the reduced 56-item list. However, there were only a few outliers items assigned to each cluster. The focus group members unanimously agreed that the task was easy and attributed the simplicity to the straight forwardness of the categories and the specific guidelines articulated in the task completion sheet.

Nonetheless, one group sought clarification on the difference between professional support and resource adequacy. The difference was merely clarified as a hands-on, physical presence working with teacher(s) in some aspect of science delivery whereas resource adequacy represented the physical environment that comprises the venues, facilities, classroom material and labs among others that accompany the science program delivery.

It was a straightforward task ranking the items within the clusters according to how significant they perceived these items in relation to factors impacting science programme delivery within their particular educational context. All the three groups reported that prioritising or ranking some items was not easy to decide on as they were often quite identical in their perspective. The pairs were asked to search for any present gaps in the factors that would influence delivery of science program to immigrant

students. Nevertheless, the Focus Group pairs were incapable of determining any further factors that may be influencing the transition of immigrant and refugee students in science program delivery within the DSFM educational context. After all, the focus group helped develop the necessary consensus issue around the topic researched. This consensus lead to reinforcement of the content validity that is needed to contribute to the scientific rigor of this study.

7.4 Developing the Instrument

Once the items had been sorted into categories they were then prioritised from ‘most significant’ to ‘least significant’ in influencing students’ transition. This hierarchical list by each represented each group’s perception of which items (factors) were most significant in influencing students’ transition. Once these rankings were completed, they were compared among the groups and decisions were made collectively as to which were most to least influential on the transition. This negotiated ranking, once completed, represented a hierarchy of items that were representative of the major factors influencing the transition of students in science curriculum delivery. This ranking of items along with the grouping of items now served as the foundation for the development of the instrument.

As mentioned in Chapter 3, the methodology chapter, several further considerations were made in the actual development of the science curriculum implementation Questionnaire. The instrument was supposed to be economical in regards to the amount of time required for teachers to complete it and thus ten items for

each scale were selected on the basis of the rank order list. Although ten items were chosen for the initial scale, this would be reduced for economic sake to seven items in the final instrument once statistically validated. As well, the physical layout with questions and Likert scale categories on the same page followed the format of other learning environment questionnaires and echoing the broad categories identified by Moos (1974).

The I_MISLE, in its initial form, thus comprised eight, ten-item scales. Table 7.1 featured below lists the eight categories or dimensions contained in the questionnaire and a description of each dimension and an example of one of the ten items from this dimension as follows:

Table 7.1

Scales and Sample Items from the I_MISLE

Scale	Description of Scale	Sample Item
Resource Adequacy	Teacher perceptions of the adequacy of equipment, instructional material and facilities needed to instruct immigrant students in science	The school is adequately resourced to differentiate science instruction for immigrant students
Time	Teacher perceptions of time necessary for preparation and delivery of immigrant/refugee students' learning needs	Teachers have enough time to prepare lessons that suit refugee students' learning needs
Knowledge of Students' Background	Teacher perceptions of students' socio-economic, cultural, linguistic, emotional and academic background	Teachers are inquiring about students' cultural background
Professional Support	Teacher perceptions of the support available from both school and external sources to support their teaching of immigrant students	Teachers of this school receive the ongoing support needed from the school administration to teach science to immigrant students
Professional Adequacy	Teacher perceptions of their own ability and competence to teach science to immigrant students	Teachers at this school are confident in teaching science to immigrant students
Professional Science Knowledge for Integration	Teacher perceptions of the knowledge and understandings necessary to assist students in their learning of science	Teachers have insights in integrating cultural components into the science curriculum
Professional Attitude and Interest	Teacher perceptions of the science attitudes and interest they hold towards learning and teaching science	Teachers are enthusiastic about teaching science to students from different cultural backgrounds
Equity	Teacher beliefs and disposition towards equitable teaching practices	All students are treated equally in my classroom

The three dimensions namely, resource adequacy, time and professional support are categorized as extrinsic factors impacting science program delivery. The other five dimensions (knowledge of students' background, equity, professional adequacy, professional knowledge and professional attitude) are categorized as intrinsic factors influencing science program delivery. The initial 56-item I_MISLE is included in Appendix B. These dimensions are itemised in such a manner that construct validity was ensured. That means indicators or items produce data within the limits of the conceptual framework under scrutiny; namely items belonging to the same dimension or factors generate data that correlate with each other (convergent validity) and divert from indicators belonging to other factors (divergent validity) (Brinckman, 2009).

7.5 Summary

The purpose of this chapter has been to describe the detailed procedures used in the development of the initial Instrument for Minority Immigrant Science Learning Environment with regard to the orthodoxy of the rigorous development of LER instrument and the various types of validity and reliability such endeavors entail. It detailed the approaches used in the identification and selection of items in the initial instrument and outlined the methods used in consultation with a focus group in selecting items for and developing the initial instrument. Chapter 8 which follows presents the procedures involved in the validation and modification of the initial I_MISLE.

Chapter 8 Statistical Validation of the I_MISLE

8.1 Introduction

The purpose of this chapter is to elucidate the methods and procedures used in the statistical validation and refining of the Instrument for Minority Immigrant Science Learning Environment. Section 8.2 begins by presenting key profiles on the participating schools. Section 8.3 presents the Cronbach alpha reliability validation statistical analysis data for the initial 5-item scale and the reduced 4-item scale. Section 8.4 investigates the procedures involved in the discriminant validity analysis, the refining of the 4-scale instrument. Finally, section 8.5 summarises the chapter and introduces the intentions of Chapter 9.

8.2 Participating Schools

The validation process involved 84 teachers from different Francophone schools in minority settings in Manitoba and some provinces. Participating teachers received an Internet link from Survey Monkey to complete the initial questionnaire of 56 items. The survey did not seek information about the participating schools or teacher identity, according to the consent form, as presented in Appendix D. The participating schools were junior high and senior schools located in urban Winnipeg and other Canadian urban centres in which most of the study's immigrant/refugee student population lived.

The schools that were part of the validation process were mainly belong to the DSFM network and other similar institutions across Canada. I have known several of these schools for many years since I first moved to Manitoba. These schools, in my

experience, are very committed to successfully welcome Francophone immigrant/refugee students. Indeed, because, they are often situated in the heart of Francophone neighbourhoods, such as Saint-Boniface in Winnipeg, these schools are often favored for hosting Francophone families who have to choose a school for their teenagers.

In this study, I expected to find common practices that fit with the best interests of immigrant/refugees students in science classrooms, as these teachers carried a tradition of welcoming newcomer students into their classes, as revealed in the interviews. Therefore, I anticipated extrinsic parameters such as professional support to be very positive and supportive of students' transitions.

8.3 Validation of the I_MISLE Scales – Cronbach Alpha Reliability

Statistical analysis for the initial validation was performed to determine the internal consistency and validity of each 10-item scale's Cronbach alpha reliability coefficient, mean, and standard deviations. These data are presented for the 5-item scales in Table 8.1. One item, was eliminated to reduce the length of the scales and, consequently, to improve the economy of the instrument. The new-item scale's internal consistency is also presented in Table 8.1.

Table 8.1

Scale	Alpha Reliability (5-item scale)	Mean	Standard Deviation	Alpha Reliability (4- item scale)
Resource Adequacy	.86	2.72	1.1	.90
Time	.88	3.58	.86	.88
Knowledge of Students' Background	.86	3.81	.68	.81
Professional Support	.89	3.3	.98	.86
Professional Adequacy	.85	3.7	.94	.81
Professional Science Knowledge for Integration	.87	3.10	1.1	.88
Professional Attitude and Interest	.80	3.70	1.04	.82
Equity	.71	2.9	.95	.73

Alpha Reliability, Mean, and Standard Deviation for I_MISLE

8.3.1 Resource Adequacy

The alpha reliability coefficient for *resource adequacy* in the initial 5-item scale was 0.86, indicating the high internal consistency of the scale. Elimination of one item, the least correlated to the other items, resulted in the alpha reliability being retained.

This combined scale originated from the following four items:

1. I have adequate equipment to allow my students learn science.
2. I have a budget to acquire resources to help newcomer students.

3. The newcomer students are informed of the resources available in the school to help them succeed.

4. I have the materials needed to teach my students and help newcomers learn in science.

This scale addressed the multiple facets of resource adequacy. Originally, this factor addressed the perceptions of teachers regarding physical aspects of resource adequacy of equipment, instructional material, and the facilities required to instruct immigrant students in science. But in this study, ‘resource adequacy’ is a much broader construct, referring to the availability of a wider array of resources to meet students’ needs both instructionally and at the school level. The first two items pertain to these practical elements (equipment and finance) but the latter two focus on the more divergent requirements for immigrant students. Resources needed to be customized to fit students’ needs. Resource adequacy for the respondents of this study meant first of all knowing and being aware of the students’ background in order to then provide the best resource to meet their cognitive, social, and emotional needs.

During the interviews, teachers clearly expressed the need for instructional materials that catered to students linguistic, academic and cultural backgrounds and added that the Manitoba science curriculum, currently, does not address the multicultural aspects of science. While there are a few superficial accommodations to embrace other cultural views, it is far behind what teachers expected it to be. Teachers may use some creative methods to put the rich cultural repertoire of their newcomer students at use in order to compensate for the lack of adequate instructional materials

and efficient science curricula. It is crucial to include the appropriate instructional materials for the purpose of assuring a more quality education in supporting new science teachers or those with little experience in the field of working with immigrants and even for helping teachers' aides, as demonstrated in this study that accompany the refugee students (Kanu, 2008; Lewthwaite et al 2007a). There are instructional materials to help newcomer students address their lack of schooling in science; however there are likely very few that deal with the broader worldviews and language and academic variability in science necessary within the DSFM.

Whereas resource adequacy appeared in an interview as a key element that was moderately satisfied by staff support and school administrators, it received an average score of 2.72 (on a 5-point scale) across the entire validation group; the least among the 8 factors addressed. This finding suggests that teachers in the validation group tended to agree only somewhat with the perceived level of resource adequacy available to them to tailor instruction to students' skills and readiness.

In all, the Resource Adequacy scale captures the diverse resource needs that might be anticipated as necessary for teachers to respond to the learning imperatives of immigrant and refugee students.

8.3.2 Time and its limitations

The alpha reliability coefficient for the *time* factor in the initial 5-item scale was 0.88. This value, again, indicates the high internal consistency of the scale. Elimination

of one item, the least correlated to the other items, resulted in the alpha reliability being retained. This combined scale contains the following four items:

1. I take the time necessary to plan science lessons for newcomer students.
2. I take the time in my teaching of lessons to help newcomer students.
3. I have the time to prepare my classes based on the needs of my newcomer students.
4. I need more time to help my newcomer students especially with their skills and knowledge base necessary for success in science

The four items in the scale address the important ‘time’ factors identified in the study; these being time to plan prepare, time to teach and time to provide attention to the skills and knowledge students may fail to possess because of underschooling. The time factor was a critical element, according to teachers’ responses during the interviews. Teachers identified in the interviews a concern for the adequacy of time to support immigrant students.

In all, these elements assist in recognising that teaching time is not equally reported to as only learning time. Since we are studying these factors under the LER lenses and critical pedagogy, the human, social and cultural factors may play a major role in translating instructional time into evident, lasting and engaging science learning. Teachers may need more time to plan for immigrant/refugee students, but their class climate may hamper such effort if time is not spent creating a nourishing and open learning where all learners can develop to the best of their abilities. Strategic planning

that focuses more on students' needs and backgrounds instead of the mere coverage of scientific concepts may be the beginning of a new humanistic era in teaching science effectively to students with schooling deficits who are transitioning to DSFM classrooms (Aikenhead, 2006; Lee et al., 2005).

With an average score of 3.58, the fourth in perceived agreement among the 8 factors, time was noted in the survey completion as a dimension not contributing to their ability to supports students' successful integration. The combination of questions that formed this factor suggests that teachers across the larger validation group tended to agree with the perception of the adequacy of time as a resource.

8.3.3 Knowledge of Students' Background

The alpha reliability coefficient for *knowledge of students' background* in the initial 5-item scale was 0.86. This value, again, indicated the high internal consistency of the scale. Elimination of one item, for economy purpose, the least correlated to the other items, resulted in the alpha reliability being retained. This combined scale contains the following four items:

1. Socio-emotional factors must be taken into account in teaching newcomer students.
2. The historical and personal background of newcomer students affects their performance in science.
3. I have strategies to inquire about the origins and other educational pathways of my newcomer students.

4. I know how to take advantage of the cultural background of students in my teaching of science.

The four items in this factor deal with multiple dimensions of knowledge, these being primarily associated with knowledge of students and strategies that might be used to address the broad cultural, academic and socio-emotional needs of these students.

During the interviews, teachers said they saw the importance of knowing about students' background, especially students' cultural background. Teachers had confessed that they had minimal knowledge of students' background whereas this knowledge appears critical into supporting effective science teaching as documented by several science educators (Bishop, 2012; Cobern, 1991; Lewthwaite et al., 2007b; Rivard, 2009). Critical pieces of information that teachers said they required were the origins of positive educational pathways for these students. It seems a standard procedure that school counselors and principals gather all information from these students without sharing this information with teachers. This obvious flaw in the knowledge management has real consequences on how teachers will handle pedagogical issues toward accommodating immigrant/refugee students both socially and academically.

While science teachers who participated in this study showed they were doing their best at helping their newcomer students, their efforts may have been impeded by improper flow of critical information making their professional judgment and decisions ill-informed. This may have definitely impacted these newcomer students' academic success. Teachers that ignore their personal and cultural background are missing great

opportunities to enhance better learning science environment for all, since students' backgrounds is one of the core teaching competencies (Lewthwaite et al., 2007a).

This factor received an average score of 3.81 amongst the larger validation group, ranking it as the first among the 8 factors perceived to be positively influencing students' transition. This dimension involves a collective knowledge of students' background, especially with regard to the availability of knowledge that is shared amongst peers in the milieu. This acquired knowledge facilitates the valorisation of all students, guiding teachers towards a fair balance in teachers/student relationships.

8.3.4 Professional Support

The alpha reliability coefficient for *professional support* in the initial 5-item scale was 0.89. This value is, again, indicated the high internal consistency of the scale. Elimination of one item, which was the least correlated to the other items, resulted in the alpha reliability being retained. This combined scale contains the following four items:

1. I do not have the support needed to teach newcomer students.
2. Administrators give me the necessary support to teach the newcomer students.
3. Lack of schooling is a major challenge among the newcomer students.
4. The school division does not offer professional development to improve my teaching with newcomer students.

