

CODE-SWITCHING AS A LINGUISTIC RESOURCE IN THE MULTILINGUAL SCIENCE CLASSROOM

Annika Karlsson¹

¹ Malmö University, Faculty of Education and Society, Sweden

Abstract: This study investigates the significance of language in science learning by analyzing students' authentic use of language in science in a multilingual classroom. The study is ethnographic and describes how student who have newly arrived in a country use translanguaging, that is, different linguistic resources – in the form of code-switching between their first and second language. The translanguaging process develops as a linguistic movement between students' everyday practical experience of the world and the subject-specific discourse that students encounter in the context of school science instruction. The switch between languages often occurs within *linguistic loops* between discourses, which are an important condition to describe and develop new knowledge. The students often express everyday experiences of the world through their first language, but frequently use their second language for more subject-specific words and terms, such as “carbon dioxide” and “oxygen”. This implies that the linguistic loops constitute a movement between both national languages and different discourses. Thus, the students' *discursive mobility* (Nygård Larsson, 2011) increases when they have the opportunity to use both their first and second languages in school science instruction. The *translanguaging practice* (García & Wei, 2014) enables multilingual students to link abstract subject content to their own experiences, which empowers the students to contextualize the subject and creates preconditions for deeper understanding. An important implication of this finding for science education is that it enables multilingual students to use translanguaging as a linguistic resource, and creates translanguaging situations that encourage and enable code-switching, switching between languages, and different modes of expressions in science instruction contexts.

Keywords: code-switching, discursive mobility, science learning, translanguaging

MULTILINGUAL SCIENCE CLASSROOMS

Swedish schools have become increasingly multicultural in recent decades; currently, approximately 20 percent of students in Swedish schools have a mother tongue other than Swedish. This phenomenon can be seen as an important educational asset and resource in teaching, and it also creates new opportunities for cultural and linguistic encounters, which in turn creates value for Swedish compulsory schools. However, the National Agency for Education examination in (2010) reveals the shortcomings of these perspectives. Teachers are often deficient in information about the linguistic and subject knowledge of newly arrived students, and multilingual and intercultural perspectives are rarely included in the education. Moreover, the teaching in the students' mother tongue is often situated outside the regular education, which can mean that newly arrived students do not have the opportunity to relate the expression of the first and second language to each other, which in turn delays the language development in both languages. Several studies (Collier & Thomas, 1999) stress that

one of the most important factors for newly arrived students' performance is the ability to develop their first language in subject-specific contexts. Thomas and Collier (1997) also show that it takes an average of five years for newly arrived students to develop a subject-specific second language.

Language and texts used in school science contexts are characterized by high lexical density, abstraction, and technicality (Martin & Veel, 1998). Halliday (1998) asserts that the subject-specific use of nominalizations and passive forms is a grammatical functional technology to describe the science subject content. Another feature in the subject-specific language is that concepts often get their meaning by being organized taxonomically in *thematic patterns* (Lemke, 1990). Therefore, subject-specific language in science presents a challenge in the learning processes of many students (Lemke, 1990), and this challenge is even greater for newly arrived students and second-language learners. Hajer and Meestringa (2014) point out that there is an obvious risk that teachers in schools where the majority of students have Swedish as a second language will tend to lower their expectations of these students and adjust the science teaching content to the students' second-language skills. This can lead to the subject content and the subject-specific language in teaching being simplified, and increase the risk that the students will not be challenged cognitively and linguistically. This, in turn, can lead to a downward spiral in which students' appropriation of both the subject content and the subject-specific language will be limited. Successful education for newly arrived students is characterized by a high level of intellectual challenges level with support to meet high expectations (Cummins, 2000; Gibbons, 2008). Under these conditions, the students have greater opportunity to develop a subject-specific language and a deeper understanding for the subject content.

Language is a tool for learning

In order to become involved in various discourses and participate in different cultural contexts, people develop skills and acquire tools, the most extensive of which is language (Engeström & Middleton, 1998; Säljö, 2010; Wells, 1999). Language is a tool for social interaction and is used in a wide range of social contexts. Language develops with a functional purpose of communicating in different situations (Halliday & Matthiessen, 2004). Lemke (1990) argues that language cannot be understood as a tool for information unless it represents a prerequisite for all the meaning-making processes between people. This means that language is not only a tool to convey information in science education, but also a tool in the process of meaning, to create understanding. Several learning and language development theories assume that the content and the language are intimately interwoven and that learning takes place through interaction in social contexts (Engeström & Middleton, 1998; Säljö, 2010; Wells, 1999). Therefore, an important conclusion in relation to the educational context is that the language and context are inextricably linked, and that the subject and language constitute one another and cannot be developed separately.

