

TEACHING SCIENCE TO FRENCH-SPEAKING STUDENTS IN ENGLISH CANADA USING AN INSTRUCTIONAL CONGRUENCE MODEL INVOLVING DISCOURSE-ENABLING STRATEGIES

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Abstract. Outside the province of Quebec in Canada, most Francophones live in a minority-language context in which English dominates the linguistic and cultural landscape. In North America and the world, the English language has become the *lingua franca* of the scientific community and of society, generally. Enhancing the teaching of science for Francophones will require providing a rich array of discursive opportunities in the minority language while moving students from contextualised to de-contextualised language. Cormier (2004) developed a model for teaching science to minority Francophone students where reading, talking, and writing are core activities. The authors present a revised model that better addresses the needs of all linguistic minority learners in the science classroom.

Keywords: academic language, francophone, identity, instructional congruence, linguistic insecurity, science education

Dutch

Samenvatting [Translated by Tanja Janssen]

De meeste Franstaligen die in Canada buiten de provincie Quebec wonen, leven in een context van een minderheidstaal: het Engels domineert het talige en culturele landschap. In Noord-Amerika en de rest van de wereld is de Engelse taal de lingua franca geworden van het wetenschappelijke bedrijf en van de samenleving als geheel. Het bevorderen van onderwijs in de natuurwetenschappen voor franstaligen vereist dat men een rijk aanbod geeft aan gelegenheden om in de minderheidstaal te communiceren, en zo leerlingen van een gecontextualiseerde naar een gedecontextualiseerde taal te brengen. Cormier (2004) ontwikkelde een model voor onderwijs in de natuurwetenschappen aan franstalige leerlingen, waarin lezen,

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praten en schrijven kernactiviteiten zijn. In deze bijdragen presenteren de auteurs een herzien model dat beter toegesneden is op de behoeften van alle leeders met een minderheidstaal in science klassen.

Keywords: academische taal, Franstalig, identiteit, congruentie in instructie, onzekerheid op het gebied van taal

French

Résumé [Translated by Laurence Pasa]

En dehors de la province du Québec au Canada, la plupart des francophones vivent dans un contexte de minorité langagière où l'anglais domine le paysage linguistique et culturel. En Amérique du nord et dans le monde, l'anglais est devenu la *lingua franca* de la communauté scientifique et, plus généralement, de la société. L'amélioration de l'enseignement des sciences pour les francophones nécessitera de leur fournir un large choix d'occasions discursives dans la langue minoritaire tout en les aidant à passer d'un langage contextualisé à un langage décontextualisé. Cormier (2004) a développé un modèle de l'enseignement des sciences destiné aux élèves des minorités francophones où l'oral, la lecture et l'écriture sont des activités centrales. Les auteurs en présentent un modèle revu qui correspond plus largement aux besoins de tous les élèves issus des minorités linguistiques en cours de sciences.

Mots-clés: langage académique, francophone, identité, congruence de l'enseignement, insécurité linguistique.

Italian

Abstract [Translated by Manuela Delfino]

Fuori dalla provincia del Quebec, in Canada, la maggioranza dei Francofoni vive in un contesto di lingua di minoranza, in cui l'inglese domina il paesaggio linguistico e culturale. Nel Nord America e nel mondo, l'inglese è diventato lingua franca della comunità scientifica e della società, in generale. La valorizzazione dell'insegnamento delle scienze ai francofoni richiederà di fornir loro un ricco assortimento di opportunità discorsive nella lingua di minoranza, spingendo gli studenti al passaggio da una lingua contestualizzata a una lingua decontestualizzata. Cormier (2004) ha sviluppato in modello per l'insegnamento delle scienze alla minoranza di studenti francofoni per cui la lettura, la conversazione e la scrittura sono attività di base. Gli autori presentano un modello migliorato e rivisto che si rivolge ai bisogni degli studenti di scienze appartenenti alla minoranza linguistica.

Parole chiave: linguaggio accademico, francofonia, identità, congruenza didattica, insicurezza linguistica

Polish

Streszczenie [Translated by Elżbieta Awramiuk]

Poza prowincją Quebec w Kanadzie większość frankofonów żyje jako językowa mniejszość w pejzażu lingwistycznym i kulturowym zdominowanym przez język angielski. W Ameryce Północnej i na świecie język angielski stał się *lingua franca* wspólnoty naukowej oraz – ogólnie – społeczeństwa. Poprawianie efektywności nauczania przedmiotów ścisłych wśród frankofonów będzie wymagało uwzględnienia bogatego wariantu dyskursywnych możliwości w języku mniejszości podczas przechodzenia studentów z języka kontekstualizowanego (używanego w społeczności, do której uczeń należy) do języka dekontekstualizowanego. Cormier (2004) stworzył model nauczania nauk ścisłych dla mniejszości uczniów francuskojęzycznych, w którym czytanie, mówienie i pisanie są podstawowymi aktywnościami. Autorzy prezentują poprawiony model, który lepiej uwzględnia potrzeby uczniów wszystkich językowych mniejszości na lekcjach przedmiotów ścisłych.