Professional support in this factor deals with primarily school and divisional aspects that provide professional support to teachers, especially in addressing the

underschooling experience of immigrant and refugee students at both the school and classroom level. Teachers identified professional support as critical to enhancing teachers' professional effort toward newcomer students' academic success. During the data collection, teachers had mixed perceptions about the professional support received from both school and external sources. Professional support referred to administrative measures, peer collaboration and input from the community, especially from parents. As stated in the qualitative analysis, in one of the schools, teachers felt a supportive environment, in the other one they were asking for more. All teacher participants agreed that the lack of immigrant/refugee students' knowledge background needed to be addressed and that focused professional development to support such development endeavors was non-existent. Language barriers and the lack of knowledge of the Canadian education system prevented immigrant and refugee parents from supporting teachers, although the system expects it to happen. Therefore, parents needed more orientation from the beginning of their settlement in Manitoba in order to get a better sense of what to expect from the school system and what the school system requires from them (Kanu, 2008; Tobin et al., 1990).

The francophone school division created a task force on best practices to frame policies to regulate the integration of immigrant/refugee students in their schools. However, these guidelines uniquely address administrative guidelines and some placement issues and neglect to cope with daily pedagogical challenges that teachers are facing within their classrooms. The DSFM might, in the future, have interest in designing high quality PD for these teachers where, for example, they can be exposed to

first hand witness and expertise about immigrant/refugee students' educational, cultural and socio-economic background for the sake of a successful transition for this student population.

This factor received an average score of 3.3 across the validation group, the fifth in importance among the 8 factors addressed. This finding suggests that teachers tended to be responding favourably to the degree of professional support they were receiving, even though at the DSFM level participant teachers, especially at one school, were dissatisfied with the support they were receiving.

8.3.5 Professional Adequacy Influenced by the Milieu

The alpha reliability coefficient for *professional adequacy* in the initial 5-item scale was 0.85. This value is aligned with the internal consistency of the scale. Elimination of one item - the least correlated to the other items - resulted in the alpha reliability being retained. This combined scale originated from the following four items:

1. I can teach in a way that acknowledges students' linguistic background so they can learn science.
2. I can teach in a way that is cognizant of students' cultural and social background.
3. I know how to plan a lesson incorporating a cultural perspective appropriate for immigrant and refugee students.
4. I am satisfied with how I teach science to newcomer students.

In all, the four items address the areas where teachers identified issues with professional adequacy, these being teaching in a way that addressed students' cultural,

linguistic, academic and social capabilities. Interviews with teachers indicated that they were not well prepared to cope with the complexity of immigrant/refugee students' integration in science due to the recency of the phenomenon and the lack of their initial training. They all questioned their ability to assist students in their learning of science despite the adequate oral linguistic ability of newcomer students. They seemed not ready to use adequately this French linguistic repertoire to build a fair command of scientific terminology. While teachers had complained about the Canadian born students' lack of French language command to support the understanding of science concepts, they missed the opportunity to make this immigrant student linguistic and asset for their learning, an issue also identified by Lee et al. (2005) and Lewthwaite et al., 2007a).

This factor received an average score of 3.7, the second among the 8 factors addressed. That score suggests that teachers across the validation group tended to only somewhat agree with their perceived professional readiness to deal adequately with immigrant/refugee students.

8.3.6 Professional Science Knowledge for Integration versus Time

The alpha reliability coefficient for *professional science knowledge for integration* in the initial 5-item scale was 0.87. This value is again aligned with the high internal consistency of the scale. Elimination of one item - the least correlated to the

other items - resulted in the alpha reliability being retained. This combined scale originated from the following four items:

1. I know best practices in science education that can help newcomer students linguistically to learn in science.
2. I feel myself competent to teach science to newcomer students.
3. I have a variety of methods to help students learn science.
4. My students do well because they need more instructional time.

This factor includes items that pertain to methods for use in fostering the learning success of newcomer students recognising the additional instructional time they are likely to require. This factor emerged with strong optimism during teachers' interviews. Teachers believed they knew enough science to adequately guide newcomer students. The integration part, per se, was a continuous challenge. Knowing enough science to teach secondary school science is but one part of the story. These teachers are required to be culture brokers (Aikenhead, 2006), providing means by which the science worldviews brought by newcomer students are addressed in classrooms (Cobern, 1991; Matthews, 1994). This requirement makes their professional duty a very complex issue but not impossible if they integrate the adequate tools such as congruency and a cultural sensitive pedagogy (Jegede, 1989; Phillips et al., 2009; Rivard, 2009).

Professional science knowledge for integration obtains an average score of 3.1 across the validation group, the sixth among the 8 factors treated in this data analysis.

This factor encourages teachers working diligently in the students' best interests using a variety of methods and instructional materials.

8.3.7 Professional Attitude and Efforts to Address Students' Needs

The alpha reliability coefficient for *professional attitude and interest* in the initial 5-item scale was 0.80. This value aligned with the high internal consistency of the scale. Elimination of one item - the least correlated to the other items - resulted in the alpha reliability being retained. This combined scale originated from the following four items:

1. I pledge to change my teaching to meet the needs of the newcomer students.
2. I try to know each student personally.
3. I have changed my teaching practices to meet the science learning needs of the newcomer students.
4. Working with newcomer students gives me the opportunity to innovate my teaching.

In all, this factor and its items address teachers' willingness to teach responsively. Teachers showed a very professional attitude when dealing with immigration/refugee students, as reported in the interviews. They were enthusiastic about learning to teach science to newcomer students. They were open to go to professional development to learn more about their students' background. One teacher had travelled to Africa to explore this culturally enriched continent. Others reported that they participated in

extra-curricular activities with their immigrant/refugee students even though they were not invited to participate in other cultural and social events taking place within the ethnic communities of their new students. This curiosity and openness to learn about other cultures and worldviews are keys for transforming these teachers to change agents into the successful transitioning of immigrant/refugee students (Kanu, 2006). Moreover, interviews with students did confirm this welcoming attitude of teachers toward them. They reported that teachers were very attentive to their integration needs supporting the claim that teachers held the right disposition to invest into these students, wellness and successful learning journey (Bishop, 2012; Cobern, 1991)

This factor scored an average of 3.7 across the validation group, one of the second among the 8 factors being analyzed. This interest manifested in the teachers' commitment to modifying their teaching style and practices to help these students. That attitude reflected a very professional and ethical behavior toward every student, particularly those who were new in the system.

8.3.8 Equity and Fairness to Others and Integrity: Are we ready to deal adequately with newcomer students (Due diligence)

The alpha reliability coefficient for *equity* in the initial 5-item scale was 0.71. This value aligned with the internal consistency of the scale. Elimination of one item - the least correlated to the other items - resulted in the alpha reliability being retained. This combined scale originated from the following four items:

1. I do not favor any student in my class.
2. I value all students in my class.
3. If I have concerns about a newcomer student, I know whom to talk to.
4. My colleagues are willing to help me so newcomer students succeed.

In all, the items in this scale focus on teachers' advocacy for all students equally, not just a select few who may show greater propensity for science success. A sense of equity was noticed in the data during analysis of the teacher interviews. They said they were not only eager to treat every student equally but also to treat them according to their level of need. Immigrant/refuge students also weighed in on this view as they consistently mentioned they were treated with care, especially in teachers seeking to respond to their concerns.

This factor scored 2.9 across the validation group, the seventh among the 8 factors being examined suggesting that across the group attending to all students was potentially problematic. This factor suggests that equity is understood by teachers but potentially hard to enact because it requires teachers to be personally engaged to help students succeed beyond their socioeconomic status or cultural heritage. In this survey, teachers' pursuit of intellectual integrity also appeared to be the natural corollary of the equity factor.

8.3.9 Summary

The initial statistical analysis allowed for the validation of each 4-item scale's internal consistency (see Cronbach alpha reliability coefficient) and the descriptive statistics such as mean and standard deviation. These measures allowed the researcher to filter the survey using the strongest items; that is, those with highest correlations. The new survey instrument was established using these procedures. Beyond the correlations, how the different scales are interrelated or overlapped using discriminant analysis will now be explored by examining, first, the Inter-Scale Correlations for the eight scale and, second, the factor loadings of the I_MISLE.

8.4 Discriminant validity and factor loadings

The discriminant validity was conducted to compare the mean correlation of a scale with the other seven scales for the reduced 4-item scale.

Table 8.2:

I_MISLE Mean Correlation of 4-Item Scale with the Other Seven Scales

Scale	Discriminant validity 4-item scales
Resource Adequacy	0.21
Time	0.15
Knowledge of Students' Background	0.04
Professional Support	0.07
Professional Adequacy	0.01
Professional Science Knowledge	0.04
Professional Attitude and Interest	0.16
Equity	0.17

Discriminant validity is viewed as the intrinsic capacity of measurement scales to measure the construct they are designed to measure instead of other related constructs. It is performed by comparing the square root of the average variance of each scale with the correlations between each scale (Chen, 2002). The very low mean correlations above show that the scales that are supposed to measure different constructs are, in fact, unrelated with little overlap. This finding is understandable because we use the four highest correlated items to build each factor that and this contributes to this divergent measurement (John & Benet-Martinez, 2000). The mean correlation suggests that we should conduct a closer examination of the Inter-Scale table of correlations as presented in Table 8.3.

Table 8.3

Inter-Scale table of correlations

			Knowledge			Professional	Professional	
	Resource		Students'	Professional	Professional	Science for	Attitude and	
	Adequacy	Time	Background	Support	Adequacy	Integration	Interest	Equity
RA	1	,298	,167	,104	,041	-,075	,448	,496
T		1	,274	,055	,137	-,156	,332	,121
KSB			1	-,120	-,141	-,061	,095	,044
PS				1	-,137	,166	,115	,314
PA					1	-,058	,194	-,088
PSI						1	-,217	,153
PAI							1	,138
E								1

This inter-scale table above shows very low correlation among the factors. The highest correlations are observed between equity and resource adequacy ($r = .496$). Were teachers saying that the more equipped they are, the better they will provide equal access to learning in science? Interestingly, professional adequacy and professional support are negatively correlated ($r = -.137$). Did teachers receive the support needed because they were trying their best to provide quality science instruction to immigrant/refugee students? In all, the discriminant validity results indicate that there is little overlapping amongst the factors identified.

We can now explore the factor loadings to examine how the items are distributed among the eight factors which are listed in Table 8.4. As seen below, the first factor accounts for 25.81% of the variance of the data. The eight factors, together, contribute for 86.44% of the total of variance, meaning that the eight factors cover well the constructs that were measured in the instrument.

The number of items for each factor was reduced for the purpose of economy of use hoping to eliminate any time management issues associated with the instrument being administrated. The factors comprised items that had at least .60 in correlation and with the Eigenvalue superior to 1. Table 8.4 presents items with great correlations varying from .67 to .93 when taking the first four items for each factor. I chose to not reverse items with negative scores since that might lead to systematic errors and reduce the validity of the questionnaire as stated demonstrated by Schriesheim & Hill (1981) and Jackson, Wall, Martin & Davids (1993).

The discriminant analysis, the Inter-score factors and the factor loadings contribute to the validated 4-item-8-scale instrument are presented in Appendix C.

Table 8.4

Factor Loadings with Eigenvalue and Cumulative Variance (%)

	FACTORS							
	RA	T	KSB	PS	PA	PSKI	PAI	E
Q24	.860							
Q55	.782							
Q9	.764							
Q45	.744							
Q43	.602							
Q18		.903						
Q56		-.877						
Q2		.841						
Q11		-.778						
Q1			.935					
Q30			-.896					
Q5			.849					
Q36			.706					
Q37				.920				
Q28				-.682				
Q8				-.630				
Q12				.596				
Q48					.898			
Q21					-.862			
Q20					-.722			
Q22					0.64			
Q44						-.904		
Q25						-.865		
Q51						-.854		
Q42						-.752		
Q22						-.622		
Q47							-.871	
Q13							-.825	
Q53							-.780	
Q10							.680	
Q19								.858
Q7								.812
Q54								.807
Q57								0.67
Eigenvalue	14.46	8.79	5.95	4.75	4.47	4	3.42	2.55
Cumulative variance (%)	25.81	41.52	52.15	60.63	68.63	75.77	81.89	86.44

8.5 Summary

This chapter has presented the procedures used to validate and refine the Instrument for Minority Immigrant Science Learning Environment. It has reviewed the different statistical analyses implemented such as principal component analysis, mean correlation, and discriminant analysis. The result is the elaboration and design of the 4-item scale questionnaire with eight independent factors. The next chapter will describe the application of the instrument using the same participants that were interviewed in Phase I of the study.

Chapter 9 Application of the I_MISLE

9.1 Introduction

This chapter outlines the results of the application of the Instrument for Minority Immigrant Science Learning Environment and compares these findings to those derived from teachers' interviews at chapter 7. The questionnaire when completed by participants should illustrate statistically what is happening with immigrant/refugee students in the context of Francophone Immigrant minority science teaching and learning. Therefore, the questionnaire should reflect the same perceptions teachers expressed during the interviews, especially given that it was implemented using the same eight teacher participants who were interviewed. That is, the quantitative data should correspond with the qualitative data. The hope is that the I_MISLE will be an effective tool in the hands of school administrators and stakeholders for conducting effective change through the collection of real and reliable data. In brief, does the data collected from the instrument echo the same perceptions teachers hold about instructing newcomers in science class?

This chapter outlines the quantitative results of the application of the I_MISLE in 9.2. A comparison between the interviews and the results of the application of the I_MISLE along with the justification of methodological decisions to aggregate data collected at both schools will follow in 9.3 before concluding the chapter, in 9.4.

9.2 Quantitative Results of the Application of the I_MISLE

The validated 4-item, 8-scale Instrument for Minority Immigrant Science Learning Environment was administered at the same two schools of the Francophone School Division in which interviews with eight teachers were conducted in Phase I of this study. The themes explored in this instrument were identified through analysis of the interviews. Therefore, it was crucial that the same teachers filled out the survey. The questionnaire is part of Appendix C. The mean score and standard deviations are presented in Table 9.1.

Table 9.1

I_MISLE Implementation Statistics

Scale	Mean	Standard Deviation
Resource Adequacy	3.75	1.12
Time	3.59	1.09
Knowledge of Students' Background	3.47	1.00
Professional Support	3.68	1.23
Professional Adequacy	3.54	0.93
Professional Science Knowledge	3.62	0.88
Professional Attitude and Interest	3.53	1.00
Equity	3.68	0.97

In the next section, we will analyse each factor against the results of the interviews.