A translanguaging practice

In a translanguaging practice, the learner appropriates new *linguaging* abilities in relation to their own available *linguistic repertoire* and new skills emerge through social interaction (García & Wei, 2014). According to Canagarajah (2007), language is not a constant system of completed structures, but an ongoing process depending on societal constructions. In this view, language is a construction of social forces and emotions in a context, and cannot be

translated immediately in a new context. Language is acculturated. García and Wei (2014) argue that language and culture are interrelated, which means that new practices constitute new languages and new cultures from the various “originals”. They wrote: “for us translanguaging refers to *new* language practice that make visible the complexity of language exchanges among people with different histories, and releases histories and understandings that had been buried within fixed language identities constrained by nation-states” (p. 21).

Many studies show how multilingual students use translanguaging in order to learn and understand their world (Creese & Martin, 2003; García & Wei, 2014). In translanguaging practices, multilingual students use all of their languages in a dynamic and functionally integrated manner to organize and mediate processes in understanding, speaking, literacy, and learning (Lewis, Jones, & Baker, 2012). For example, Kibler (2010) shows how multilingual students utilize their home language in secondary classrooms and move between their first and second language in the interaction with peers and teachers during writing activities to cognitively manage the tasks. García (2011) found that multilingual students who enter school used translanguaging for six metafunctions: to mediate understanding among each other, to co-construct meaning of what others are saying, to construct meaning within themselves, to include others, to exclude others, and to demonstrate knowledge. Another study shows how emergent bilinguals tend to use translanguaging as a *support*, and sometimes to *expand* their understanding (*dependent translanguaging* pattern), while more experienced bilinguals seem to use translanguaging more for their own *enhancement* (*independent translanguaging* pattern) (García & Kano, 2014). In post-colonial contexts, scholars describe translanguaging in form of code-switching as a norm in education. Martin (2005), who has studied multilingual classrooms in Malaysia, argues that code-switching gives students a greater opportunity to succeed and to express themselves in the classroom.

The term code-switching commonly refers to a shift between two autonomous languages. Early definitions of bilingualism meant that the bilinguals’ two languages constituted two different systems, with separate codes, that should be kept apart (Weinreich, 1953/1974). A great deal of research about code-switching concerns the speakers’ switch between two different grammatical systems (Myers-Scotton, 1993). Cummins (1979) show a cognitive *interdependence* between bilinguals’ two languages – known as *Common Underlying Proficiency* (CUP) – which is the bilinguals’ two languages interacting and benefiting each other instead of being separated. García and Wei (2014) argue that bilingualism is beginning to shift from bilingual in dual to bilingual as *dynamic*. They propose there are no two autonomous languages, no two separate systems that are added (traditional bilingualism) or interdependent of each other (linguistic interdependence), only one dynamic language.

In this study, the concept of code-switching is used to describe how students switch between their first and second languages and different modes of expressions in translanguaging science instruction contexts. Code-switching means that multilingual speakers alternate between different use of language in a communicating situation (Gumperz, 1967; Park, 2004) and is a common phenomenon among multilingual participants (Cromdal, 2000; Jørgensen, 2004). Code stands both for language and variety (Cromdal, 2000), which means that code-switching not only concerns switching between different national languages, but also switching between different modes of expression, such as everyday use of language and a more subject-specific use of language. In this way, monolinguals also use translanguaging in the form of code-switching.

The movement between different discourses in science learning

Creating an understanding for science requires students to be able to contextualize the abstract science subject content in their own everyday practical and concrete experiences. When students use different discourses, and interaction between different discourses in learning, they develop a deeper understanding for the subject content. Dewey (1902) stresses the importance of a conscious and explicit instruction based on interaction between the child's everyday experiences of the world (an everyday discourse) and the more scientific description of the world (a school-related discourse). Dewey also asserted that the school-related discourse is often characteristic of an impersonal world, specialized subjects and science abstract principles, and thought patterns. *Systemic functional linguistics* (SFL) (Halliday & Matthiessen, 2004) is an approach to linguistics that considers language as a social semiotic system and the concept of a *register* suggests that all use of language can be linked to a specific situation. Therefore, language use is regarded as being situated and variable, and differs depending on the situation and the context. SFL refers to different modes of expressions, such as everyday modes of expression and more scientific modes of expression. The language moves between these two discourses in a continuum and forms different modes along the way, which constitute the register. Many studies in science education reveal that students' modification of language in their movement between different discourses, benefiting the learning of science (Ash, 2008; Brown & Spang, 2008; Brown & Ryoo, 2008; Olander, 2010; Varelas, Pappas, & Rife, 2006). Students develop a *hybrid language* (Bakhtin, 1981), a language between an everyday use of language, and a more scientific use of language (Brown & Spang, 2008; Gomez, 2007; Lemke, 1990). The present study uses the concept of *discursive mobility* (Nygård Larsson, 2011) to analyze students' ability to move linguistically between and within different discourses.