Słowa-kucze: język naukowy, frankofon, tożsamość, instruktażowa stosowność, lingwistyczna niepewność

Portuguese

Resumo [Translated by Paulo Feytor Pinto]

Fora da província do Quebec, muitos francófonos do Canadá vivem em contextos de língua minoritária em que o inglês domina a paisagem linguística e cultural. Na América do Norte e no mundo, a língua inglesa tornou-se na língua franca da comunidade científica e, regra geral, da sociedade. A aposta no ensino de ciências a francófonos exige disponibilizar um rico leque de oportunidades discursivas na língua minoritária ao mesmo tempo que os alunos passam de usos contextualizados para usos descontextualizados da língua. Cormier (2004) desenvolveu um modelo de ensino das ciências a alunos francófonos minoritários em que a leitura, a interação oral e a escrita são actividades centrais. Os autores apresentam

um modelo revisto de modo a melhor corresponder a todas as necessidades de todos os estudantes minoritários presentes na aula de ciências.

Palavras-chave: linguagem acadêmica, francofonia, identidade, congruência instrucional, insegurança linguística.

Spanish

Resumen [Translated by Bertha Rodríguez from Universidad Pedagógica Veracruzana, Mexico].

Enseñanza de las ciencias para alumnos francoparlantes en Canadá angloparlante, utilización de un modelo de congruencia instruccional que incluye estrategias para la habilitación del discurso.

En las afueras de la provincia de Quebec en Canadá, la mayoría de los Francoparlantes constituyen una minoría lingüística en un contexto en el que el inglés domina el terreno lingüístico y cultural. En Norteamérica y el mundo, el idioma Inglés se ha convertido en la *lingua franca* para la comunidad científica y la sociedad en general. Para mejorar la enseñanza de las Ciencias para los francoparlantes se requiere un gran número de oportunidades discursivas en la lengua minoritaria mientras los estudiantes se mueven de un lenguaje contextualizado a uno descontextualizado. Cornier (2004) desarrolló un modelo para enseñar Ciencias a la minoría francoparlante donde la lectura, la expresión oral y la escritura son actividades esenciales. Los autores presentan un modelo revisado que atiende de mejor manera las necesidades de los estudiantes pertenecientes a minorías en el salón de Ciencias.

Palabras clave: lenguaje académico, francoparlante, identidad, congruencia en la enseñanza, inseguridad lingüística.

The point must not be to eliminate students' home languages, but rather to add other voices and Discourses to their repertoires. (Delpit, 1993: 293)

1. REDRESSING PAST INJUSTICES

Although culturally very diverse and with a rich history involving Aboriginal nations and competing European colonial powers, Canada became bilingual in 1969 when it adopted the *Official Languages Act* declaring English and French as the two official languages of the country (Martel, 1993). The act was supposed to confer equal status upon these two languages; but in reality, English is still regarded as the language of power by many political observers. Canada's population of just over 30 million is represented linguistically with 59.1% declaring English as their first language, 22.9% French, and 18.0% other languages (Statistics Canada, 2002). Even though 22.9% seems to be a significant proportion of the Canadian population, Francophones (French speakers) are largely concentrated in the province of Québec where they represent 81.4% of the population. In the rest of what is commonly called 'English Canada', Francophones represent only 4.4% of the population. However, regional variations occur with 33.2% of the province of New Brunswick (a province bordering the Atlantic) and 4.2% in Manitoba (a province at the geographic centre of the country) declaring French as their first language. In other provinces and territories, this proportion ranges from 0.5% in Newfoundland to 4.5% in Ontario. Francophone minorities outside of Québec are thus dispersed over a vast territory and are found mainly in isolated pockets in rural and urban communities. This relative isolation results in frequent contacts with the English language, through the media as well as through cultural and socioeconomic activities. In fact, 85.6% of Francophone workers use mainly English at work (Landry & Rousselle, 2003). English thus dominates the linguistic, cultural, political, and economic landscape. This paper

specifically addresses issues related to the teaching of science within these isolated, minority Francophone communities outside of Québec.

1.1 An Historical Overview

Historically, Francophones have been dominated and oppressed before as well as after the birth of Canada in 1867. Acadians (descendants of the first French colony in the New World established in 1604) settled in what is now Nova Scotia on the east coast of North America. In 1755, Acadians were banished from this prime farmland; some were deported to France, others were exiled to New England, and many eventually relocated in Louisiana, which was under Spanish rule at the time. Some Acadians managed to avoid deportation while others returned to their homeland in Canada after the conflict subsided. Present-day Acadians are descendants of these colonists.