9.3 Comparison of I_MISLE Data with the Results of Teachers' Interviews.

The decision to aggregate the data collected at both participating schools was purposely made in order to address the ethical and methodological orientations of the study. First, the Ethics document approval stated that the quantitative phase of the study should remain anonymous. This filter criteria was crucial for two main reasons: a) the researcher, as a teacher in the DSFM, was seen as an insider within the field where data was collected and b) the researcher was also a member of the visible minorities; therefore he belonged to the student population being studied. The choice of anonymity was a judicious rationale to allow fellow teachers to independently voice their views, perceptions and their real concerns on the social and academic accommodation of the immigrant and refugee students. In addition, that methodological choice allowed opportunity to cross-validate and triangulate data coming from interviews and survey data that was collected anonymously. This decision was considered a strong asset for the rigor of the study enhancing the parallel-form reliability among interviews and survey, knowing purposely that reliability, as a measurement, is an imperfect endeavor (Creswell, 2008; Hinkin, 1995).

Taking account, this study followed as closely as possible the orthodoxy informing the development and validation of LER instruments, and captured the variability within the dimensions, especially that of Professional support, as already mentioned in the interviews; it is, therefore, established as a valid instrument. That being said, this research is also confronted with the constraints of the minority milieu where it was conducted. Statistical power issues, such as the sample size effect, were compensated by increased reliability and diverse range of validity - face validity,

content validity and conclusion validity- supported through both teachers' and students' interviews, exhaustive literature review of the Manitoba francophone minority settings and the refinement of the questionnaire. In summary, these methodological decisions contributed to adequately respond to the third objective of the study which refers to the validation of the I_MISLE.

Data collected from the I_MISLE application allowed confirmation that science teachers held, overall, quite consistent and only some concern across the schools on resource adequacy, with a mean score of 3.75 and a standard deviation of 1.12. The I_MISLE data echoed the comments teachers made during the interview phase about available resources operating as a critical factor in working with immigrant/refugee students. These growing concerns were aligned with professional support where teachers clearly admitted that there was a systematic scarcity of instructional materials to support the effective learning of the newcomer students. A critical issue that would support teachers in this area would be for them to be guided in creating differential sets of instructional material, especially in supporting student deficiencies in science knowledge and skills.

Time was another factor that was seen as a key to newcomer students learning in science. With a mean score of 3.59, and a standard deviation of 1.09, time was presented as somewhat of an issue for teachers in planning for and supporting immigrant/refugee students learning science. The standard deviation of 1.09, the third highest in the group, suggested that teachers did not share the same concerns around this factor - even though it was a matter of great importance. In the interviews, teachers regretted not having adequate time to respond to students' needs, especially those who

had lived in refugee camps and came to Canada with emotional trauma and huge schooling deficit.

Even if more time were allowed, best practices in pedagogical planning could not be guaranteed to make a difference in the way teachers were helping these newcomer students. Time was a crucial factor of influence, and equally its management and fair usage. Overall, it is urgent to translate instruction time into effective and lasting learning for these newcomer students and it was evident teachers were identifying the need for support in this area.

Knowledge of students' background was also a critical factor emerging in the interviews, as many teachers realized that they needed to know more about the newcomer students' backgrounds they received, sometimes in the midst of the academic school year. A mean score of 3.47 and a standard deviation of 1.00 showed that the I_MISLE accurately portrays teachers' concerns about students' background and their ability to work with students backgrounds, socially, culturally and linguistically. They were curious to know more about these students and identified the need to build better relationships with them in order to bridge the cultural gap that would eventually improve the learning climate in science classrooms.

The effort of these teachers to participate in extracurricular activities and social and cultural activities organized by ethnic communities testified their willingness to get immersed into real cultural experiences of their newcomer students. It is hoped that these cultural opportunities will help these teachers overcome their first impression of pity regarding these students and see them, instead, as very resilient individuals who

had survived and aspired for a better life where everyone is treated with justice and dignity.

Professional support was also measured by the I_MISLE, with a mean score of 3.68 and a standard deviation of 1.23. Teachers generally agreed that they needed a nurturing environment to foster immigrant/refugee student learning. During the interviews, they acknowledged that the effort had been made to meet these students' needs, but that there was also room for improvement to foster students' effective transition. As noted, the high standard deviation of 1.23 may be explained by the fact that teachers, as reported during the interviews, were not unanimous on the level of support they received from schools' administrators. As already mentioned, in one school the professional support was more up to teachers' expectations whereas in the other one, teachers were left with their expectations not quite met.

School administrators have a major role to play to assist teachers in the delivery of a quality science education program for all, especially these coming from a more vulnerable population which is composed, in this study, of the immigrant/refugee students. Teachers said they were in great need of effective professional development, membership to professional learning communities that reflect on academic and social integration of the newcomer students, and the empowerment of immigrant/refugee students to meet Manitoba school expectations.

From professional adequacy to professional attitude and interest, the mean score is 3.6 with a standard deviation of 0.90 when combining these three intrinsic factors. Effectively, teachers reported needing more training to do a better work with

immigrant/refugee students in science and were open to this possibility. Initial teacher training must address teachers' lack of knowledge in the integration of newcomer students in science. Notably, teachers expressed interested in receiving more professional development and learning opportunities to engage in meaningful peer collaboration and thus to better serve these newcomer students. These data corresponded to that emanating from the interviews. A change in Manitoba curriculum orientation would also help these teachers to align learning goals with cultural belonging needs of immigrant/refugee students. This change may bridge the cultural discontinuities that were threatening the adequate social and academic integration of the newcomer students (Piquemal et al., 2009).

Last, but certainly not the least, was the equity factor that emerged during interviews of both teachers and students. I sensed that these teachers were well aware that they were dealing with vulnerable students coming mainly from disturbing living circumstances and more often from war conflict zones. For these students who had experienced a steady survival mode, peace was a luxury. Also equity toward these students could be translated into providing them with the same learning opportunities as these given to their Canadian peers, so the former can strive and achieve their full potential in science. And when teachers are neglecting aspects of students' cultural background, negating cultural worldviews in science may be unintentionally oppressive (Aikenhead, 2006; Bishop, 2012; Piquemal et al., 2009).

With a mean score of 3.68 and a standard deviation of 0.97, the equity dimension appeared to be accurately measured by the I_MISLE, because, as noticed in the interview results, teachers were, overall, committed to working with newcomer

students, showing an openness to their individual needs and concerns. Under the lens of the post-colonial theory, it is mandatory for teachers coming from a mainstream cultural background to be aware of the power relationship that exists between them and their visible minority students with different cultural and socio-economic backgrounds and historical trajectories. It is imperative for teachers to not only continuously learn about these students' background but also to show open-mindedness and act accordingly.

9.4 Summary

In this chapter, the quantitative results of the Application of the Instrument for Minority Immigrant Science Learning Environment were presented and tabulated. A discussion that put these results into perspective regarding the interviews followed. It is evidenced through these data that the I_MISLE accurately echoed the main themes and related concerns voiced during the interviews as supported by the mean scores mainly around 3.50 on a scale of 5 and standard deviations that gravitated around 1.00, although higher in the professional support scale. In all, the instrument was measuring that in all scales, teachers were quite neutral to slightly positive in their perceptions of how they, the school and the division were operating in terms of supporting students in their transition. As well, the instrument was able to show the variability in perception amongst teachers, although, overall, teachers did not show significant variability in their perceptions, other than in the professional support dimension. The instrument gives indication that it accurately measures the existing condition. The next, and final, chapter offers a review and outlines the significance and limitations of the study.

Chapter 10 Conclusions and Implications

10.1 Introduction

The purpose of this final chapter is to provide an overview of this study, as well as to present the major findings that associated with the development, validation and application of the Instrument for Minority Immigrant Science Learning Environment. The first intention of this instrument was to support the DSFM school community in collecting accurate data through teacher completion of the instrument to support teacher consideration of practice and adjust school and classroom practices in order to better serve the immigrant/refugee student population. To meet this goal, the chapter is organised as follows: section 10.2 will present a review of the study; section 10.3 will outline the major findings; section 10.4 will summarize the limitations of the study and the recommendations; section 10.5 will look at the significance of the study; section 10.6 will articulate the study's significance; and 10.7 will close this final chapter and the dissertation.

10.2 Review of the Study

This study was motivated by the urgency for greater collaboration among stakeholders to improve the quality of science instruction that immigrant and refugee students are receiving in the context of the French School Division in Manitoba. As a teacher-researcher personally involved in the lives of these immigrant students and because of the related challenges evident through interactions with this population, I sought to develop an instrument that would allow school personnel to easily and

economically portray the characteristics of the science classrooms that host these newcomer students.

The study integrated several stages. After the required forms and letters were submitted to the Ethic Review Board of the University and the Superintendent of the DSFM, in the intent of following guidelines for conducting research in education settings, data collection started with teachers' and students' interviews within the DSFM. This study was articulated in a two-fold process with three different data collection and analysis phases.

During Phase One, interviews with teachers and students were conducted. Sixteen students and eight teachers answered questions on the state of science teaching and learning that involved immigrant/refugee students. These data contributed to the generation of the first draft of the questionnaire in collaboration with the focus group.

During Phase Two, 84 teachers of the DSFM that had been involved in teaching science and/or had or had not taught immigrant/refugee students were surveyed from the long form of the instrument (see Appendix B). Even though the number of participants should have been higher, this participation allowed the researcher to validate and refine the instrument into a shorter version. This latter version was implemented to gather results that were validated against teachers' interview results. While thematic coding and the focus group were elaborated upon to conduct the qualitative phase, principal component analysis with factor loadings and alpha reliability were used to strengthen the quantitative phase. All phases of the study took place over one year, from May 2013 to July 2014.

10.3 Major Findings

This study initially sought to tackle three main questions. Below are outlined answers to the questions that guided the design and conduct of this study.

1. What, if any, characteristics of effective science teaching are identified among new immigrant/refugee students and teachers in Franco-Manitoban learning environments as supportive of their transition? What teacher and student specific and environmental conditions contribute to effective teaching for new immigrant/refugee students?

Interviews with both students and teachers made it clear that students showed evidence of experiencing social, pedagogical, academic and linguistic discontinuity, especially at the classroom level, and were aware that they were navigating a new educational system that was different to what they were used to in their home countries (Lee et al., 2005; Piquemal et al., 2008). For example, they voiced that the teachers here in Canada are more attentive to their social-cultural integration and their wellbeing than fellow teachers, for example, in Congo. Also, students, during the interviews, praised pedagogical practices such as group work, science projects, hands-on activities and especially one-on-one instruction. However, teachers were concerned about one-on-one instruction because it required more time for effective instruction for each student. This perceived need to assist newcomer students was compounded by the fact that, in the DSFM, teachers were already complaining about time as a very constraining factor (Lewthwaite et al., 2007a). Some teachers were very conscious of the complexity of the tasks required for better serving refugee/immigrants students and advocated for a wider

scope of resources, both physical and human, to improve science learning in their classrooms.

Moreover, they all thought that initial and continuing education for teachers should integrate components that foster the social-integration of newcomer students (Kanu, 2008; Lee, 2008; Piquemal et al. 2010). In general, teachers voiced they had limited resources to serve students who were, possibly, not only traumatized by intensive war conflicts but also academically underschooled compared to their Canadian peers and others coming more stable countries. To paraphrase one of the teachers who was interviewed, best science instruction practices for all students also worked well for immigrant/refugee students. Teachers also reported that they needed more time and more instruction guidelines – meaning more professional development- to help newcomer students engage in science.

Unfortunately, and possibly disturbingly, teachers acknowledged that culture did not play a major role in their science teaching. They underplayed the cultural factor and emphasized conventional ways of teaching science to address newcomer students' needs for social-integration in science classrooms. Nevertheless, other studies have shown the propensity of science teachers to foster francophone culture in the minority settings, choices that sometimes reduced the time allocated to fully explore into science concepts (Lewthwaite et al., 2007a, 2007b). In this case, francophone culture in classrooms became the cultural norm, which dominated any inclusion of the minority cultures represented by these new students. This point echoed concerns highlighted by the works of several researchers on cultural and epistemological hegemony in Western science (Cobern, 1997; Ogbu, 1987; Said, 1993). In brief, teachers showed little consideration

of adjusting practice for epistemological reasons. Moreover, it was evident during analysis of the data that teachers were aware of the challenges and the profound responsibility that the presence of teaching newcomers entails. In sum, the teachers seemed very open to learn more about immigrant/refugee cultural backgrounds and adjust instructional strategies to help their new student population succeed in science. That open attitude to improve what they knew about students' background is a prerequisite for effective teaching and quality science education. Although this adjustment was deemed important, it primarily was limited to social and linguistic matters rather than deeper cultural and epistemological considerations.

- 2) How can the characteristics of effective teaching of science—if these exist among immigrant/refugee students—be used in the development and field validation of an instrument designed to measure teacher effectiveness in French-language settings in Manitoba?

The literature has emphasized the importance of teachers who are aware of their particular mission, have an eagerness to be long-life learners, and show readiness to help their students grow in a meaningful learning environment (Bishop, 2011). One common characteristic among teacher participants in this study was the relational aspect of teaching and learning in science.

They all said they were ready to know more about their students' social and cultural backgrounds and to take professional development to enhance their teachings. Overall, they were eager to contribute to offer better learning opportunities to newcomer students. These are all characteristics that can particularly help in a francophone

minority settings (Lewthwaite et al., 2007a; Piquemal et al., 2009). These findings also emerged from this study but indicated the special attention teachers sought in addressing students' social, linguistic and cultural difference, especially as compared to their Canadian counterparts.

Indeed, the instrument was constructed using the themes that emerged from the interviews. From the literature review and the emergent issues and recurrent themes from the interviews, a long questionnaire of 84 items was developed. Afterwards, a focus group composed of science educators and professional science teachers helped to refine the questionnaire into 56 items instrument. This questionnaire was administered to science teachers of the DSFM and corresponding francophone-minority schools where immigrant and refugee students were resident. Using the data from this administration, the instrument was again refined through statistical methods before its validation. Such statistical procedures involved Cronbach-alpha reliability, discriminant analysis and factor loadings that belong to the Principal Component Analysis in the perspective of an exploratory factor analysis study. Although the validation process was threatened by the number of participants in the context of a minority setting because the number of science teachers is not significant and science teachers who have taught immigrant/refugee students are a few, the sample closely approximated the population; therefore this validation carries some concern of statistical robustness.

3) If validated, can an instrument measuring teacher effectiveness in Francophone-minority settings among immigrant/refugee students in Manitoba be utilized to initiate critical reflection among teachers of science towards the improvement of their teaching practices in similar learning environments?

The Instrument for Minority Immigrant Science Learning Environment application exercise captured the main themes and related preoccupations of teachers and students during the interview and the validation phases. Teachers were given opportunities to add some remarks at the end of the questionnaire once it was completed. They unanimously appreciated the items and asked the researcher for the final version of the I_MISLE, which they indicated allowed them to continue developing awareness of influences on newcomer students, especially as related to teaching science to students coming from all over the world with different views about science (Cobern, 1997). In addressing factors pragmatic issues such as time constraints, resource available, professional support and more elusive factors such as knowledge of students' background, especially linguistically, socially and culturally, teachers commented on how the instrument assisted them in positioning themselves in their teaching science to immigrant and refugee students.