Translanguaging science instruction situations often include different national languages, and during these circumstances the hybrid language receives an additional dimension. Garcia and Wei (2014) extend the term code-switching to a concept including what Gutiérrez, Baquedano-López and Alvarez (2001) call "hybrid language use" (p. 128) and argue for the importance of all bilinguals in multilingual contexts using "hybrid language" systematically in sense making-processes. The *translanguaging space* (Wei, 2011) is associated with the vision of *third space* (Soja, 1996), which is the hybridity theory that recognizes the complexity of people's everyday spaces and multiple resources to make sense of the world (Bhabha, 1994). Higgins (2009) uses the term *multivocality* to describe how bilinguals use multilingual voices, based on Bakhtin's concept of *voice* (Bakhtin, 1981). Higgins argues that speakers who have two national languages are double-voiced and move linguistically in the interstices of multivocality. Such double-voiced speakers use *features* (linguistic features) in their conversations, which they strategically select from their *multilingual repertoire* (Jørgensen, 2008). Bilinguals use different features depending on the events and topics and who they are communicating with. In a *flexible bilingual pedagogy*, in which translanguaging is used, teachers and students bring all of their semiotic resources together and use them to access academic content (Creese & Blackledge, 2010).

The aim of the study

The aim of the present study is to investigate whether – and, if so, in what ways – a translanguaging practice in which multilingual students are allowed to use both their first and second languages, are a resource for making sense of natural science content and developing a

subject-specific language. In other words, the study explores the ways in which multilingual students translanguage in communicative situations in the science classroom, and how this opportunity can be a resource for their learning. This includes exploring whether and in what ways translanguaging, in the form of code-switching, can help these students bridge the differences between an everyday modes of expressions and the more scientific modes of expressions. In other words, how the students' ability to use both their first and second language increases their *discursive mobility* (Nygård Larsson, 2011).

METHOD

This ethnographic study was conducted with students at a multicultural primary school located on the outskirts of a large Swedish town. During data collection, the science subject was “photosynthesis, combustion, and ecological relationships”. In an attempt to create a language development instruction, the teacher used a genre pedagogical approach (Rose & Martin, 2012). The Arabic-speaking teacher participated in teaching with tutoring about half of the observed lessons. The study followed 11 science lessons using three video cameras and two voice recorders, and the collected material comprised a total of 28.5 hours of student conferences and teaching sequences.

Analysis

The analytical work is based on a sociocultural theoretical framework. In this method, the perceived language development and learning are intimately interwoven and the development largely takes place through interaction in social contexts. Individuals and groups gradually acquire the knowledge and the language that constitutes the discourses, which can then be used for communicative purposes (Engeström & Middleton, 1998; Jakobsson, 2012; Säljö, 2010; Wells, 1999). The translanguaging epistemological conceives language relationships in creativity and dynamic terms. The participants' different semiotic resources become part of an integrated resource for all meaning making processes. By analyzing these processes in detail, it becomes possible to understand how the students in this study were able to use translanguaging in the form of code-switching as a resource in their science learning. The analysis focused on code-switching situations between Swedish and Arabic, which arose in authentic science instruction situations. The analysis was conducted in three distinct but clearly related phases. The first phase focused on situations in which students use translanguaging in the form of code-switching between Arabic and Swedish. The analysis was limited to the three lessons that contained mostly exploratory talk. From these lessons, 28 typical and representative code-switching situations were selected. In the second phase, the functions of the selected code-switching situations were analyzed based on Appel and Muysken's (2005) four main functions of code-switching: give an emotional charge to the conversation, express identity, include or exclude others from the conversation, and provide information about the world. However, quantifying and categorizing code-switching situations based on those functions proved problematic. The analysis revealed the functional complexity of code-switching, whereby one code-switch often serves several different functions simultaneously; this finding is consistent with previous research (Cromdal, 2000; Gumperz, 1982; Rampton, 2014). Instead, the analysis focused on the students' use of translanguaging in the form of code-switching in their linguistic movement between and within different discourses in science learning. Two main discourses were used: the students'

everyday experience of the world, and the subject-specific discourse that students encounter in the school science instruction context. Discourses related to students' social and cultural backgrounds were also used. The term *discursive mobility* was used to describe students' ability to move between different discourses (Nygård Larsson, 2011).