As French explorers and voyageurs pushed further into the interior of the continent, many settled in developing communities and married native women. These cross-cultural marriages gave rise to a unique Métis language and culture that combined many features of both European and aboriginal traditions. The Métis descendants of these early settlers helped establish the Red River colony along one of Manitoba's primary waterways that became a thriving community in Canada's hinterland during the 19th century. Louis Riel, head of a provisional government that negotiated Manitoba's entry into the Canadian Confederation and leader of the Métis people's resistance against the federal government to protect their rights, was hung for treason in 1885. Like the Acadians, the Métis were also increasingly marginalised over time as British culture and the English language became firmly established in all provinces outside of Québec.

The authors of this paper are descendants of the Acadians in New Brunswick and the Métis in Manitoba. The perspective that we present here is rooted in our linguistic and cultural heritage, and reflects our experiences over time as students, teachers, and researchers living in minority language contexts.

1.2 A Political Overview

Well into the 20th century, laws and educational policies in most provinces prohibited or restricted teaching in the minority French language. The prevailing political ideology was intent on creating a homogeneous school system that transmitted one language and one culture (Martel, 1993). As Canada approached its centennial celebration, Francophones became increasingly politicized, demanding that governments allow education in French, fully realizing that their language and culture would be otherwise lost. A gradual shift in ideology occurred through the 1960s and 1970s and was formally recognized in 1982 when Section 23 of the *Canadian Charter of Rights and Freedoms* established the right to education in the official minority language. Regardless of these entrenched rights, parents have had to regularly petition the courts so that governments respect their obligations (Foucher, 1999).

1.3 Literacy and Schooling

This historical oppression has had a profound effect on the minority population who often undervalued their language, culture, and schools (Ogbu & Simons, 1998; Wagner & Grenier, 1991). It has also left a legacy of low literacy and underachievement among both the young and adults. In Canada overall, assessments have shown that Francophones are less literate than Anglophones (English speakers). For instance, the International Adult Literacy Survey assessed literacy levels on a 5-point scale, with level 3 deemed to be the basic functional level for most occupations. More than half (60%) of Francophones living outside of Quebec scored at the two lowest levels (1 and 2), well below what is considered essential (Wagner, Corbeil, Doray, & Fortin, 2002).

Francophone students' results have also been unsatisfactory in national and international school-based assessments in science. In a pan-Canadian study of 13- and 16-year-old students, Francophone students living in minority situations consistently obtained lower scores in science, compared to Anglophone students from the same provinces (Council of Ministers of Education Canada, 1999). In 2001, the Programme for International Student Assessment (PISA) conducted by the Organisation for Economic Co-operation and Development (OECD) found similar results. For all provinces in which the number of students participating in the assessment permitted statistical comparisons, the Francophone linguistic minority always obtained lower results in science, mathematics, and reading than Anglophone students (OECD-PISA Study, 2001). Moreover, Cummins (1997) reported that Francophones are less likely to be enrolled in postsecondary preparation programs while in secondary school.

Along with low literacy levels, many Francophones outside Quebec are characterized by linguistic insecurity (Boudreau & Dubois, 1992). Victims of linguistic insecurity believe that their particular register is of little value, being incapable of speaking the language according to established norms. Linguistic insecurity may lower self-esteem and in turn negatively impact on the individual's written and oral expression. This perception may come from the harsh corrections encountered in school or even in the community (Gérin-Lajoie, 2003). Thus, instead of risking criticism while clumsily using the minority French language, individuals may revert to using the majority English language. This choice ultimately reduces their use of the minority language and consequently erodes their language competencies over time, thus exacerbating linguistic insecurity (Krashen, 1998). Moreover, Francophones have often had to tolerate an "ideology of contempt" from reactionary members of the dominant language group, further diminishing the status of the minority language in some jurisdictions (Laitin & Reich, 2003: 85).

Low demographic density, linguistic contacts that occur predominantly in English, poor literacy levels, and linguistic insecurity all contribute to assimilation, which is widespread throughout Canada (Martel & Villeneuve, 1995). The aim of Section 23 of the *Charter* is to reverse this trend. The Supreme Court of Canada has stated that the ultimate purpose of Section 23 is "redressing past injustices and providing the official language minority with equal access to high quality education in its own language, in circumstances where community development will be en-

hanced” (Arsenault-Cameron v. Prince Edward Island [2000]). Throughout the 1980s and 1990s, Francophone communities focused on gaining control of schools. French schools and school districts are now well established in all Canadian provinces and territories. Francophone control of education has meant that students can now complete most of their schooling, all but English language arts, in the French language.