These students represent cultural, linguistic, and socio-cultural backgrounds of which they have limited familiarity with. The I_MISLE promises to help science teachers reflect on the core issues and to continue an iterative process of improvement of both teaching and learning in science for the benefit of immigrant/refugee students. This self-criticism is essential and of critical importance to the effective social and academic accommodation of these newcomer students.

10.4 Recommendations

According to the trends that emerged from both teacher and student interviews, the recommendations that emerged are summarized using these thematic patterns:

1. **Teachers' training and cultural-relevant pedagogy:** From the collected narratives, it is evident that faculties of education should reinforce the exposure of their student teachers to more multicultural experiences in order for these future teachers to teach science adequately to a more culturally diverse clientele. By doing so, teachers will be better skilled at designing more inclusive classes, acting as cultural brokers, and implementing a more cultural responsive pedagogy (Aikenhead, 2006; Baskerville, 2010; Bishop, 2010; Gay, 2000; Kanu, 2006; Piquemal & Nickels, 2005; Rivard & Cormier, 2008).
2. **Pragmatic teaching issues:** Consistent with the interview data, teachers must prioritize science-based project learning for science instruction; labs and hands-on activities should be a regular part of science lessons; teachers must be more assertive in forming student groups to make sure they are as varied as possible to maximize interaction between Canadian-born students and new immigrant/refugee students; teachers should make effort to differentiate instruction in order to integrate multicultural perspectives into science learning; teachers may create assessment science instructional materials through Professional Learning Communities (PLC) to assess newcomer students.
3. **Academic placement:** Further, academic placement decisions should be negotiated with the newcomer students and/or the students' parents. Information on students' academic and sociocultural backgrounds must be shared among science teachers, academic advisors, and special education teachers.
4. **Immigrant/refugee students' integration task force.** Teachers who have experienced some success with immigrant/refugee students may volunteer to

help other colleagues that recently started teaching this student population. It is the role of the DSFM to put together a task force to spread and share best practices on immigrant/refugee students' integration. Other school divisions welcoming immigrant/refugee may also follow these exemplary practices.

5. **Teachers' recruitment.** As suggested by previous studies (Piquemal et al. 2009, 2010) and found in this study, teachers from visible minorities related better with immigrant/students. First, these teachers acted like cultural insiders because they were accustomed to their new students' socio-cultural, linguistic and academic backgrounds and second, these students had seen these teachers as their role models, as documented during the interviews with both teachers and students. Therefore, the human resources sector of the DSFM may be thinking of recruiting more teachers of color to adequately respond to this observation.
6. **Epistemological** – Teachers need authentic and adequate professional development programs to help them deal adequately with the challenges that multicultural classes pose. This PD should offer first-hand experiences and expertise in the field of students' transition without neglecting cultural brokerage, cultural sensitive pedagogy, and knowledge of other school systems which may be part of seminars focused on International education.

10.5 Limitations and Further Research

The researcher identifies some limitations mostly related to the context and constraints, already outlined in the methodology chapter, this study was conducted under. First, this study is limited in terms of generalizing the results because of (a) the

specificity of the participant community being studied, namely refugee and immigrant students in a francophone minority settings and (b) the size of the sample being treated, which is relatively small (16 students and eight teachers interviewed and 84 teachers surveyed). Because of the rule of thumb using 1:5 ratio of items to participant or at least 150 participants for an exploratory factor analysis study, the questionnaire needs more occasions to be implemented to cross-validate the results (Schriesheim & Hill, 1981).

In general, it should be noted that this study has been primarily concerned with:

- 1) **Minority contexts in education.** Minority educational settings such as these of the Maori in Australia (Bishop, 2012) and those living in Canada (Gilbert et al., 2004; Rivard et al., 2008) have their own set of social dynamics and issues, especially these of linguistic oppression, acculturation and neocolonial concerns. These characteristics should be factored when applying this instrument to other milieus not very identical to the original learning environment where this instrument was elaborated.

- 2) **Small number statistics.** As stated at the beginning of this section, the fact that this research was dealing with very small numbers, less than what is usually deemed necessary as per as the ratio of participant per item (as the rule of thumb of 5 participants per item), should be taken into consideration for any potential transferability to other studies (Brinkman, 2009; Prentice & Miller, 1992).

3) **Position of the researcher.** The researcher himself is an immigrant, a visible minority teacher working for the school division where the study was done. Therefore, the data that were collected during interviews with fellow teachers and students for which he was an authoritative figure might influence their answers and considerations (Hinkin, 1995). This double aspect (ethnicity and insider from the milieu) might also transpire in the process of data interpretation and the conclusions of the study. Adding to the fact, students were very straightforward when responding to the questions that were open. There was a lack of desire to articulate or elaborate their thinking even though the researcher did explicitly ask them to do it. Is this reluctance to talk more and deeper about some issues are symptomatic of a lack of linguistics tools to frame their perceptions of the new learning environment? Or was that related to the position of the researcher as a teacher researcher working for the same school division these students were registered? These issues could be addressed in a further investigation.

That being said, all effort was made to follow the orthodoxy of valid mixed-method research such as content validity, criterion-related validity, construct validity, and internal consistency (Hinkin, 1995). These well-accepted parameters were followed to assure that the instrument met the criteria of validity and reliability. Overall, if there were instances where statistical significance might be a problematic issue; content significance was a reliable compensation in such occurrences.

Despite the DSFM being a provincial wide division, immigrants and refugee students are mainly concentrated in places like Winnipeg, where the school division has its largest high school, Collège Louis Riel. The results of this study are not to be generalized, per se, but trends identified herein might eventually inspire new studies and policies in the field of immigrant/refugee student integration in science classrooms or in minority settings, and an adaptation of the instrument to assess other classroom learning environments.

For further research, the followings are suggested:

- 1) Improving survey instrument robustness is a continuous process; therefore, the I_MISLE will gain in validity and reliability if many iterations of data collection and analyses in similar learning environments occur afterwards.
- 2) The I_MISLE may serve as the first instrument in the Francophone community to support understanding and improved practices in serving diversity and culturally relevant pedagogy in science. That specific context may help refine and improve the instrument validity over time.
- 3) Because this instrument was implemented in French, even though it was translated into English, it should be also validated in English in the near future, and even for investigators to compare both English and French results as it is the common is LER research methodology as outlined in Chapter 4.
- 4) It may be time to put together consensual procedures to deal with small number statistics research within the francophone minority settings in Canada. Because as suggested by other studies conducted by Gilbert et al.

(2004) and Rivard et al. (2008), it is a recurrent issue in the methodology section, more specifically for quantitative and mixed-method study.

- 5) It might be pertinent to revisit this learning environment to gauge how teachers have evolved in their perceptions of dealing with immigrant/refugee students. One of the question might be if they had moved from the perception of providing the basic needs of emotional and academic support to immigrant/refugee students to a more cultural, linguistic and social-related pedagogy.

10.6 Significance

This study has different levels of significance. At a provincial level, it will contribute to gathering more accurate data regarding the integration of immigrant/refugee students in science classrooms in francophone minority settings. The DSFM and potential French Immersion school division in Manitoba may benefit from using it in their classrooms. These school divisions may use this study to provide better professional developments as requested by the teachers that were interviewed. They may also use the findings to improve their students' services and support these parents. Overall, school divisions could use the instrument derived from this study to work in reconceptualising the science curriculum delivery to better meet the students for not only emotional and academic support but also for cultural, linguistic and epistemological integration, apt to minimize the plethora of discontinuities they may encounter in their journey of becoming members of a new learning community.

Moreover, Manitoba has relied, for almost a decade, on Francophone immigration, especially, from Africa. There is no doubt that this study will help improve many services and programs related to the academic and social integration of newcomers students. Bringing more young Francophone immigrants into the province remains a laudable initiative especially for those who come from war-torn territories but neglecting to put in place adequate welcome facilities which offer educational services including science education would minimize the opportunity for these young people to integrate into society and become active and involved citizens. Thus, the schools of the province that provide services to immigrant and refugee youth have an immediate interest in appropriating the conclusions and suggestions of this research to improve their mandate which is: a quality education for all, notable a quality science education for all.

At the national level, French minority settings around Canada that have seen immigrant populations increase may use the I_MISLE to provide a portrait of the level of integration of immigrant/refugee students and identify practices that likely need to be adjusted to support students in their transition. The French minority settings in New-Brunswick, Ontario, Nova Scotia, Alberta and Saskatchewan have already come to Manitoba to observe best practices of integration of immigrants. This kind of knowledge sharing could be extended to collaboration among the DSFM and other French speaking schools in other minority contexts in Canada. The existence of nationwide network of francophone organizations in minority settings will help spread best practices within francophone schools through the country. Organizations such as

Canadian parents for French and the Canadian Association of French teachers are among of these featured networks that may promote the agenda for a more inclusive science education through workshops, publications and consistent advocacy.

At the international level, where immigrant populations are concentrated, school divisions may use this instrument to help teachers reflect on their practices related to newcomer student integration. Modification of the instrument for these settings may be necessary as suggested by the methodological constraints mentioned above. In the main, minority settings such as studied by Lee (2005) in United States and Bishop (2010) in Australia may benefit from an adjusted instrument derived from the I_MISLE as it is currently done for other LER instruments documented in Chapter 4. Even minority settings are characterized by their own peculiarities, best practices can still be shared across those settings if proper adaptations are made. For the sake of this explanation, in Manitoba we have been adapting educational practices coming from over the world to better serve the students' community. Equally, Manitoba may have practices to share that are able to promote a quality science education especially for students who are the most vulnerable and at risk of systematic academic failure.

10.7 Final Remarks

The Learning Environment Research field has a reputation for offering numerous LER instruments to assess student and teacher perceptions of their milieu (Aldridge, 2011; Fraser, 1998). However, despite recent endeavors to study Francophone-minority education in Manitoba such as through the Science Delivery Questionnaire (Lewthwaite et al., 2007b) and ethnographic studies conducted by

Piquemal et al. (2009, 2010), more research was needed to adequately portray and support the integration of newcomer students within the Francophone Division, especially in science. This study has sought to address these issues by providing a comprehensive validated instrument to assess the perceptions of teachers in supporting the transition of this target student group in science classrooms.

These instrument findings are not completely aligned with those that emerged from the above studies. I anticipated a certain malaise on the part of immigrant and Canadian students, a certain frustration from teachers facing the burden of integration, and low performance attitudes among students regarding their academic performance in science (Lafontant, 2007; Piquemal et al., 2010). I also thought that this research would assist in identifying ways in which practices might be improved. The first assumption was not aligned with the actual results, firstly because teachers were content with what they were able to achieve in helping the new immigrant/refugee students and, secondly, because of the educators' lack of knowledge in the field and the recency of the mass immigration phenomenon. While teachers were willing to help in the social integration of these new students, they were not ready to accommodate alternative worldviews into their teaching. The researcher identifies this as a disturbing picture of science education, as it is well documented (Aikenhead, 2006; Cobern, 1994; Matthews, 1994) that such consideration of alternative worldviews are necessary.

It may be beneficial to integrate these concerns into potential professional development to help science teachers realize the critical urgency of a science education open to new cultural perspectives. Because the contrary view would be one that is oppressive or resistant to alternative views, such teaching practices will likely hinder

newcomer students' views of science and their active participation in classrooms as it is probed during the interviews.

This follow-up from teachers requires intellectual openness and acknowledgement of the real nature of science which encompasses cultural tenets and views. While teachers in this study have neglected the cultural component in their teachings, the Manitoba curriculum, as the interviewees have claimed, still omit the multicultural dimensions of science as well. Therefore, shifting from a neutral science paradigm to a more humanistic/multicultural science will require systematic changes in both the science education teaching and the science curriculum.

It is my hope that this instrument will contribute to the improvement of teaching science to every student, especially those with less advantaged backgrounds. I have learned significantly through the design and validation of this instrument and hope it will be of use to teachers and other researchers in the field and find its place alongside other well-known instruments that support Learning Environment Research.

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Appendices

Appendix A: Interview guidelines

A. Interview questions for students

1. What cultural teaching practices best contribute to your engagement in science?

- Quelles sont les pratiques culturelles et pédagogiques qui contribuent le mieux à ta participation dans une classe de sciences?

2. When are you most engaged in science?

- En quelles occasions es-tu plus impliqué en sciences?

3. What is happening in your classroom when you are learning? Tell me about a situation when you were learning in science.

- Dans quelles circonstances, as-tu l'opportunité d'apprendre en classe de sciences? Raconte-moi un de ces moments.

4. Next year you will be in Grade X, What do you want your teacher do to help you learn in science?

- L'année prochaine, tu seras en classe X, que voudrais-tu que l'enseignant fasse pour t'aider à apprendre?

5. Using some of the artifacts you have here (portfolios, tests, etc), can you tell me about one of them and the learning you experienced?

- Peux-tu me parler davantage de l'un des artifacts dont tu disposes (portfolios, tests, etc.), et l'apprentissage que tu as vécu.

6. If you were to tell another student from your country about learning in science

in this school, what would you tell them about the learning and classroom culture? What do teachers do that causes learning to be easy? What could teachers do more to cause learning? What could teachers do less to cause learning?

- Si tu avais à parler de l'apprentissage et la culture de votre classe de sciences à un étudiant de ton pays, qu'est-ce que tu dirais? Que font les enseignants pour favoriser l'apprentissage? Que font-ils pour décourager l'apprentissage? Ou pour avoir moins d'apprentissage?

7. Tell me about yourself: your country of origin, country (ies) where you lived before coming to Canada.

- Parle-moi au sujet de ton parcours: pays d'origine et pays où tu as séjourné avant de venir au Canada?

8. How are your experiences working/interacting with peers in the science class? Is there any cultural conflict?

- Comment décrirais-tu tes expériences avec tes camarades en classe de sciences? Existe-t-il des conflits culturels?

9. Do you have access to your science teachers when needed, or as often as the Canadian students?

- As-tu accès à ton enseignant de sciences ou aussi souvent que tes pairs canadiens?

10. Are there any tutoring services available in science? If yes, do you think it is useful?

- Existe-t-il un service de tutorat en sciences? Si oui, penses-tu qu'il répond à tes besoins?

11. What do you think you can do to better perform in science? What can your science teacher do differently to help you reach this goal?

- Que penses-tu que tu peux faire pour mieux performer en sciences. Quels changements ton enseignant doit-il faire pour t'aider à réaliser cet objectif?