RESULTS

The analysis showed that most of the 28 different code-switching situations were used to increase the understanding of the science subject content. The analysis also indicates that concretizing and relating the abstract subject content to the students' own experiences helps them understand abstract concepts and is therefore a resource in learning processes. In this translanguaging practice, the students often use code-switching between their first and second languages in their *linguistic loops* between different discourses.

Table 1 presents a conversation from the multilingual science classroom. The students were asked to work out what would happen if the sun was extinguished. One of the students, named Ali, had been in Sweden for about one year at the time of the study and had recently moved from an introductory class to the regular science lessons.

Table 1. A student conversation about the photosynthesis in a multilingual science classroom.

27	Yousef	I think we would have died / because we need to ...		Yousef formulates the text they are going to write
28	Furkan	.. Because we need / a tree / because a tree needs ..		
29	Yousef	Energy / Energy / and that's the sun / trees give us oxygen / we give them carbon dioxide		Yousef fills in and takes charge of the conversation.
30	Mariam	What are we going to write ..		Mariam is a student whose role in the group is to take notes.
31	Yousef	..Aha teacher, teacher, we wouldn't be able to breathe without the sun because the sun helps the trees / and the trees help us and we help the trees // that's why we would have died		The teacher passes their desk and Yousef seeks the teacher's attention to explain his conclusion.
32	Ali	If the sun wasn't there / could not breathe so well / why because we could not breathe well / because ..		Ali is eager and requires the teacher's attention.
33	Yousef	...I know		Yousef interrupts Ali.
34	Ali	Sss wesel! Waqef bes eshajer bins... (<i>we understand stop..only the trees..</i>)	وسس.. وصل وقف! بس الشجر بنس... الأشجار	Ali raises his voice and code-switches into Arabic.
35	Musa	...Are you going to collaborate with us or not		Musa interrupts Ali.

Yousef summarizes the group's discussion about the importance of sunlight for photosynthesis and the relationship between photosynthesis and cellular respiration (31). Yousef contextualizes the abstract subject content, the photosynthetic process, to an everyday discourse by using an everyday expressions when he says, "the sun helps the trees / and the

trees help us” (31). Yousef moves between the subject-specific discourse and the everyday discourse in linguistic loops. Even Ali tries to deepen the discussion about the importance of solar radiation (32) when he is interrupted. Yousef does not seem to understand (33) Ali’s attempt to expand the reasoning, which leads to Ali raising his voice and code-switching into Arabic (34). Ali is then interrupted by Musa, who questions whether Ali wants to work with the group (35). In this example, Ali tries to develop arguments about the subject content using his second language (32), but is probably not really able to do this yet. However, in the next example, Table 2, Ali uses translanguaging in the form of code-switching when he explains to the native language teacher what he knows about photosynthesis.

Table 2. A conversation about photosynthesis between a newly arrived student and an Arabic-speaking teacher.