1.4 The Role of Identity

An important factor to consider when attempting to counter assimilation is the role of social identity (Gérin-Lajoie, 1997). While an individual is characterized by one true personal identity, he or she may also project multiple social identities – Acadian, student, rugby fan, etc. Social identity can be limited to a self-assigned definition – I am Francophone – or broadened to include the affective values underlying this identity – It is an integral part of who I am. On the one hand, although a person might affirm that they are Francophone, their everyday behaviour may actually diminish the purported importance assigned to this identity. On the other hand, everyday choices may demonstrate a strong commitment to one’s language and culture (Dallaire & Roma, 2003). When a particular identity is highly valued, empowerment and affirmation are possible and assimilation is less likely (Cummins, 1996; Deveau, Landry, & Allard, 2005). It has been argued that a strong social identity related to one’s minority group is among the most resilient factors toward assimilation (Landry, 2003). However, the status and prestige of English is likely to provoke an identity crisis thereby creating tensions in certain individuals, especially school-aged children, where identity is still actively being negotiated, constructed, and defined (Tse, 1998). In fact, Gérin-Lajoie (2003) observed that many of the Francophone students in her study viewed themselves as bilingual. These students thus live at the boundary between Anglophone and Francophone worlds. Similar trends are evident among adults with 84% of adults considering themselves bilingual (Patten, 2003). Although a bilingual identity does not necessarily lead to assimilation, it requires compensatory strategies in the home, school, and community (Landry, Deveau, & Allard, 2006). Moreover, Bernard (1998) argued that in many communities the form of bilingualism encountered is asymmetrical and Anglo-dominant, essentially diminishing the status of French to that of a second language.

In our view, decisions with regard to instructional design, the establishment of learning communities, and the choice of classroom materials must all be framed by a commitment to enhancing minority language use and to fostering positive social growth in learner identities (Cormier, 2005). Individuals must be given ample opportunities for building strong affective ties with peers and other significant persons while also developing an affinity, or sense of belonging, with their community.

2. CREATING DISCURSIVE SPACES

Language activities, such as talking, reading, and writing, are considered a fundamental and constitutive part of doing science (Lemke, 1990, 2004; Norris & Phillips,

2003; Osborne, 2002; Rivard, 1994, 2004; Rivard & Straw, 2000; Wellington & Osborne, 2001). However, the language of science is very different from everyday language. Halliday and Martin (1993) underlined some of the difficulties inherent in scientific language. For instance, the lexical density and syntactic ambiguity of science texts constitute an important challenge for many secondary school students. Some scholars have advocated accepting students' vernacular or home language, particularly when teaching students from linguistic and cultural minorities, while moving them toward academic language (Ballenger, 1997; Boudreau & Dubois, 2001; Gibbons, 1998; Prain & Hand, 2006). Others have suggested that instructional time would be better spent focusing on more formal language registers (Halliday & Martin). We support the view that language development is continuous from early literacies in the home to more academic literacies of the school and society (Cazden, 2000; Street, 2005; Warren, Ballenger, Ogonowski, Rosebery, & Hudicourt-Barnes, 2001).

2.1 Levels of Discourse

Perez (2004: 27) defined discourses as the ways "communicative systems are organized within social practices." For instance, children learn the mother tongue in the home primarily through social interactions with parents and siblings. Gee (2001) suggested that this primary discourse involves more than language by embracing aspects of social and cultural identity. The repertoire of discursive activities is expanded as the child later interacts with peers and other adults outside the home. Once in school, however, students are exposed to standard language forms – what Gee has referred to as secondary discourses. These might involve the use of more formal registers in discursive practices in the science classroom. For many students, there is a clash between the discursive practices in the home and those in the school (Minami & Ovando, 2004). Cummins (1991: 162) argued that "minority students' academic difficulties [can be] attributed to a 'linguistic mismatch' between home and school." Hybrid language practices in which multiple codes and registers co-exist characterize many schools and classrooms in minority situations (Gutiérrez, Asato, Santos, & Gotanda, 2002). For instance, students may code-switch from a formal French register when talking with the teacher to English or even 'Franglais' (a hybrid code combining the majority and minority languages) in open conversations with classmates. A diglossic situation may also arise in those communities in which English is perceived to be the prestige language, with students using the minority language in the classroom and the majority language outside of school (Cummins, 1997).

Yore (2008) suggested that three levels of discourse might be considered when addressing issues related to language, culture, and science literacy: L1 or first language, the language of the home; L2 or language of instruction, the language of the school; and L3 or the language of western science. Although Canada is a bilingual country, outside of Quebec most Francophones live in minority-language settings in which English dominates the linguistic and cultural fabric. In this context, describing the discursive climate using the L1–L2–L3 model is clearly inadequate. We

would argue that a more accurate representation would have the languages of the home, the school, and science all aligned along a continuum from *L*, the dominant language or language of the majority, to *l*, the minority language. Points along the continuum represent the universe of literacy events possible in the home, the school, and the science classroom. Literacy events in the school can be defined as “social action going on around a piece of writing” (Brandt & Clinton, 2002: 342). We have expanded this definition to include events that combine social practice, or talk, while students work through reading and writing tasks (Wenger, 1998). Figure 1 depicts this model.