12. What do you see as the most difficult barrier(s) in learning science?

- Quels sont les obstacles les plus difficiles, d'après toi, pour apprendre les sciences?

13. How do you like participating in science labs, experiments or scenarios?

- Dans quelle mesure, aimes-tu participer aux labos de sciences, aux expériences scientifiques et aux scénarios?

14. How often do you work in groups? Tell me more about it? Are you always working with the same students?

- À quelle fréquence, travailles-tu en groupe? Décris tes expériences. Travailles-tu toujours avec les mêmes élèves?

15. How do you keep up with class instruction pace?

- Te sens-tu confortable avec le rythme d'enseignement de la classe?

16. How do you compare Canadian science teachers to those of your home/other country?

- Comment peux-tu comparer les enseignants d'ici à ceux de ton pays?

17. What do you want to add to about your learning adventure in science

classrooms?

- Que peux-tu ajouter sur ton parcours en classe de sciences?

18. Is the teacher taking in account your cultural background when teaching and/or choosing instructional resources?

- Penses-tu que l'enseignant de sciences tient compte de ton background culturel dans son enseignement et dans le choix des méthodes et moyens pédagogiques?

B. Interview questions for teachers and stakeholders

1. How long have you been teaching (involving with) refugee/immigrant students?

- Depuis combien de temps enseignez-vous (travaillez-vous avec) aux élèves immigrants et réfugiés

2. How can you describe the experiences of teaching (working with) these students?

- Décrivez vos expériences en enseignant à ces élèves immigrants et réfugiés

3. How is teaching (advising, working with) these students different from the native Canadian students?

- En quoi enseigner à ces étudiants diffère-t-il d'enseigner à ceux nés et vivant au Canada?

4. How do you describe their learning in science?

- Comment décrivez-vous leur apprentissage en science?

5. What do you think you can do to foster their learning in science? For example, do you think incorporate their cultural backgrounds into the

curriculum?

- Que pensez-vous faire pour améliorer leur apprentissage en sciences. Par exemple, comptez-vous intégrer leur background culturel dans vos leçons?

6. What are the main obstacles to learning/teaching science with the immigrant/refugee students?

- Quels sont les obstacles majeurs à l'enseignement ou à l'apprentissage des sciences en travaillant avec les nouveaux arrivants?

7. Do you think having enough support from the administration to enhance the science learning in your classroom for these students?

- Pensez-vous avoir le support nécessaire de l'administration pour aider ces étudiants?

8. Do you feel prepared (training, life experiences) to teach (work with) these students? What do you think may help to make you better effective? Have you taken some time to investigate these students' backgrounds?

- Sentez-vous préparé, formation initiale et expériences de vie comptant, pour enseigner ces immigrants? Que pensez-vous qui pourrait vous aider à être mieux efficace? Avez-vous pris du temps pour connaître le background de tes étudiants?

9. Do you get experiences outside of the classrooms with refugee/immigrant students? What do you know about their cultures?

- Avez-vous des expériences en dehors de la salle de classe avec les étudiants immigrants/réfugiés. Que savez-vous de leur culture?

10. Which methods (pedagogy) have worked more efficiently to teach science to address cultural diversity in your classrooms?

- Quelles sont les méthodes jugées efficaces pour enseigner la science tout en tenant compte de la diversité culturelle dans vos classes?

11. Do you think the curriculum and/or our teaching styles have addressed the cultural diversity of the science classroom? Do you think you have devoted enough time to create a sense of belonging among your minority students? Have you tried to reach out to them?

- Pensez-vous que le curriculum de sciences traite-t-il assez de diversité culturelle? Pensez-vous avoir réservé assez de temps aux nouveaux arrivants pour qu'ils développent un sentiment d'appartenance? Avez-vous essayé de les rejoindre?

12. How do you describe the immigrant/refugee student social network in the science classroom?

- Comment pouvez-vous décrire le réseau social des élèves immigrants/réfugiés dans vos salles de classe?

13. Do you feel these students are open to interact (asking, answering questions, taking leadership roles, taking initiatives) with you and the peers?

- Avez-vous l'impression que ces étudiants sont ouverts à l'interaction avec vous et avec leurs pairs?

14. According to you, are these students are treated equally (same amount of attention and care) compared to native Canadian students?

- Selon vous, est-ce que les étudiants nouvellement arrivés sont traités de la même manière que leurs pairs canadiens?

15. Do you have any success story you want to share in terms of the integration immigrant/refugee students into the science classroom?

- Avez-vous une quelconque histoire de réussite à partager avec nous sur l'intégration des les étudiants immigrants/réfugiés dans vos salles de classe?

16. What could be done to improve the academic and social integration of these students in your classroom?

- Qu'est-ce qui peut être fait pour améliorer l'intégration académique et sociale des étudiants dans votre classe?

17. What should we stop doing to promote equal treatment to all students regardless their culture and origins? What will you do different next year in this regard?

- Que comptez-vous arrêter de faire afin de traiter tous les étudiants de manière équitable? Que feriez-vous différemment l'année prochaine?

Appendix B: I_MISLE Long Version

Il y a 56 questions dans ce questionnaire. En sélectionnant une réponse vous devez penser au contexte de l'école où vous travaillez. Réfléchissez sur les énoncés et déterminez jusqu'à quel point ils décrivent l'environnement de votre école.

Indiquez votre réponse sur la feuille en choisissant:

TD: Si vous êtes totalement en désaccord avec l'énoncé

D: Si vous êtes en désaccord avec l'énoncé

N: Si vous n'êtes ni en accord ni en désaccord avec l'énoncé ou si vous n'êtes pas certain

A: Si vous êtes en accord avec l'énoncé

TA: Si vous êtes totalement en accord avec l'énoncé

Vérifiez vos réponses avant de soumettre le questionnaire pour être certain(e) que vous avez fait le choix que vous avez eu l'intention de faire.

1. Je dispose de ressources humaines nécessaires dans ma classe pour aider mes étudiants nouveaux arrivants

TD D N A TA

2. Je dispose du temps nécessaire pour préparer mes classes en fonction des besoins de mes étudiants nouveaux arrivants.

TD D N A TA

3. Le manque de communication entre les partenaires concernés est l'un des défis identifiés.

TD D N A TA

4. Il n'est pas nécessaire d'intégrer des éléments culturels dans mon enseignement des sciences.

TD D N A TA

5. Je valorise tous les étudiants de ma classe.

TD D N A TA

6. Les administrateurs me donnent le support nécessaire pour enseigner les élèves nouveaux arrivants.

TD D N A TA

7. Travailler avec les élèves nouveaux arrivants me donnent l'occasion d'innover mon enseignement.

TD D N A TA

8. Le manque de scolarité représente un défi majeur chez les élèves nouveaux arrivants.

TD D N A TA

9. Les élèves nouveaux arrivants sont informés des ressources disponibles à l'école pour les aider à réussir.

TD D N A TA

10. Je dispose assez de temps pour développer des ressources pour aider les étudiants nouveaux arrivants.

TD D N A TA

11. Ma formation initiale ne m'a pas préparé à travailler avec les élèves nouveaux arrivants.

TD D N A TA

12. C'est important que j'intègre la culture dans mon enseignement.

TD D N A TA

13. Je ne favorise aucun étudiant dans ma classe.

TD D N A TA

14. Mes collègues sont prêts à m'aider à faire réussir les élèves nouveaux arrivants.

TD D N A TA

15. Je fais un effort pour connaître chaque étudiant personnellement.

TD D N A TA

16. Je suis conscient des facteurs socio-économiques de l'environnement qui puissent influencer les étudiants nouveaux arrivants.

TD D N A TA

17. Je me fais disponible en dehors des heures de salle de classe pour aider mes élèves.

TD D N A TA

18. Je prends le temps nécessaire pour planifier des leçons de science au bénéfice des élèves nouveaux arrivants.

TD D N A TA

19. Je me sens compétent pour enseigner les sciences aux élèves nouveaux arrivants.

TD D N A TA

20. Je sais comment planifier une leçon en y intégrant une vision culturelle.

TD D N A TA

21. Je pense que tous les élèves peuvent réussir quel que soit leur background culturel et socio-économique.

TD D N A TA

22. La division scolaire n'offre pas de développement professionnel pour améliorer mon enseignement aux élèves nouveaux arrivants.

TD D N A TA

23. Je suis curieux au sujet du background culturel de mes élèves nouveaux arrivants.

TD D N A TA

24. L'histoire ou la trajectoire personnelle des élèves nouveaux arrivants influent sur leur performance en science.

TD D N A TA

25. Je dispose du matériel nécessaire pour enseigner et aider mes élèves nouveaux arrivants à apprendre en sciences.

TD D N A TA

26. Je prends le temps dans mes leçons pour aider les élèves nouveaux arrivants.

TD D N A TA

27. Je sens le besoin de suivre des séminaires en intégration des ÉNA (Élèves Nouveaux Arrivants) en salle de classe.

TD D N A TA

28. Je sais comment différencier mes leçons en utilisant la culture de mes élèves.

TD D N A TA

29. Tous mes étudiants ont le potentiel de faire face aux mêmes difficultés en sciences.

TD D N A TA

30. Je n'ai pas l'appui nécessaire pour enseigner aux élèves nouveaux arrivants.

TD D N A TA

31. Je rencontre les élèves nouveaux arrivants en dehors des salles de classe.

TD D N A TA

32. Les facteurs socio-affectifs doivent être pris en compte dans l'enseignement des élèves nouveaux arrivants.

TD D N A TA

33. Je dispose de matériel adéquat pour faire apprendre mes élèves en sciences.

TD D N A TA

34. J'ai besoin de plus de temps pour aider mes élèves nouveaux arrivants.

TD D N A TA

35. Je suis satisfait de mon travail d'enseignement des sciences avec les élèves nouveaux arrivants.

TD D N A TA

36. Je sais comment mettre à profit le background culturel des étudiants dans mes leçons.

TD D N A TA

37. Je pense que les élèves nouveaux arrivants peuvent réussir au même niveau que leurs camarades qui sont nés ici.

TD D N A TA

38. L'engagement des parents des nouveaux arrivants m'aident dans mon enseignement.

TD D N A TA

39. Je ne pense pas qu'il est nécessaire d'adapter ma pédagogie pour les élèves nouveaux arrivants.

TD D N A TA

40. Je dispose de stratégies pour m'informer sur les origines, entre autres du cheminement scolaire des élèves nouveaux arrivants.

TD D N A TA

41. Je dispose d'infrastructures nécessaires pour aider les étudiants à découvrir les sciences.

TD D N A TA

42. Mes élèves ne réussissent pas assez à cause de manque de temps.

TD D N A TA

43. Mes élèves disent que je fais un bon travail comme enseignant des sciences.

TD D N A TA

44. Je sais les pratiques gagnantes en didactique des sciences qui puissent aider les élèves nouveaux arrivants dans l'apprentissage des sciences.

TD D N A TA

45. Je pense qu'il y a un effort qui se fait pour satisfaire les besoins d'apprentissage des élèves nouveaux arrivants.

TD D N A TA

46. Les ressources de la communauté m'aident à enseigner les élèves nouveaux arrivants.

TD D N A TA

47. Je m'engage à modifier ma pédagogie en fonction des besoins des élèves nouveaux arrivants.

TD D N A TA

48. Je pense que le background linguistique des étudiants immigrants/réfugiés les empêche de maîtriser les concepts scientifiques.

TD D N A TA

49. Je dispose d'un budget pour acquérir des ressources pour aider les élèves nouveaux arrivants.

TD D N A TA

50. Je pense que si on dispose du temps nécessaire, tous les élèves nouveaux arrivants peuvent réussir.

TD D N A TA

51. Je dispose d'une variété de méthodes pour aider les élèves à apprendre les sciences.

TD D N A TA

52. Je peux identifier les caractéristiques d'un enseignement de qualité en sciences dans un contexte multiculturel.

TD D N A TA

53. J'ai modifié mes pratiques d'enseignement pour satisfaire les besoins d'apprentissage des sciences des élèves nouveaux arrivants.

TD D N A TA

54. Si j'ai des inquiétudes par rapport à un élève nouvel arrivant, je sais à qui m'adresser.

TD D N A TA

55. Je suis intéressé à connaître les expériences des élèves nouveaux arrivants en sciences.

TD D N A TA

56. Je pense que le background scolaire des élèves nouveaux arrivants les empêche de réussir en sciences.

TD D N A TA

English version

There are 56 questions in this survey. Answer according to the context of the school where you work. Think about the statements and determine to what extent they describe the environment of your school.

Mark your answer on the sheet by selecting:

TD: If you totally disagree with the statement

D: If you disagree with the statement

N: If you neither agree nor disagree, or if you are unsure

A: If you agree with the statement

SA: If you are totally in agreement with the statement

Check your answers before submitting the questionnaire to be sure that you have made the choice that you've been meaning to do.

1. I have enough human resources in my classroom to help my newcomer students

SD D N A SA

2. I have the time to prepare my classes based on the needs of my newcomer students.

SD D N A SA

3. The lack of communication between partners is one of the challenges identified.

SD D N A SA

4. It is not necessary to integrate cultural elements in my science teaching.

SD D N A SA

5. I value all students in my class.

SD D N A SA

6. Administrators provide me with the necessary support to teach the newcomer students.

SD D N A SA

7. Working with newcomer students give me the opportunity to innovate my teaching.

SD D N A SA

8. Lack of schooling is a major challenge among the newcomer students.

SD D N A SA

9. The newcomer students are informed of the resources available in the school to help them succeed.

SD D N A SA

10. I have enough time to develop resources to help newcomer students.

SD D N A SA

11. My initial training does not prepare me to work with newcomer students.

SD D N A SA

12. It is important that I incorporate culture into my teaching.

SD D N A SA

13. I do not favor any student in my class.

SD D N A SA

14. My colleagues are willing to help me so newcomer students succeed.

SD D N A SA

15. I make an effort to know each student personally.

SD D N A SA

16. I am aware of the socio-economic environmental factors that can influence newcomer students.

SD D N A SA

17. I am available after class hours to help my students.

SD D N A SA

18. I take the time necessary to plan science lessons for newcomer students.

SD D N A SA

19. I feel competent to teach science to newcomer students.

SD D N A SA

20. I know how to plan a lesson incorporating a cultural vision.

SD D N A SA

21. I believe that all students can succeed regardless of their cultural background and socio-economic status.

SD D N A SA

22. The school division does not offer professional development to help me improve my teaching to newcomer students.

SD D N A SA

23. I am curious about the cultural background of my newcomer students.

SD D N A SA

24. The history and personal trajectory of newcomer students affect their performance in science.

SD D N A SA

25. I have the materials needed to teach my students and help newcomer students learn in science.

SD D N A SA

26. I take the time in my lessons to help newcomer students.

SD D N A SA

27. I feel the need to attend seminars in integration of ENA (Newcomer Students) in science classroom.

SD D N A SA

28. I know how to differentiate my lessons using the culture of my students.

SD D N A SA

29. All my students regardless their background have the potential to face the same difficulties in science.

SD D N A SA

30. I do not have the support needed to teach newcomer students.

SD D N A SA

31. I meet newcomer students outside the classroom.

SD D N A SA

32. Socio- emotional factors must be taken into account in teaching science to newcomer students.

SD D N A SA

33. I have adequate equipment to make my students learn science.

SD D N A SA

34. I need more time to help my newcomer students.

SD D N A SA

35. I am satisfied with my job of teaching science to newcomer students.

SD D N A SA

36. I know how to take advantage of the cultural background of students in my teaching of science.

SD D N A SA

37. I think newcomer students can succeed at the same level as their peers who were born here.

SD D N A SA

38. Parental involvement of newcomer students helps me in my teaching

SD D N A SA

39. I do not think it is necessary to adapt my teaching to accommodate newcomer students.

SD D N A SA

40. I have strategies to inquire about the origins, among others of the educational trajectories of the newcomer students.