36	Ali	ashams tabât lqowa liwaraq eshagar, asheâto shams todfie almae Tamtaso eshagara almae <i>(the sun sends power to the leaves on the trees/sunbeams /the water reaches the trees)</i>	الشمس تبعث القوة للورق الشجر, أشعة الشمس تدفئ الماء تمتص الشجرة الماء	Ali is eager and talks rapidly and gesticulates while he is speaking.
37	The Arabic-speaking teacher	men win btetlae? <i>(where does it come from?)</i>	يتأت ال امنأ شيح نم	The Arabic-speaking teacher asks Ali in Arabic.
38	Ali	min roo.. agza3 <i>(from roo... roots)</i>	والمي تطلع للشجرة من أج... أجذاع	Ali says first the Swedish word for roots but code-switches into Arabic.
39	The Arabic-speaking teacher	shatour <i>(good)</i>	شطور	
40	Ali	aw el ...carbon dioxide byetla^ ... <i>(or ...carbon dioxide that comes from...)</i>	أو ... التركيب الضوئي	Ali uses the Swedish word for carbon dioxide.
41	The Arabic-speaking teacher	...sho howa carbon dioxide <i>(...what is carbon dioxide)</i>	ثاني أكسيد الكربون	The Arabic teacher supports Ali with the Arabic word for carbon dioxide.
42	Ali	anna anna.. <i>(that that...)</i>	أن، أن	
43	The Arabic-speaking teacher	Tanioksid alkarboun <i>(carbon dioxide)</i>	ثاني أكسيد الكربون	The teacher pronounces the word very clearly.
44	Ali	Tanioksid alkarboun yaeti min assayarat wa min alensan <i>(carbon dioxide comes from the cars or from people)</i>	ثاني أكسيد الكربون يأتي من السيارات و من الأنسان	
45	Ali	Waqtama yetle^ oxygen we sockar, sockar bedal biqaklb eshajara we oxygen biyetla <i>(When it goes up oxygen and sugar // the sugar remains in the tree and oxygen goes out)</i>	وقتما يطلع (سيره) والسكر يظل بالشجرة... تطلع برا	Ali uses both his first and second languages.
46	The Arabic-speaking teacher	Very good Ali Oktob lan bilârabi (Very good Ali <i>you can now write it in Arabic</i>)	اكتب الآن هذا بالعربي	Ali looks satisfied and Furkan and Ali continue writing.

When Ali uses translanguaging and uses all his linguistic resources, he clearly demonstrates his understanding of the photosynthesis clearly. This can be compared with Ali's attempt to explain and expand the reasoning about the photosynthesis in his second language, shown in the previous example (32) (Table 1). It becomes clear that Ali's second-language development is still limited and he needs to use translanguaging by code-switching in order to explain his understanding and to develop a deeper understanding of photosynthesis. This result is consonant with that of García (2011), who finds that multilingual students used translanguaging to mediate understanding among each other, to co-construct meaning of what the other is saying, to construct meaning within themselves, and to demonstrate knowledge, among other things. Ali uses code-switching within his linguistic loops between discourses, which are an important condition to describe and develop new knowledge in the field. The analysis shows that newly arrived students' everyday experiences are often expressed using their first language. Here, for example, Ali uses Arabic to express "*the sun sends power*" (36) and "*goes out*" (45), in Arabic (Table 2). But when the students use more subject-specific words, such as carbon dioxide (40) and oxygen (45) (Table 2), they more commonly use their second language. This shows that newly arrived students and multilingual students not only switch between different modes of expressions and different use of language depending on discourse, but they also switch between their first and second languages in their linguistic loops between different discourses in science learning. The linguistic loops constitute a movement both between national languages and different discourses. On a more general level, it appears as though the students' ability to use all their linguistic resources – that is, their *discursive mobility* (Nygård Larsson, 2011) – expands. Linking the natural science subject content with the students' own experience is enabled through code-switching, which enables the students to contextualize subject content as a precondition for deeper understanding. In other words, the use of code-switching in a translanguaging practice facilitates the use of the available languages and helps increase students' communicative spectrum; this finding is supported in previous research (Creese & Blackledge, 2010; Gutiérrez, 2008).

DISCUSSION AND CONCLUSIONS

The purpose of this study was to explore the ways in which multilingual students use translanguaging in primary school, and how the findings can serve as a resource for newly arrived students' science learning. The study analyzed whether and how switching between languages and different modes of expression constitutes a resource when it comes to developing a deeper understanding for the topic, and the related subject-specific language. The study investigates how students are able to use both their first and second languages in communicative science situations as a resource for learning, and how this option affects students' discursive mobility (Nygård Larsson, 2011).

The National Agency for Education (2010) finds that newly arrived students are not often given the opportunity to relate linguistic expressions in their first and second languages to each other, which impedes language development in both languages. Hajer and Meestringa (2014) also note the risk that the teachers at schools where the majority of students have a first language other than Swedish tend to lower their expectations of their students, which leads to the science teaching being adapted to the students' linguistic abilities in the second language. Subject-specific language in natural science is particularly problematic. However, the later

years of research in science education indicate that a linguistic movement between everyday use of language and a more scientific use of language promotes students' learning in science subjects (Ash, 2008; Brown & Ryoo, 2008; Brown & Spang, 2008; Olander, 2010; Varelas et al., 2006). The question is how to create the same opportunities for newly arrived students, and what happens if these students are able to use both of their language resources in learning.