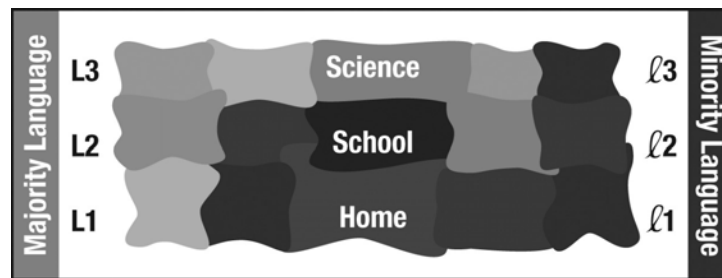


Figure 1: Literacy in the home, school, and science classroom in bilingual environments.

In the home, for instance, parents create a milieu in which the child has rich opportunities for using language. Once in school, it is the teacher’s job to create opportunities for learning the curriculum using various language-based activities. In the science classroom, it is again the teacher who establishes the linguistic and discursive boundaries for learning science. In Canadian schools where students are taught in the majority language, all of these events occur in English. However, in a minority Francophone situation, fewer literacy events occur in French as one moves from the home to the school and then to the secondary school science classroom. For example, d’Entremont (1990: 22) observed that “many Acadians speak Acadian French but live in English. They watch English television, listen to English radio, read English books and newspapers.” As Landry and Allard (1991: 199) pointed out, in these settings “societal pressures are so strong that linguistic assimilation may occur.” Other studies suggest that Francophone students have had minimal contact with the literate aspects of the minority language (Hamers & Blanc, 2000).

2.2 Expanding Literacy Experiences

In Canada where the English language is the *lingua franca*, Francophone parents and teachers must continually create learning situations in which the use of the minority language is encouraged. As such, it is imperative that teachers create a milieu in which students are engaged with scientific texts using various language-based activities in French. Teachers must provide access to more formal academic language while building on students’ primary or vernacular language (Lee & Luykx,

2007). Moreover, studies suggest that teachers tend to simplify linguistic forms and restrict opportunities for extended discourse use in second-language classrooms (Bartolomé, 1998; Swain, 1988; Valdés, 2004). We would argue that a similar situation prevails in minority language classrooms where instruction is often linguistically sheltered, what Brutt-Giffler and Varghese (2004: 3) termed “linguistic ghettoisation.” The aim of minority-language instruction must be linguistic restoration by expanding literacy experiences using authentic materials while scaffolding discourse acquisition.

Western science originated in Europe with both British and French scientists playing key roles in its development. Descartes, Newton, Hooke, and Pasteur all made significant contributions toward unravelling nature’s secrets. Although cultural differences between these nations are evident, the two still share a common worldview and similar epistemic and ontological approaches to the study of nature. Even the language of science in these two linguistic groups is closely related with the etymology of many words arising from greco-latin roots, as well as with parallel syntactic and discursive patterns characterising both text and rhetorical structures. Even for the Métis and the Acadians – groups for which history, tradition, and culture are significant markers of identity – it is not the philosophical or epistemological differences that hinder the acquisition of science literacy. Rather, language is the primary obstacle toward developing scientific literacy among Francophones.

Minority language students in the science classroom must be provided with a multiplicity of learning experiences using various discourses, genres, registers, and media, both print and electronic (Cope & Kalantzis, 2000; Lemke, 1990; Pomeroy, 1994). Enhancing the teaching of science for Francophones will require providing a rich array of discursive opportunities in French while moving students from contextualised to decontextualised language (Cummins, 2000; Gibbons, 1998). Teachers must work with students to analyse and unpack diverse sources of science information, thus encouraging them to appropriate the metalinguistic and metacognitive tools required for critical literacy. Moreover, science literacy involves the use of argumentative discourse in which language is used to frame arguments in canonical accounts of science experiments or on societal issues involving science. The capacity to weigh evidence, evaluate warrants and assumptions, and draw inferences and conclusions is crucial to all scientific endeavours. To be fully literate in science, students must also appropriate the linguistic and discursive tools underlying argumentation and persuasive discourse (Simon, Erduran, & Osborne, 2002). In minority language situations, this requires enriching the discursive diet beyond traditional textbooks and worksheets. Bakhtin (1981: 293) suggested “a new discourse is only acquired when the individual populates it with his own intention, his own accent.” Minority Francophone students must thus be provided with pedagogical spaces for populating the multiple discourses of science (Wallace, 2004).