SD D N A SA

41. I have the necessary infrastructure to help my newcomer students discover science.

SD D N A SA

42. My students do not pass because they need more instructional time.

SD D N A SA

43. My students say I do a good job as a teacher of science.

SD D N A SA

44. I know best practices in science education that can help newcomer students in learning science.

SD D N A SA

45. I think there is an effort to meet the learning needs of newcomer students.

SD D N A SA

46. Community resources help me to teach the newcomer students.

SD D N A SA

47. I pledge to change my teaching to meet the needs of the newcomer students.

SD D N A SA

48. I think the linguistic background of immigrant/refugee students prevents them from mastering scientific concepts.

SD D N A SA

49. I have a budget to acquire resources to help newcomer students.

SD D N A SA

50. I think if we have enough time, all newcomer students can succeed.

SD D N A SA

51. I have a variety of methods to help students learn science.

SD D N A SA

52. I can identify the characteristics of a quality education in science in a multicultural context.

SD D N A SA

53. I changed my teaching practices to meet the learning science needs of the newcomer students.

SD D N A SA

54. If I have concerns about a newcomer student, I know whom to talk to.

SD D N A SA

55. I am interested to know the experiences of newcomer students in science.

SD D N A SA

56. I think the academic background of newcomer students prevents them to succeed in science.

SD D N A SA

Appendix C: I_MISLE Short Version

Il y a 32 questions dans ce questionnaire. En sélectionnant une réponse vous devez penser au contexte de l'école où vous travaillez. Réfléchissez sur les énoncés et déterminez jusqu'à quel point ils décrivent l'environnement de votre école.

Indiquez votre réponse sur la feuille en choisissant:

TD: Si vous êtes totalement en désaccord avec l'énoncé

D: Si vous êtes en désaccord avec l'énoncé

N: Si vous n'êtes ni en accord ni en désaccord avec l'énoncé ou si vous n'êtes pas certain

A: Si vous êtes en accord avec l'énoncé

TA: Si vous êtes totalement en accord avec l'énoncé

Vérifiez vos réponses avant de soumettre le questionnaire pour être certain(e) que vous avez fait le choix que vous avez eu l'intention de faire.

1. Les administrateurs me donnent le support nécessaire pour enseigner les élèves nouveaux arrivants.

TD D N A TA

2. Je dispose du temps nécessaire pour préparer mes classes en fonction des besoins de mes étudiants nouveaux arrivants.

TD D N A TA

3. Je valorise tous les étudiants de ma classe.

TD D N A TA

4. Travailler avec les élèves nouveaux arrivants me donnent l'occasion d'innover mon enseignement.

TD D N A TA

5. Le manque de scolarité représente un défi majeur chez les élèves nouveaux arrivants.

TD D N A TA

6. Les élèves nouveaux arrivants sont informés des ressources disponibles à l'école pour les aider à réussir.

TD D N A TA

7. Mes collègues sont prêts à m'aider à faire réussir les élèves nouveaux arrivants.

TD D N A TA

8. Je fais un effort pour connaître chaque étudiant personnellement

TD D N A TA

9. Je prends le temps nécessaire pour planifier des leçons de science au bénéfice des élèves nouveaux arrivants.

TD D N A TA

10. Je me sens compétent pour enseigner les sciences aux élèves nouveaux arrivants.

TD D N A TA

11. Je pense que tous les élèves peuvent réussir quelque soit leur background culturel et socio-économique.

TD D N A TA

12. Je ne favorise aucun étudiant dans ma classe.

TD D N A TA

13. Je dispose du matériel nécessaire pour enseigner et aider mes élèves nouveaux arrivants à apprendre en sciences.

TD D N A TA

14. Je sais comment planifier une leçon en y intégrant une vision culturelle.

TD D N A TA

15. Tous mes étudiants ont le potentiel de faire face aux mêmes difficultés en sciences.

TD D N A TA

16. La division scolaire n'offre pas de développement professionnel pour améliorer mon enseignement aux élèves nouveaux arrivants.

22. Je dispose d'un budget pour acquérir des ressources pour aider les élèves nouveaux arrivants.

TD D N A TA

23. Je suis satisfait de mon travail d'enseignement des sciences avec les élèves nouveaux arrivants.

TD D N A TA

24. J'ai modifié mes pratiques d'enseignement pour satisfaire les besoins d'apprentissage des sciences des élèves nouveaux arrivants.

TD D N A TA

25. Je sais les pratiques gagnantes en didactique des sciences qui puissent aider les élèves nouveaux arrivants dans l'apprentissage des sciences.

TD D N A TA

26. Je pense qu'il y a un effort qui se fait pour satisfaire les besoins d'apprentissage des élèves nouveaux arrivants.

TD D N A TA

27. Je m'engage à modifier ma pédagogie en fonction des besoins des élèves nouveaux arrivants.

TD D N A TA

28. Je dispose d'une variété de méthodes pour aider les élèves à apprendre les sciences.

TD D N A TA

29. Mes élèves ne réussissent pas assez à cause du manque de temps.

TD D N A TA

30. Si j'ai des inquiétudes par rapport à un élève nouvel arrivant, je sais à qui m'adresser.

TD D N A TA

31. Les facteurs socio-affectifs doivent être pris en compte dans l'enseignement des élèves nouveaux arrivants.

TD D N A TA

32. Je pense que le background scolaire des élèves nouveaux arrivants les empêche de réussir en sciences.

TD

D

N

A

TA

English version

There are 32 questions in this survey. Answer according to the context of the school where you work. Think about the statements and determine to what extent they describe the environment of your school.

Mark your answer on the sheet by selecting:

TD: If you totally disagree with the statement

D: If you disagree with the statement

N: If you neither agree nor disagree, or if you are unsure

A: If you agree with the statement

SA: If you are totally in agreement with the statement

Check your answers before submitting the questionnaire to be sure that you have made the choice that you've been meaning to do.

1. I have the time to prepare my classes based on the needs of my newcomer students.

SD D N A SA

2. I value all students in my class.

SD D N A SA

3. Administrators provide me with the necessary support to teach the newcomer students.

SD D N A SA

4. Working with newcomer students give me the opportunity to innovate my teaching.

SD D N A SA

5. Lack of schooling is a major challenge among the newcomer students.

SD D N A SA

6. The newcomer students are informed of the resources available in the school to help them succeed.

SD D N A SA

7. My colleagues are willing to help me so newcomer students succeed.

SD D N A SA

8. I make an effort to know each student personally.

SD D N A SA

9. I take the time necessary to plan science lessons for newcomer students.

SD D N A SA

10. I feel competent to teach science to newcomer students.

SD D N A SA

11. I believe that all students can succeed regardless of their cultural background and socio-economic status.

SD D N A SA

12. I do not favor any student in my class.

SD D N A SA

13. I have the materials needed to teach my students and help newcomer students learn in science.

SD D N A SA

14. I know how to plan a lesson incorporating a cultural vision.

SD D N A SA

15. All my students regardless their background have the potential to face the same difficulties in science.

SD D N A SA

16. The school division does not offer professional development to help me improve my teaching to newcomer students.

SD D N A SA

17. The history and personal trajectory of newcomer students affect their performance in science.

SD D N A SA

18. I have strategies to inquire about the origins, among others of the educational trajectories of the newcomer students.

SD D N A SA

19. I know how to differentiate my lessons using the culture of my students.

SD D N A SA

20. I do not have the support needed to teach newcomer students.

SD D N A SA

21. I know how to take advantage of the cultural background of students in my teaching of science.

SD D N A SA

22. My students do not pass because they need more instructional time.

SD D N A SA

23. I am satisfied with my job of teaching science to newcomer students.

SD D N A SA

24. I changed my teaching practices to meet the learning science needs of the newcomer students.

SD D N A SA

25. I know best practices in science education that can help newcomer students in learning science.

SD D N A SA

26. I think there is an effort to meet the learning needs of newcomer students.

SD D N A SA

27. I pledge to change my teaching to meet the needs of the newcomer students.

SD D N A SA

28. I have a variety of methods to help students learn science.

SD D N A SA

29. My students say I do a good job as a teacher of science.

SD D N A SA

30. If I have concerns about a newcomer student, I know whom to talk to.

SD D N A SA

31. Socio- emotional factors must be taken into account in teaching science to newcomer students.

SD D N A SA

32. I think the academic background of newcomer students prevents them to succeed in science.

SD D N A SA

APPENDIX D: Letters, Consent Forms and Ethics Approval Certificates

(Letter to prospective School Boards: Superintendent)

University letterheads (University of Manitoba)

Title of study:

Designing a Science Classroom Learning Environment Instrument for Francophone Minority Settings Which Attends to the Voiced Concerns of Immigrant/Refugee Students and Their Teachers

U of M Researcher: Bathelemy Bolivar, PhD Candidate: 000-000-000, email:

bolivarb@myumanitoba.ca

Supervisor: Brian Lewthwaite, PhD (brian.lewthwaite@jcu.edu.au)

Institutional Affiliation: Faculty of Education, University of Manitoba.

Dear Administrator,

The study to be described herewith purposely responds to the experiences of new immigrant and refugee students and their teachers in science classrooms within the Division Scolaire Franco-manitobaine (DFSM). Based upon an understanding of these experiences, the study aims, ultimately, at developing a Learning Environment Instrument that will be an accurate portrait of what is happening in these particular classrooms. By accurately capturing the existing situation in classrooms through the items contained in the instrument, teachers are in a position to move, individually and collectively, responsively towards enacting practices that will support immigrant and refugee students in their learning of science. Although this research will be carried out with regard to these stated objectives, the study addresses a long time personal pursuit of the author as teacher and researcher to help provide quality education for all, especially those likely least able to advocate changes to adjusted pedagogy to support their learning. The data from this study will be used in a dissertation that partially fulfills the requirements for the Ph.D. degree.

The specific research questions are:

- How can we inventory the effective teaching practices in science teaching among new immigrant/refugee students in Franco-Manitoban learning environments?
- How can we integrate these effective practices to develop and validate an instrument designed to measure teaching effectiveness in French- language settings in Manitoba?
- If validated, can this instrument initially emerged in the Francophone-minority settings among immigrant/refugee students in Manitoba be utilized towards the improvement of science teaching practices in similar learning environments?

I would be very grateful if you could facilitate the process of collecting data from teachers. I am looking for secondary science teachers who have had the opportunity to

teach immigrant/refugee students. **Those who agree to be part of the study will be invited to participate in an anonymous online survey that will take 15-20 minutes to complete through Survey Monkey. Could you please forward the electronic version of this letter of consent to the science teachers in your school division with a copy to my own email address? Therefore, I can great access to teachers' email list.** A confidentiality agreement is included within the survey to be presented to participants. Participation in the study is voluntary and participants can withdraw at any time without penalty before submitting their online survey.

Phase II of this project that has to do with the quantitative part of the study. **This research has been approved by the Education/Nursing Ethics Board. If you have any concerns or complaints about this project, you may contact the Human Ethics Coordinator at 204-474-7122 or email: Margaret.bowman@umanitoba.ca.**

We thank you in advance for your help to complete this study. If you have any questions regarding the procedures and objectives of the study, you may contact Bathélemy Bolivar (**phone: 000-000-0000 or email: bolivarb@myumanitoba.ca**)

A summary of the research results will be made available to each participant by request the researcher a month after the closure of the online survey.

Sincerely,

Bathélemy Bolivar, PhD Candidate

P.S Letter of Invitation for teachers and Informed consent included

TRANSLATION

LETTER

Winnipeg, le 25 avril 2013

Titre de l'étude:

Élaboration d'un Instrument de Recherche en Environnement d'apprentissage des sciences en milieu francophone minoritaire se basant sur les perceptions des élèves immigrants/réfugiés et de leurs enseignants.

Chercheur: Bathélemy Bolivar, Doctorant **000-000-0000**, **adresse électronique:**
bolivarb@myumanitoba.ca

Superviseur: Brian Lewthwaite, PhD (brian.lewthwaite@jcu.edu.au)

Affiliation institutionnelle: Faculté de l'Éducation, Université du Manitoba.

Cher Administrateur/ Chère Administratrice,

L'étude que j'entreprends entend refléter les expériences des nouveaux étudiants immigrants et réfugiés et de leurs enseignants dans les classes de sciences au sein de la Division scolaire franco-manitobaine (DFSM). Fondée sur une compréhension de ces expériences, l'étude vise à l'élaboration d'un questionnaire qui pourra rendre compte de ce qui se passe dans ces classes de science. En capturant la situation existante dans les salles de classe à travers les éléments contenus dans cet instrument, les enseignants seront en mesure d'implémenter des stratégies d'enseignement efficaces qui aideront les élèves immigrants et réfugiés dans leur apprentissage de la science. Bien que cette recherche soit effectuée en accord avec les objectifs que je viens d'énoncer, l'étude s'inspire du parcours personnel de l'auteur en tant que professeur et chercheur qui veut contribuer à une éducation de qualité pour tous, en particulier ceux qui sont les plus vulnérables dans le système scolaire. Les données de cette étude seront utilisées dans le cadre de l'élaboration d'une dissertation qui répond partiellement aux exigences de l'obtention d'un doctorat en éducation.

Les questions de recherche s'articulent ainsi:

- Comment dresser un inventaire des pratiques pédagogiques efficaces dans l'enseignement des sciences chez les nouveaux immigrants / réfugiés étudiants dans des environnements d'apprentissage franco-manitobains?
- Comment pouvons-nous intégrer ces pratiques efficaces pour développer et valider un instrument destiné à mesurer l'efficacité de l'enseignement des sciences en français en milieu linguistique minoritaire au Manitoba?
- S'il est validé, cet instrument peut-il aider à explorer et à améliorer les meilleures pratiques en enseignement/apprentissage des sciences dans des environnements d'apprentissage similaires?