The present study reveals that multilingual students use translanguaging in the form of code-switching as resource in science instruction contexts. Most of the 28 code-switching situations were used in order to increase understanding of the natural science subject content. The analysis also indicates that the students' *discursive mobility* increased when they use both their first and second languages. This, in turn, led to an increased ability for the students to contextualize the abstract science subject content to their own everyday experiences. In everyday discourse, the students more often use their first language; for example, "**sends power**" (36) and "**goes out**" (45) (Table 2). However, when the students use more subject-specific words, such as carbon dioxide (40) and oxygen (45) (Table 2), they more often use their second language. This means that the newly arrived students and other multilingual students not only use translanguaging by code-switching between different modes of expressions and different registers, but they also code-switch between their first and second languages in science learning. There are two forms of code-switching in these students' linguistic loops between the discourses. In this way, the ability to use code-switching extends the students' communicative spectrum. This becomes clear in the comparison of Ali's communicative ability when he only uses his second language – "If the sun wasn't there / could not breathe so well / why because we could not breathe well / because .." (32) (Table 1) – with his communicative ability, when he uses all his linguistic resources by code-switching between his first and second languages – "**When it goes up oxygen and sugar // the sugar remains in the tree and oxygen goes out**" (45) (Table 2).

The students' opportunity to use all their linguistic resources in a translanguaging practice is also an important prerequisite for them to participate fully in exploratory conversations and dialogical negotiations about the subject content. Jakobsson, Mäkitalo and Säljö (2009) argue that the use of scientific concepts, and their definition and delimitation, is "internalized" by a gradual appropriation in dialogical negotiation processes. Those authors show how a gradual appropriation of subject knowledge and subject-specific language occurs in communicative situations between students. The translanguaging pedagogy is transformative and also develops *sociocritical literacy* among students (Gutiérrez, 2008). Gutiérrez (2008) shows how the repertoires of practice among youth multilinguals expanded when they are allowed to use "hybrid" language, and he argues that this expanded linguistic space is a precondition for a critical pedagogy. In this way, translanguaging critical pedagogy develops a higher degree of linguistic and social awareness, and therefore becomes a medium for social justice and a tool for multilingual students in science education, especially when it involves *socioscientific issues*. A translanguaging pedagogy emphasizes all students' experiences and strives to provide students who have diverse "luggage" and linguistically, socially, and educationally different backgrounds, with differentiating instructions to ensure that all students will be challenged.

Although code-switching occurs as a pragmatic resource in every multilingual context, it is not endorsed or pedagogically underpinned to use code-switching as a linguistic resource in education (Blackledge & Creese, 2010). Lemke (2003) questioned whether it is more important to obey dominant and ideological pressures to keep languages pure and separate, or to develop current pedagogical methods so they also accommodate multilingual students.

Gumperz and Cook-Gumperz (2005) responded that the language cannot be kept separate as the bilingual students need to have interactive spaces in which they are allowed to use all linguistic resources. The students' use of their entire linguistic repertoire, derived from different discourses, is important for all bilingual students, particularly for the development of critical thinking skills and in-depth comprehension (García & Wei, 2014).

Important implications to the results of this study include the fact that newly arrived students, who had started their schooling and developed a basic knowledge of science in their home country, had the opportunity to continue their knowledge development in a language that makes this possible. These students' science learning benefits from *dynamic multilingualism* (García & Wei, 2014) in education. This is a model for learning and teaching with multiple language interactions and other linguistic interrelationships, in which the participants use the full repertoire of their complex resources as part of the meaning-making process. Creating an expanded continuity between previous education, language development in both languages, and subject-specific teaching, leads to improved achievement for these students. Science instruction situations that allow and encourage different use of language and modes of expressions can be an important tool in this development.