Lee and Fradd (1998: 12) defined instructional congruence as “the process of mediating the nature of academic content with students’ language and cultural experiences to make content (e.g., science) accessible, meaningful, and relevant for diverse students.” We argue that an appropriate instructional strategy for minority students provides them with ample opportunities for talk and collaboration while engaging them with learning tasks using a wide assortment of texts. The goal must

be to expand students' discursive repertoire in science while they are engaged with literacy events involving both comprehension and production tasks. Instruction for minority language learners must be "discourse enabling" (Moje, Collazo, Carrillo, & Marx, 2001: 469). Giving students multiple opportunities for using their native language in the development of literacy empowers them. Empowerment allows students to view membership in the minority group in a positive light, alleviating their ambivalence toward the minority identity (Cummins, 1997).

Bartolomé (1998: 21) argued that "any discussion of linguistic-minority students' language and literacy practices must take into account the larger sociopolitical context in which these practices have developed and in which teacher and student negotiate the maintenance of primary discourses and the acquisition of the dominant culture's secondary discourses." We have argued that Francophone minority students must be provided with rich opportunities for appropriating the discourses of science in their mother tongue despite the overwhelming dominance of English as the international language in the world of science. Language is more than a means of communication; it is also a "marker of identity" (Rubio-Marín, 2003: 56). Once Francophone students have acquired the secondary discourses in their mother tongue, they should be able to cross the linguistic border and transfer these discursive competencies to the majority language as well (Aikenhead, 1996; Cummins, 2000). As Skutnabb-Kangas (2004: 128) suggested, "additional languages should be learnt ADDITIVELY", building on a solid foundation in a person's native language.

3. COMMON UNDERSTANDINGS ACROSS ALL CLASSROOMS

Gutiérrez and Rogoff (2003: 20) cautioned educators to avoid adjusting instruction "merely on the basis of a group categorization." Although the suggestions for reforming classroom teaching reflect our concerns with the current situation underlying the science instruction of minority Francophone students, we believe that they also have merit for other linguistic groups studying science in languages other than English. Many other languages and cultures are currently under attack by Anglo-American language and culture through the effects of globalisation, particularly domination by both print and electronic media (Skutnabb-Kangas, 2004). Moreover, adding other voices to the discourses of science can only enrich its conceptual vocabulary. We believe that language and culture are intimately intertwined through the metaphors they create in the various linguistic repertoires. Being bilingual or multilingual thus provides individuals with alternatives, both linguistic and conceptual, for representing scientific phenomenon.

3.1 *Home Language as Entry Point*

Francophone minority students in Canadian communities, like many other minorities around the world, often speak a language register that deviates from the formal standard one. It is often viewed by the minority population itself as an illegitimate vernacular register of little value (Boudreau & Dubois, 2001). While attending school,

these speakers are confronted only with the standard academic register. Difficulties in comprehending and producing language may arise with the result that some students may be silenced. To avoid silencing students, teachers must respect their language and encourage them to use it while valuing the ideas contributed. The vernacular register must be considered the starting point for conceptual learning, rather than extinguishing it outright (Cormier, 2005). This provides access to the rich prior experience, cultural memories, and knowledge stored in the home language. Without accessing these stores through the learners' primary language, they remain inert and unavailable for constructing new understandings. When students have difficulty processing academic language, teachers may respond by simplifying it so that it is more accessible (Bartolomé, 1998). However, Gibbons (1998: 100) cautioned against this strategy:

While this strategy may help to make language comprehensible to learners, it fails to take into account how the learner is to obtain new linguistic data, and can lead to what is effectively a simplified, reductionist and 'alternative' curriculum, which may in turn create lower academic expectations in some classrooms.

3.2 *Extending the Linguistic Repertoire*

Rather, we argue that an approach that enables students to use academic language by gradually removing contextual supports would be more effective. Context-embedded language usually occurs in face-to-face situations; thus, speakers may actively negotiate meaning by asking questions or giving feedback. Exophoric references (this, these, that) may be used so that the conversational situation provides situational and interpersonal cues that enhance comprehension. Furthermore, in such situations the presence of gestures and other visual cues may result in fewer content words or a low lexical density (Roth, 2004). By contrast, context-reduced language uses mainly linguistic cues and an increased lexical density. Comprehension and production in this latter case are largely dependant on language abilities and available lexicon. Schools, by their very nature, use more context-reduced language.