Je serais très reconnaissant si vous pouviez faciliter le processus de collecte de données auprès des enseignants. Ils devraient être des enseignants de sciences au secondaire qui ont eu l'occasion d'enseigner à des nouveaux arrivants. **Ceux qui acceptent de faire partie de l'étude seront invités à participer à un sondage anonyme en ligne d'environ 15-20 minutes au site Survey Monkey. Pourriez-vous rediriger par email la lettre de consentement aux enseignants de sciences de votre division scolaire avec une copie à mon adresse courriel? Donc, je pourrai avoir accès à la liste des courriels des enseignants.** Un accord de confidentialité est inclus dans le cadre du formulaire de consentement qui sera présenté aux participants. La participation à l'étude se fait sur une base volontaire et les participants peuvent se retirer à tout moment sans pénalité avant de soumettre leur sondage en ligne.

La phase II de ce projet qui a à voir avec la collecte de données en ligne a été approuvée par le comité d'éthique de la recherche à l'Université du Manitoba. Si vous avez des questions ou des préoccupations, vous pouvez contacter le Secrétariat à l'éthique au 204-474-7122, ou par courriel: margaret_bowman@umanitoba.ca.

Nous vous remercions d'avance de votre aide pour compléter cette étude. **Cette recherche a été approuvée par le comité d'éthique en Éducation/Sciences Infirmières. Si vous avez des plaintes ou inquiétudes concernant ce projet, vous pouvez contacter la coordinatrice du comité d'éthique humaine au 204-474-7122 ou par courriel à: Margaret.bowman@umanitoba.ca.**

Si vous avez des questions concernant les procédures et les objectifs de l'étude, vous pouvez communiquer avec Bathélémy Bolivar (téléphone: 000-000-0000 ou par courriel: bolivarb@myumanitoba.ca).

Un résumé des résultats de la recherche sera mis à la disposition de chaque participant qui en fait la demande au chercheur un mois après la fermeture du formulaire en ligne.

Cordialement vôtre,

Bathélemy Bolivar, Doctorant

P.S Lettre d'invitation aux enseignants et les formulaires de consentement y sont inclus.
(Letter to prospective participants: parents)
University letterheads (University of Manitoba)

Title of study:

Designing a Science Classroom Learning Environment Instrument for Francophone Minority Settings Which Attends to the Voiced Concerns of Immigrant/Refugee Students and Their Teachers

U of M Researcher: Bathelemy Bolivar, PhD Candidate

Institutional Affiliation: Faculty of Education, University of Manitoba.

Dear parent:

The study that I will undertake purposely responds to the experiences of new immigrant and refugee students and their teachers in science classrooms within the Division Scolaire Franco-manitobaine (DFSM). Based upon an understanding of these experiences, the study aims, ultimately, at developing a Learning Environment Instrument that will be an accurate portrait of what is happening in these particular classrooms. By accurately capturing the existing situation in classrooms through the items contained in the instrument, teachers are in a position to move, towards effective teaching strategies that will support immigrant and refugee students in their learning of science. Although this research will be carried out with regard to these stated objectives, the study addresses a long time personal pursuit of the author as teacher and researcher to help provide quality education for all, especially those likely least able to advocate for changes to adjusted pedagogy to support their learning. The data from this study will be used in a dissertation that partially fulfills the requirements for a Ph.D. degree.

The specific research questions are:

- How can we inventory the effective teaching practices in science teaching among new immigrant/refugee students in Franco-Manitoban learning environments?
- How can we integrate these effective practices to develop and validate an instrument designed to measure teaching effectiveness in French- language settings in Manitoba?
- If validated, can this instrument initially emerged in the Francophone-minority settings among immigrant/refugee students in Manitoba be utilized towards the improvement of science teaching practices in similar learning environments?

Students in the study will be asked to participate in an interview of approximately 40 minutes in length. A confidentiality agreement is included as part of the attached consent form. In summary documents, as well as in any publications resulting from this research, individual students will not be identified. Participation in the research study is completely voluntary and your child may withdraw at any time without penalty by simply informing the researcher.

This project has been approved by The Research Ethics Board at the University of Manitoba. If you have any questions or concerns about the rights or treatment of your child as subjects, you may contact the Human Ethics Secretariat at 474-7122, or e-mail margaret_bowman@umanitoba.ca.

If you are willing your child to take part in this study, please complete the attached consent form.

Thank you in advance for your assistance with this research study. If you have any questions regarding the procedures and goals of the study, you may contact Bathelemy Bolivar (Phone: 000-000-0000 or e-mail:bolivarb@myumanitoba.ca).

A summary of the research findings will be made available to each participant.

Sincerely,

TRANSLATION

Cher parent:

L'étude que j'entreprends entend refléter les expériences des nouveaux étudiants immigrants et réfugiés et de leurs enseignants dans les classes de sciences au sein de la Division scolaire franco-manitobaine (DFSM). Fondée sur une compréhension de ces expériences, l'étude vise à l'élaboration d'un questionnaire qui pourra rendre compte de ce qui se passe dans ces classes de science. En capturant la situation existante dans les salles de classe à travers les éléments contenus dans cet instrument, les enseignants seront en mesure d'implémenter des stratégies d'enseignement efficaces qui aideront les élèves immigrants et réfugiés dans leur apprentissage de la science. Bien que cette recherche soit effectuée en accord avec les objectifs que je viens d'énoncer, l'étude porte s'inspire du parcours personnel de l'auteur en tant que professeur et chercheur qui veut contribuer à une éducation de qualité pour tous, en particulier ceux qui sont les plus vulnérables dans le système scolaire. Les données de cette étude seront utilisées dans le cadre de l'élaboration d'une dissertation qui répond partiellement aux exigences de l'obtention d'un doctorat en éducation.

Les questions de recherche spécifiques s'articulent ainsi:

- Comment dresser un inventaire des pratiques pédagogiques efficaces dans l'enseignement des sciences chez les nouveaux immigrants / réfugiés étudiants dans des environnements d'apprentissage franco-manitobains?
- Comment pouvons-nous intégrer ces pratiques efficaces pour développer et valider un instrument destiné à mesurer l'efficacité de l'enseignement des sciences en français en milieu linguistique minoritaire au Manitoba?
- S'il est validé, cet instrument peut-il aider à explorer et à améliorer les meilleures pratiques en enseignement/apprentissage des sciences dans des environnements d'apprentissage similaires?

Les étudiants participant à l'étude seront invités à participer à une entrevue d'environ 40 minutes. Un accord de confidentialité est inclus dans le cadre du formulaire de consentement ci-joint. Dans les documents de synthèse, ainsi que dans toute publication résultant de cette recherche, les élèves ne seront pas identifiés. La participation à l'étude se fait sur une base volontaire et votre enfant peut se retirer à tout moment sans pénalité simplement en informant le chercheur.

Ce projet a été approuvé par le comité d'éthique de la recherche à l'Université du Manitoba. Si vous avez des questions ou des préoccupations concernant les droits ou le traitement de votre enfant en tant que sujets, vous pouvez contacter le Secrétariat à l'éthique au 474-7122, ou par courriel: margaret_bowman@umanitoba.ca.

Si vous êtes prêt à permettre à votre enfant de participer à cette étude, s'il vous plaît remplissez le formulaire de consentement ci-joint.

Nous vous remercions d'avance de votre aide pour compléter cette étude. Si vous avez des questions concernant les procédures et les objectifs de l'étude, vous pouvez communiquer avec Bathélémy Bolivar (téléphone: 000-000-0000 ou par courriel: bolivarb@myumanitoba.ca).

Un résumé des résultats de la recherche seront mis à la disposition de chaque participant.

Cordialement vôtre,

University letterheads (University of Manitoba)

Title of study:

Designing a Science Classroom Learning Environment Instrument for Francophone Minority Settings Which Attends to the Voiced Concerns of Immigrant/Refugee Students and Their Teachers

U of M Researcher: Bathelemy Bolivar, PhD Candidate

Institutional Affiliation: Faculty of Education, University of Manitoba.

Consent Form for parents

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 the participation of your child 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.

The study that I will undertake purposely responds to the experiences of new immigrant and refugee students and their teachers in science classrooms within the Division Scolaire Franco-manitobaine (DFSM). Based upon an understanding of these experiences, the study aims, ultimately, at developing a Learning Environment Instrument that will be an accurate portrait of what is happening in these particular classrooms. By accurately capturing the existing situation in classrooms through the items contained in the instrument, teachers are in a position to move, towards effective teaching strategies that will support immigrant and refugee students in their learning of science. Although this research will be carried out with regard to these stated objectives, the study addresses a long time personal pursuit of the author as teacher and researcher to help provide quality education for all, especially those likely least able to advocate for changes to adjusted pedagogy to support their learning.

I, _____, parent of
_____ agree to participate in the research study.

I understand that:

- Participants should feel free to ask any questions about the study, before as well as while the study unfolds.
- The data from this study will be used in a dissertation that partially fulfills the requirements for a Ph.D. degree.
- Participants will be asked to participate in an interview of approximately 40 minutes in length. This interview will take place outside of school hours and at a mutually agreeable time between parents and the researcher.

- A pseudonym will be assigned to each student so that the confidentiality of all participants will be protected in any written report as well as in the transcripts. Real names will not appear in the transcripts or in written reports.
- Each individual interview will be audio-taped by the researcher (Bathelemy Bolivar) who will follow the terms of the confidentiality that delineates this study. Each interview will be transcribed by the researcher. The transcripts will then be submitted to each participant to review, so that I may use direct quotations in our reports and publications. Again, while direct quotations will be used when reporting the results of the study, the participants' real names will not be used. Only pseudonyms will be used and this will explicitly said in any publication where these results will be used.
- I understand that students will share their experiences by talking around their science experiences possibly through artifacts such as projects, tests, written exercises, experiences with textbook, portfolios and any artifacts produced in the context of science learning
- Students have the right to withdraw from this project at any time, without penalty. Participants may withdraw from the study by simply contacting Bathelemy Bolivar (Phone: 000-000-0000 or e-mail: bolivarb@myumanitoba.ca). In the case of a withdrawal, all data will be destroyed. In the case of a withdrawal, all data collected will be destroyed.
- As I only need about 10-15 students to participate, should we receive more than 15, I will choose up to 20 interviewees using a first come first served approach.
- Students have the right to refuse to answer one or more of the interview questions, without penalty, while still remaining part of the study.
- Participants will receive a written transcript of their interview. It will take approximately 3 weeks to get the interviews transcribed. Participants will be expected to review their transcripts within 2 weeks. The University of Manitoba may look at the research records to see that the research is being done in a safe and proper way.
- Audio-tapes and written transcripts will be kept under lock and key in a secure cabinet and destroyed three years after the study is completed. The study will be completed within two years, which means that data will be destroyed in 5 years.
- The name of the province will be disclosed. Specific school names will not be disclosed. A pseudonym will be chosen to refer to specific schools, if needed.
- The University of Manitoba may look at the research records to see that the research is being done in a safe and proper way.

Your signature on this form indicates that you have understood the information regarding the participation of your child in the research project and agree that he/she participate as a subject. In no way does this waive the legal rights of your child nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. Your child is free to withdraw from the study at any time, and /or refrain from answering any questions you prefer to omit, without prejudice or

consequence. His/her continued participation should be as informed as your initial consent, so he/she should feel free to ask for clarification or new information throughout his/her participation.

The phase I of this project, which has to do with the interview process, has been approved by The Research Ethics Board at the University of Manitoba. If you have any concerns or complaints about this project you may contact the Human Ethics Secretariat at 474-7122, or e-mail margaret_bowman@umanitoba.ca. A copy of this consent form has been given to you to keep for your records and reference.

I, _____, parent _____,
agree to the conditions stated in this letter of consent and certify that I have received a copy of the consent form.

Parent's Signature

Date

Researcher

Date

TRANSLATION

Formulaire de consentement pour les parents

Ce formulaire de consentement, dont je vous laisserai une copie pour vos dossiers, n'est qu'une partie du processus de consentement éclairé. Il devrait vous donner une idée de l'objet de la recherche et ce qu'implique la participation de votre enfant. Si vous souhaitez plus de détails sur quelque chose mentionné ici, ou information non incluse ici, vous devriez vous sentir libre de nous l'adresser. S'il vous plaît prendre le temps de lire attentivement et de comprendre toute l'information qui accompagne ce formulaire.

L'étude que j'entreprends entend refléter les expériences des nouveaux étudiants immigrants et réfugiés et de leurs enseignants dans les classes de sciences au sein de la Division scolaire franco-manitobaine (DFSM). Fondée sur une compréhension de ces expériences, l'étude vise à l'élaboration d'un questionnaire qui pourra rendre compte de ce qui se passe dans ces classes de science. En capturant la situation existante dans les salles de classe à travers les éléments contenus dans cet instrument, les enseignants seront en mesure d'implémenter des stratégies d'enseignement efficaces qui aideront les élèves immigrants et réfugiés dans leur apprentissage de la science. Bien que cette recherche soit effectuée en accord avec les objectifs que je viens d'énoncer, l'étude porte s'inspire du parcours personnel de l'auteur en tant que professeur et chercheur qui veut contribuer à une éducation de qualité pour tous, en particulier ceux qui sont les plus vulnérables dans le système scolaire. Les données de cette étude seront utilisées dans le cadre de l'élaboration d'une dissertation qui répond partiellement aux exigences de l'obtention d'un doctorat en éducation.

Je, _____, parent de _____ accepte que mon enfant participe à l'étude.

Je comprends que:

- Les participants doivent se sentir libres de poser toutes les questions au sujet de l'étude, aussi bien avant et pendant son déroulement.
- Les données de cette étude seront utilisées dans une dissertation qui répond partiellement aux exigences de l'obtention d'un doctorat.
- Les participants seront invités à participer à une entrevue d'environ 40 minutes. Cet entretien aura lieu en dehors des heures de classe et à un moment mutuellement convenu entre les parents, l'étudiant et le chercheur.
- Un pseudonyme sera attribué à chaque étudiant afin que la confidentialité de tous les participants soient protégés que dans les rapports écrits, ainsi que dans les transcriptions. Les vrais noms n'apparaîtront pas dans les transcriptions et dans les rapports de recherche.
- Chaque entretien individuel sera enregistré sur bande audio par le chercheur (Barthélémy Bolivar) qui suivra les termes de la confidentialité qui délimitent cette étude. Chaque entrevue sera retranscrite par le chercheur. Les transcriptions seront ensuite remises à chaque participant pour les examiner, afin que je puisse utiliser des

citations directes dans nos rapports et publications. Encore une fois, tandis que des citations directes seront utilisées lors de la présentation des résultats de l'étude, les vrais noms des participants ne seront pas utilisés.