REFERENCES

- Appel, R., & Muysken, P. (2005). *Language, contact and bilingualism*. Amsterdam: Amsterdam Academic Archive.
- Ash, D. (2008). Thematic continuities: Talking and thinking about adaptation in a socially complex classroom. *Journal of Research in Science Teaching*, 45(1), 1–30.
- Bakhtin, M. (1981). *The dialogic imagination: Four essays*. Austin: University of Texas Press.
- Bhabha, H. K. (1994). *The location of culture*. New York and London: Routledge.
- Blackledge, A., & Creese, A. (2010). *Multilingualism: A critical perspective*. London: Continuum.
- Brown, B. A., & Ryoo, K. (2008). Teaching science as a language: A “content-first” approach to science teaching. *Journal of Research in Science Teaching*, 45(5), 529–553.
- Brown, B. A., & Spang, E. (2008). Double talk: Synthesizing everyday and science language in the classroom. *Science Education*, 92(4), 708–732.
- Canagarajah, S. (2007). The Ecology of Global English. *International Multilingual Research Journal*, 1(2), 89–100.
- Collier, V. P., & Thomas, W. P. (1999). Making US Schools Effective for English Language Learners, part 1. *TESOL Matters*, 9(4), 1.
- Creese, A., & Blackledge, A. (2010). Translanguaging in the bilingual classroom: A pedagogy for learning and teaching? *The Modern Language Journal*, 94(1), 103–115.
- Creese, A., & Martin, P. (2003). Multilingual Classroom Ecologies: Inter-relationships, Interactions and Ideologies. *International Journal of Bilingual Education and Bilingualism*, 6(3–4), 161–167.
- Cromdal, J. (2000). *Code-switching for all practical purposes: Bilingual organization of children's play* (Doctoral dissertation). Linköpings universitet, Filosofiska fakulteten, Institutionen för tema, Tema barn.
- Cummins, J. (1979). "Cognitive/Academic Language Proficiency, Linguistic Interdependence, the Optimum Age Question, and Some Other Matters", *Working Papers on Bilingualism*, 19, 121–129.

- Cummins, J. (2000). *Language, power, and pedagogy: Bilingual children in the crossfire*. Clevedon: Multilingual Matters.
- Dewey, J. (1902). *The child and the curriculum*. Chicago: The University of Chicago Press.
- Engeström, Y., & Middleton, D. (1998). *Cognition and communication at work*. Cambridge: Cambridge University Press.
- García, O., & Kano, N. (2014). Translanguaging as process and pedagogy: Developing the English writing of Japanese students in the US. In J. Conteh, & G. Meier (Eds.), *The multilingual turn in languages education: Benefits for individuals and societies* (pp. 258–277). Clevedon, UK: Multilingual Matters.
- García, O. (2011). Translanguaging of latino kindergarteners. In K. Potowski, & J. Rothman (Eds.), *Bilingual youth: Spanish in English-speaking societies* (pp. 33–55). Amsterdam: John Benjamins Publishing.
- García, O., & Wei, L. (2014). *Translanguaging: Language, bilingualism and education*. Basingstoke: Palgrave Macmillan.
- Gibbons, P. (2008). "It was taught good and I learned a lot": Intellectual practices and ESL learners in the middle years. *Australian Journal of Language and Literacy*, 31(2), 155.
- Gomez, K. (2007). Negotiating discourses: Sixth-grade students' use of multiple science discourses during a science fair presentation. *Linguistics and Education*, 18(1), 41–64.
- Gumperz, J. J. (1967). On the linguistic markers of bilingual communication. *Journal of Social Issues*, 23(2), 48–57.
- Gumperz, J. J. (1982). *Discourse strategies*. Cambridge: Cambridge University Press.
- Gumperz, J. J., & Cook-Gumperz, J. (2005). Making space for bilingual communicative practice. *Intercultural Pragmatics*, 2(1), 1–23.
- Gutiérrez, K. (2008). Developing a sociocritical literacy in the third space. *Reading Research Quarterly*, 43(2), 148–164.
- Gutiérrez, K., Baquedano-Lopez, P., & Alvarez, H. (2001). Literacy as hybridity: Moving beyond bilingualism in urban classroom. In Reyes, Maria de la Luz, & J. J. Halcon (Eds.), *The best for our children: Critical perspectives on literacy for latino students. language and literacy series*. (pp. 122–141). New York: Teacher College Press.
- Hajer, M., & Meestringa, T. (2014). *Språkinriktad undervisning: En handbok* (Ny uppl. ed.). Stockholm: Hallgren & Fallgren.
- Halliday, M. (1998). Things and realtions. regrammaticising experience as technical knowledge. In J. R. Martin, & R. Veel (Eds.), *Reading science: Critical and functional perspective on discourses of science* (pp. 185–235). London: Routledge.
- Halliday, M., & Matthiessen, C. (2004). *An introduction to functional grammar* (Third ed.). London: Hodder Arnold.
- Higgins, C. (2009). *English as a local language: Post-colonial identities and multilingual practices*. Bristol, UK: Multilingual Matters.
- Jakobsson, A. (2012). Sociokulturella perspektiv på lärande och utveckling: Lärande som begreppsmässig precisering och koordinering. *Pedagogisk Forskning I Sverige*, 17(3–4), 152–170.
- Jakobsson, A., Mäkitalo, Å, & Säljö, R. (2009). Conceptions of knowledge in research on students' understanding of the greenhouse effect: Methodological positions and their consequences for representations of knowing. *Science Education*, 93(6), 978–995.
- Jørgensen, J. N. (2008). Polylingual languaging around and among children and adolescents. *International Journal of Multilingualism*, 5(3), 161–176.
- Jørgensen, J. N. (2004). Languaging and language. *Koebenhavnerstudier i Tosprogethed*, 36, 5–23.
- Kibler, A. (2010). Writing through two languages: First language expertise in a language minority classroom. *Journal of Second Language Writing*, 19(3), 121–142.