Gibbons (1998) suggested a three-step approach to help move students from context-embedded to context-reduced language. She argues that students' ideas in science can be expressed when they are permitted to speak using their familiar, context-embedded, vernacular language – as this language is sufficiently developed for students to explain their point of view in their own way. The role of the teacher in this situation is to extend the students' linguistic capacity by moving them toward more academic and scientific discourse. This movement can be realised in three steps. First, students initially work in small groups, discuss their understandings on the topic at hand, then work with concrete materials and participate in experiments or other science activities that favour the use of context-embedded discussions. Second, each peer group reports its findings to the rest of the class while the teacher scaffolds students' discourse. Prior to reporting, the teacher can also introduce new words, lexical items that are useful for talking science. This reporting situation occurs without access to the concrete objects that were available earlier during group work. The discourse thus becomes more linguistically focused and less context-embedded. However, peers and the teacher may work together to negotiate mean-

ings when linguistic obstacles arise. Third, students can write about their work in journals. In comparison with the two previous activities, this writing activity is more context-reduced. Gibbons investigated the use of this three-step approach in Australia with minority students and found that it successfully extended their linguistic repertoire.

Gibbons' approach is also supported by work in Canadian classrooms. Rivard (1994) suggested that expressive writing – the kind often found in journals – is readily accessible to students and may be useful for initially engaging with content, thus allowing students to personalize their science learning. Rivard and Straw (2000: 588) further concluded that “talk is important for sharing, clarifying, and distributing scientific ideas among peers [whereas writing is] important for refining and consolidating these new ideas with prior knowledge.” Talk and writing are thus different but complementary modalities that are both fundamental to classroom learning environments: “talk is social, divergent, and generative, whereas writing is personal, convergent, and reflective” (Rivard & Straw: 588). Moreover, the sequencing of specific language-based tasks may be important in determining actual learning (Hand, Prain, & Yore, 2001; Rivard, 2004).

Cormier, Pruneau, Rivard, and Blain (2004) developed a model for teaching science to minority Francophone students that expands on Gibbons' (1998) approach. In this model, which is depicted in Figure 2, language takes centre stage as students talk, read, and write about science. Language activities can be designed to value students' register, to diminish linguistic insecurity, and to extend discursive opportunities. Language is a fundamental part of science. Scientists not only conduct experiments but also read journal articles, prepare funding proposals, scribble notes, summarize observations and results, discuss their findings with colleagues, attend conferences, present papers, and finally write canonical accounts that can then be submitted for publication. Scientists may also create hybrid texts integrating both scientific and political discourses when they address societal or environmental issues in public forums. Language is thus an important communicative and reflective tool in all scientific activity.

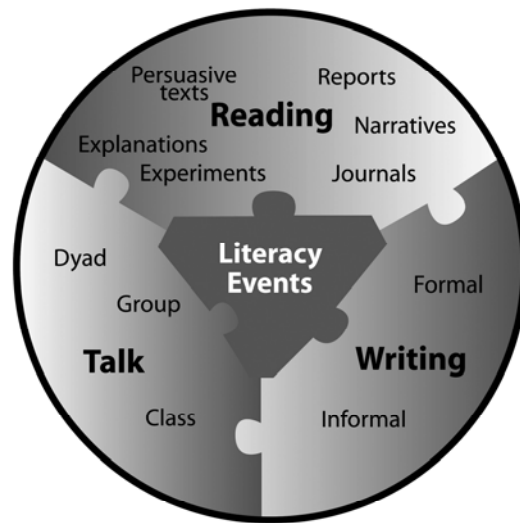


Figure 2: Using talk, reading, and writing for enabling discourse acquisition in minority language science learners.

In the linguistic minority context, Cormier et al. (2004) recommended an approach that begins with an informal use of the language. At the beginning of a unit of study, students can talk freely in dyads and small peer groups about the topic using their everyday language. This allows minority language students to access prior knowledge, explore the oral discourse underlying the science topic, and co-construct scientific understandings. As students are engaged with science activities during this initial phase, they can also write in their journals. Students can use this learning tool in whatever manner they choose, making use of abbreviations, key words, sentence fragments, and other semiotic tools, such as data tables, graphs, drawings, concept maps, flow charts, and diagrams. Students are encouraged to take risks and to explore the concepts and ideas that are integral to the science topic, rather than simply responding to teacher-produced, direct questions that can be copied verbatim from a book. During these activities, students can also read a variety of informative or narrative texts on the topic. Although trade books may be narrative in structure, many still include important ideas about science. Moreover, a lot of the vocabulary in these books may be presented in a context-embedded manner that is considerate of

linguistically challenged readers. All of these language-based activities support conceptual development while expanding students' linguistic repertoire. The idea is to provide students with many discursive opportunities and literacy events while they are engaged with science, thus allowing them to build on existing linguistic competencies and to recognise their need for more sophisticated discursive tools, as well as for additional scientific information.