- Il est entendu que les étudiants feront part de leurs expériences en parlant de leurs expériences en science. Ils peuvent éventuellement soumettre des artefacts tels que les projets, tests, exercices écrits, des expériences avec des manuels scolaires, des portefeuilles et toute production faite dans le contexte de l'apprentissage des sciences
- Les élèves ont le droit de se retirer de ce projet, à tout moment, sans pénalité. Les participants peuvent se retirer de l'étude en contactant simplement Bathélémy Bolivar (téléphone: 000-000-0000 ou par courriel: bolivarb@myumanitoba.ca). Dans le cas d'un retrait, toutes les données collectées seront détruites.

- Comme j'ai seulement besoin d'environ 10-15 élèves, si je reçois plus de 15 adhésions, je vais choisir jusqu'à 20 étudiants à interroger sur une base de qui soumet leur formulaire de consentement le premier.

- Les élèves ont le droit de refuser de répondre à une ou plusieurs des questions de l'entrevue, sans pénalité, tout en faisant partie de l'étude.

- Les participants recevront une transcription écrite de leur entrevue. Il faudra environ 3 semaines pour obtenir les entrevues transcrites. Les participants seront appelés à revoir leurs transcriptions dans deux semaines. Si les participants ne renvoient pas leur révision dans deux semaines et ne contactent pas le chercheur pour expliquer le retard, alors ce dernier interprétera cette attitude comme un OUI pour utiliser les données recueillies.

- Les interviews et les transcriptions écrites seront conservées sous clé dans une armoire sécurisée et seront détruites trois ans après que l'étude est terminée ou cinq ans après la cueillette des données.

- Le nom de la province sera divulgué. Les noms spécifiques des écoles ne seront pas divulgués. Un pseudonyme sera choisi quand on se réfère à des écoles spécifiques, si nécessaire.

- L'Université du Manitoba peut examiner les dossiers de recherche pour voir si la recherche est effectuée d'une manière correcte.

Votre signature sur ce formulaire indique que vous avez compris les informations concernant la participation de votre enfant dans le projet de recherche et acceptez qu'il / elle participera en tant que sujet. En aucun cas, cela traduirait un renoncement aux droits de l'enfant, ni de libérer les chercheurs, les promoteurs ou les institutions impliqués de leurs responsabilités légales et professionnelles. Votre enfant est libre de se retirer de l'étude à tout moment, et / ou de s'abstenir de répondre aux questions que vous préférez omettre, sans préjudice ou conséquence. Son / sa participation continue devrait être aussi informé que votre consentement initial, alors il / elle doit se sentir libre de demander des éclaircissements ou de nouvelles informations tout au long de sa participation.

La phase I de ce projet, qui a à voir avec le processus d'entrevue, a été approuvée par le comité d'éthique à la recherche de l'Université du Manitoba Si vous avez des préoccupations ou des plaintes au sujet de ce projet, vous pouvez communiquer avec le

Secrétariat à l'éthique au 474-7122, ou par courriel : margaret_bowman@umanitoba.ca.

Je, _____, parent de _____,

J'accepte les conditions énoncées dans la présente lettre de consentement et certifie que j'ai reçu une copie du formulaire de consentement.

Signature parents

Signature chercheur

Title of study:

Designing a Science Classroom Learning Environment Instrument for Francophone Minority Settings Which Attends to the Voiced Concerns of Immigrant/Refugee Students and Their Teachers

U of M Researcher: Bathelemy Bolivar, PhD Candidate: 000-000-0000,

email: bolivarb@myumanitoba.ca

Supervisor: Brian Lewthwaite, PhD (brian.lewthwaite@jcu.edu.au)

Institutional Affiliation: Faculty of Education, University of Manitoba.

This email is sent by [the Superintendent] on behalf of Bathelemy Bolivar

Dear prospective participant:

The study to be described herewith purposely responds to the experiences of new immigrant and refugee students and their teachers in science classrooms within the Division Scolaire Franco-manitobaine (DFSM). Based upon an understanding of these experiences, the study aims, ultimately, at developing a Learning Environment Instrument that will be an accurate portrait of what is happening in these particular classrooms. By accurately capturing the existing situation in classrooms through the items contained in the instrument, teachers are in a position to move, individually and collectively, responsively towards enacting practices that will support immigrant and refugee students in their learning of science. Although this research will be carried out with regard to these stated objectives, the study addresses a long time personal pursuit of the author as teacher and researcher to help provide quality education for all, especially those likely least able to advocate changes to adjusted pedagogy to support their learning. The data from this study will be used in a dissertation that partially fulfills the requirements for the Ph.D. degree.

The specific research questions are:

- How can we inventory the effective teaching practices in science teaching among new immigrant/refugee students in Franco-Manitoban learning environments?
- How can we integrate these effective practices to develop and validate an instrument designed to measure teaching effectiveness in French- language settings in Manitoba?
- If validated, can this instrument initially emerged in the Francophone-minority settings among immigrant/refugee students in Manitoba be utilized towards the improvement of science teaching practices in similar learning environments?

Participants in the study will be asked to participate in an anonymous online survey of approximately 15-20 minutes in length. A confidentiality agreement is included as part

of the attached consent form. Participation in the research study is completely voluntary and you may withdraw at any time without penalty by simply informing the researcher.

The phase II of this project, which has to do with the online survey, has been approved by The Research Ethics Board at the University of Manitoba. If research subjects have any questions or concerns about their rights or treatment as subjects, they may contact the Human Ethics Secretariat at 474-7122, or e-mail margaret_bowman@umanitoba.ca.

If you are willing to take part in this study, please complete this online survey, with the informed consent form attached, by clicking on the link below.

www.url.com

Thank you in advance for your assistance with this research study. If you have any questions regarding the procedures and goals of the study, you may contact Bathelemy Bolivar (Phone: 000-000-0000 or e-mail: bolivarb@myumanitoba.ca) **or his advisor, Dr. Brian Lewthwaite at brian.lewthwaite@jcu.edu.au**

A summary of the research findings will be made available to each participant who provided me with their email using my contact email.

Sincerely,

University letterheads (University of Manitoba)

Title of study:

Designing a Science Classroom Learning Environment Instrument for Francophone Minority Settings Which Attends to the Voiced Concerns of Immigrant/Refugee Students and Their Teachers

U of M Researcher: Bathelemy Bolivar, PhD Candidate: 000-000-0000,

email: bolivarb@myumanitoba.ca

Supervisor: Brian Lewthwaite, PhD (brian.lewthwaite@jcu.edu.au)

Institutional Affiliation: Faculty of Education, University of Manitoba.

Consent For Teachers

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.

This consent form, is embedded into the online survey. You can print it for future references.

The study to be described herewith purposely responds to the experiences of new immigrant and refugee students and their teachers in science classrooms within the Division Scolaire Franco-manitobaine (DFSM). Based upon an understanding of these experiences, the study aims, ultimately, at developing a Learning Environment Instrument that will be an accurate portrait of what is happening in these particular classrooms. By accurately capturing the existing situation in classrooms through the items contained in the instrument, teachers are in a position to move, individually and collectively, responsively towards enacting practices that will support immigrant and refugee students in their learning of science. Although this research will be carried out with regard to these stated objectives, the study addresses a long time personal pursuit of the author as teacher and researcher to help provide quality education for all, especially those likely least able to advocate changes to adjusted pedagogy to support their learning.

I, _____, agree to participate in the research study.

I understand that:

- Participants should feel free to ask any questions about the study, before as well as while the study unfolds.
- The data from this study will be used in a dissertation that partially fulfills the requirements for the Ph.D. degree.
- Participants will be asked to participate in an anonymous online survey of 60 minutes in length. This online survey will be completed at the convenience of the participant, within a timeframe indicated by the researcher.
- **Personal information of the participants will not be reported since such data will not be collected.**
- Participants have the right to withdraw from this study at any time during the completion of the online questionnaire, without penalty. However, once the submit button is clicked on; there will be no way to withdraw from the study. Therefore, participants will be asked to formally check the statement that they agree to participate before allowing to submit the survey.
- Participants have the right to refuse to answer one or more of the interview questions, without penalty, while still remaining part of the study.
- **Participants will receive a summary of the findings through mass emailing towards all science teachers from the school division headquarter. They can also ask for it using the researcher's email contact (bolivarb@myumanitoba.ca). It will take approximately 4 weeks from the last day of the study to get the report ready. Such reports will also be available through the francophone education journals network and community newspapers such as La Liberté in Manitoba. They may also be available through scientific journal in education that address minority, science education and the likes.**
- The study will be completed within two years, which means **that online data will be destroyed in two years from the last date of submission.**
- The name of the province will be disclosed. Specific school names will not be disclosed, however. **Only I and my advisor, Dr. Lewthwaite, will have access to the data.**
- The University of Manitoba may look at the research records to see that the research is being done in a safe and proper way.
- **There is no risk to participate in this study as stated above in the general presentation.**

Checking the statement below 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 during the online submission, 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.

This research has been approved by the Education/Nursing Research Ethics Board. If you have any concerns or complaints about this project you may contact the Human Ethics Secretariat at 474-7122, or e-mail margaret_bowman@umanitoba.ca. A copy of this consent form has been given to you to keep for your records and reference.

- I agree to the conditions stated in this letter of consent and certify that I have read a copy of the consent form.

TRANSLATION

LETTER

Winnipeg, le

Titre de l'étude:

Élaboration d'un Instrument de Recherche en Environnement d'apprentissage des sciences en milieu francophone minoritaire se basant sur les perceptions des élèves immigrants/réfugiés et de leurs enseignants.

Chercheur: Bathélemy Bolivar, **Doctorant:** 000-000-0000,

email: bolivarb@myumanitoba.ca

Superviseur: Brian Lewthwaite, PhD (brian.lewthwaite@jcu.edu.au)

Affiliation institutionnelle: Faculté de l'Éducation, Université du Manitoba.

Ce courriel est envoyé par [le Surintendant] pour le compte de Bathelemy Bolivar

Cher enseignant/ Chère enseignante,

L'étude que j'entreprends entend refléter les expériences des nouveaux étudiants immigrants et réfugiés et de leurs enseignants dans les classes de sciences au sein de la Division scolaire franco-manitobaine (DFSM). Fondée sur une compréhension de ces expériences, l'étude vise à l'élaboration d'un questionnaire qui pourra rendre compte de ce qui se passe dans ces classes de science. En capturant la situation existante dans les salles de classe à travers les éléments contenus dans cet instrument, les enseignants seront en mesure d'implémenter des stratégies d'enseignement efficaces qui aideront les élèves immigrants et réfugiés dans leur apprentissage de la science. Bien que cette recherche soit effectuée en accord avec les objectifs que je viens d'énoncer, l'étude s'inspire du parcours personnel de l'auteur en tant que professeur et chercheur qui veut contribuer à une éducation de qualité pour tous, en particulier ceux qui sont les plus vulnérables dans le système scolaire. Les données de cette étude seront utilisées dans le cadre de l'élaboration d'une dissertation qui répond partiellement aux exigences de l'obtention d'un doctorat en éducation.

Les questions de recherche s'articulent ainsi:

- Comment dresser un inventaire des pratiques pédagogiques efficaces dans l'enseignement des sciences chez les nouveaux immigrants / réfugiés étudiants dans des environnements d'apprentissage franco-manitobains?
- Comment pouvons-nous intégrer ces pratiques efficaces pour développer et valider un instrument destiné à mesurer l'efficacité de l'enseignement des sciences en français en milieu linguistique minoritaire au Manitoba?

- S'il est validé, cet instrument peut-il aider à explorer et à améliorer les meilleures pratiques en enseignement/apprentissage des sciences dans des environnements d'apprentissage similaires?

Vous serez invités à participer à un sondage en ligne anonyme d'une durée de 15-20 minutes. Un accord de confidentialité est inclus dans le cadre du formulaire de consentement ci-joint. Dans les documents de synthèse, ainsi que dans toute publication résultant de cette recherche, vous ne serez pas identifié. La participation à l'étude se fait sur une base volontaire et vous pouvez vous retirer à tout moment sans pénalité simplement en informant le chercheur.

Ce projet a été approuvé par le comité d'éthique de la recherche à l'Université du Manitoba. Si vous avez des questions ou des préoccupations concernant les droits ou le traitement de votre enfant en tant que sujets, vous pouvez contacter le Secrétariat à l'éthique au 474-7122, ou par courriel: margaret_bowman@umanitoba.ca.

Si vous êtes prêt à participer à cette étude, s'il vous plaît remplissez le formulaire de consentement qui est intégré au sondage.

Nous vous remercions d'avance de votre aide pour compléter cette étude. Si vous avez des questions concernant les procédures et les objectifs de l'étude, vous pouvez communiquer avec Bathélémy Bolivar (téléphone: 000-000-0000 ou par courriel: bolivarb@myumanitoba.ca) ou son directeur de thèse : **Dr. Brian Lewthwaite à brian.lewthwaite@jcu.edu.au**

Un résumé des résultats de la recherche sera mis à la disposition de chaque participant qui m'aura écrit en utilisant mon courriel de contact.

Cordialement vôtre,

Bathélemy Bolivar, Doctorant



UNIVERSITY
OF MANITOBA

Research Ethics
and Compliance

Office of the Vice-President (Research and International)

Human Ethics
208-194 Dafoe Road
Winnipeg, MB
Canada R3T 2N2
Phone +204-474-7122
Fax +204-269-7173

APPROVAL CERTIFICATE

April 18, 2013

TO: Barthelemy Bolivar (Advisor B. Lewthwaite)
Principal Investigator

FROM: Stan Straw, Chair
Education/Nursing Research Ethics Board (ENREB)

Re: Protocol #E2013:008
"Designing a Science Classroom Learning Environment Instrument for Francophone Minority Settings which Attends to the Voiced Concerns of Immigrant/Refugee Students and their Teachers"

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.

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, the auditor requires that you submit a copy of this Approval Certificate to the Office of Research Services, fax 261-0325 - please include the name of the funding agency and your UM Project number. This must be faxed before your account can be accessed.

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.



UNIVERSITY
OF MANITOBA

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Fax +204-269-7173

APPROVAL CERTIFICATE

June 19, 2014

TO: **Bathelemy Bolivar** (Advisor B. Lewthwaite)
Principal Investigator

FROM: **Lorna Guse, Chair**
Education/Nursing Research Ethics Board (ENREB)

Re: **Protocol #E2013:138**
“Designing a Science Classroom Learning Environment Instrument”

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.**

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.