- Lemke, J. (1990). *Talking science: Language, learning, and values*. Connecticut: Ablex Publishing.
- Lemke, J. (2003). Language development and identity: Multiple timescales in the social ecology of learning. In C. Kramsch (Ed.), *Language acquisition and language socialization: Ecological perspectives* (pp. 68–87). London: Continuum.
- Lewis, G., Jones, B., & Baker, C. (2012). Translanguaging: Developing its conceptualisation and contextualisation. *Educational Research and Evaluation*, 18(7), 655–670.
- Martin, J. R., & Veel, R. (1998). In Martin J. R., Veel R. (Eds.), *Reading science: Critical and functional perspectives on discourses of science*. London: Routledge.
- Martin, P. W. (2005). "Safe" Language Practices in Two Rural Schools in Malaysia: Tensions between Policy and Practice. In A. M. Lin, & P. W. Martin (Eds.), *Decolonisation, Globalisation: Language-in-Education Policy and Practice* (pp. 74–97). Clevedon, UK: Multilingual Matters.
- Myers-Scotton, C. (1993). *Dueling languages: Grammatical structure in codeswitching*. Oxford: Oxford University Press.
- Nygård Larsson, P. (2011). *Biologiämnets texter: Text, språk och lärande i en språkligt heterogen gymnasieklass* (Doctoral dissertation). Malmö högskola, Lärarutbildningen.
- Olander, C. (2010). *Towards an interlanguage of biological evolution: Exploring students' talk and writing as an arena for sense-making* (Doctoral dissertation). Göteborgs universitet, Utbildningsvetenskapliga fakulteten.
- Park, H. (2004). Kodväxling som fenomen—exemplet svenska-koreanska. In K. Hyltenstam, & I. Lindberg (Eds.), *Svenska som andraspråk: I forskning, undervisning och samhälle* (pp. 297–325). Lund: Studentlitteratur.
- Rampton, B. (2014). *Crossings: Language and ethnicity among adolescents* (second edition). London: Routledge.
- Rose, D., & Martin, J. R. (2012). *Learning to write, reading to learn: Genre, knowledge and pedagogy in the Sydney school*. Sheffield: Equinox.
- Skolinspektionen. (2010). *Språk- och kunskapsutveckling: För barn och elever med annat modersmål än svenska*. Stockholm: Skolinspektionen.
- Soja, E. W. (1996). *Thirdspace: Journeys to Los Angeles and other real-and-imagined places*. Oxford: Blackwell.
- Säljö, R. (2010). *Lärande och kulturella redskap: Om lärprocesser och det kollektiva minnet* (2. uppl. ed.). Stockholm: Norstedt.
- Thomas, W. P., & Collier, V. P. (1997). *School Effectiveness for Language Minority Students*. Washington: Washington NCBE Resource Collection Series 9.
- Varelas, M., Pappas, C. C., & Rife, A. (2006). Exploring the role of intertextuality in concept construction: Urban second graders make sense of evaporation, boiling, and condensation. *Journal of Research in Science Teaching*, 43(7), 637–666.
- Wei, L. (2011). Moment analysis and translanguaging space: Discursive construction of identities by multilingual chinese youth in Britain. *Journal of Pragmatics*, 43(5), 1222–1235.
- Weinreich, U. (1953/1974). *Language in contact, findings and problems*. The Hague: Mouton.
- Wells, G. (1999). Language and education: Reconceptualizing education as dialogue. *Annual Review of Applied Linguistics*, 19, 135–155.