3.3 Acquiring Academic Discourse

After being given ample opportunities to express their ideas about science using vernacular discourse, students can begin to explore the use of formal academic discourse, again through reading, talking, and writing. For example, students can participate in teacher-led discussions, present their results to the class, or communicate findings to a real audience. Parents or community groups could be invited to attend group presentations. Using language in an authentic situation encourages students to communicate using formal language registers. Whereas the focus in the earlier stages may have been on ideas and concepts, the focus now is on formal literacy and academic discourse. In comparison to earlier activities, the oral discourse is less context-embedded so that students are forced to use richer linguistic structures to express their ideas. Students can read other informative texts that are more challenging than earlier ones and cover a variety of genres to further refine their understandings about science, as well as their use of technical language. Students can also be asked to write different types of texts, such as descriptions, explanations, summaries, and arguments. In addition, articles could be published in community newsletters or local newspapers on current issues involving science. While reading scientific texts, students can receive explicit instruction on the use of various comprehension strategies. Production strategies for use with oral and written discourse can also be taught (Wellington & Osborne, 2001). Over the course of the unit of study, students refine their understandings about science while progressively developing more confidence in using academic registers and scientific discourse. Students are empowered when they overcome linguistic insecurities, develop affective ties with peers and the community, and negotiate understandings about discourse use in science. Brown (2006: 96) argued that science educators must "place greater emphasis on the relationship between students' identity and their scientific literacy development." We believe that individual identities can be sustained and strengthened through a myriad of reflexive activities involving language, culture, and science (Giddens, 1991).

Cormier (2004) investigated this approach with a Grade 5 classroom in New Brunswick. Results suggest that students who participated in a two-month study of salt marshes moved from informal to formal language and acquired scientific vocabulary along with an increased comprehension of salt marsh ecosystems, their structure, and function. During the course of the study, students' comprehension of salt marshes moved from vague notions that salt marshes might be a pond, a lake, or some other body of water toward more precise, scientific understandings about adaptations to the ecosystem, as well as about the many ecological functions of the marsh ecosystem. During interviews prior to the study, students' use of scientific

vocabulary was practically nil (1%); yet at the end of the study, 18% of the words used to describe the ecosystem were scientific. Motivation, curiosity, and confidence using the language of science were all enhanced. Interestingly, their conception of language use in the science classroom changed over time. Prior to the study, they believed that efficient notetaking and responding to teacher questions were prime indicators of good language use in the science classroom. After the study, they talked instead about sharing ideas with others and writing about their observations and findings. We argue that such an approach could be useful to other minority language groups in the science classroom. This approach not only allows students to bridge the gulf between vernacular discourse, their home language, and science discourse, but also enhances the development of their social identity as members of a minority language group.

Pavlenko and Blackledge (2004) argued that the negotiation of identities in multilingual settings is embedded in socioeconomic, sociohistoric, and sociopolitical perspectives. Power relations in society may often lead to a valuing of the dominant language and a belief that it is superior to one's own language. Since identities are constructed and validated through societal discourses, non-speakers of the standard variety may feel undervalued, resulting in linguistic ambivalence and serious conflicts in negotiating social identity. In our view, linguistic affirmation strategies offer a much greater potential for personal and social growth than coercive ones that simply attempt to extinguish non-standard varieties of language use (Cummins, 2000). Such affirmation strategies include literacy learning, the appropriation of rhetorical and discursive strategies, and the creation of new identity narratives (Pavlenko & Blackledge).

4. CONCLUSIONS

We have argued that an appropriate model for science instruction in minority language contexts must be congruent with the linguistic reality of the target learning community. Minority Francophone students in Canada live in two parallel language worlds: one dominant, public, and prestigious; the other suppressed, private, and familiar. As they move from the sheltered linguistic confines of the home, students are regularly immersed in the Anglophone world. The school and the community thus have a critical role to play in maintaining the linguistic vitality of minority Francophone students. Moreover, we have argued that border crossings from the primary discourse of the home to the secondary discourses of academia and western science must be facilitated by the pedagogical practices in the classroom. Using everyday language and available linguistic resources as building blocks, instruction must scaffold learners during the acquisition of the discourses of science through language-based activities using authentic materials. Classroom instruction must be discourse enabling. Further, the instructional congruence model that we have proposed includes positive, affirmative strategies for resolving linguistic tensions and negotiating social identity. We believe that developing science literacy, including the use of rhetorical and discursive strategies, through one's home language can empower students – and empowerment, in turn, enhances their resistance to assimilation.

lative forces in society. Moreover, linguistic diversity is declining globally at an alarming rate with estimates predicting the extinction of half of all existing languages over the next century (Skutnabb-Kangas, 2000). Educational policies that enhance opportunities for language maintenance not only ensure the conservation of this linguistic capital, but also provide the conceptual-metaphorical fodder for enriching science in the future.

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