

The Social Organization of Mathematics Classrooms and English Language Learners'
Opportunities to Participate

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Abstract

In this paper, I discuss the significance of classroom organization in English Language Learners' (ELLs) opportunities to participate in mathematics classrooms through a review of relevant contemporary literature. In particular, I will focus on the following areas of classroom organization: language organization, instructional organization, and discourse organization. By highlighting the relationship between classroom organization and English language learners' opportunities to participate in the mathematics classroom, I will provide insight into when and under which contexts ELLs are acknowledged (or not) with their existing resources.

Introduction

High population mobility in recent years has caused an increase in the number of students whose first language is not the language of instruction in schools, especially in urban cities. For example, in Toronto, the largest urban city in Canada, 47 % of the population has a mother tongue other than one of the official languages, English and French (City of Toronto, n.d.). In this increasingly multilingual school context, ensuring ELLs' access both to English language development as well as grade-level content knowledge has been acknowledged as one of the most significant pedagogical issues (Mohan, Leung, & Davison, 2001; Snow, Met, & Genesee, 1989). As Cummins (2000) has discussed, academic language is a specific genre of language used in the school domain and can be different from other genres of language, such as everyday conversational language. ELLs continue to learn the specific genre of academic language even after completing English as a Second Language (ESL) courses (Thomas & Collier, 2002). Given that ELLs will not acquire academic language by merely being exposed to English instruction, providing pedagogical opportunities for ELLs is essential for developing ELLs' academic language in content classrooms. I use the term ELLs to refer to the students who require focused educational support to attain English proficiency (Ontario Ministry of Education, 2007).

In mathematics education, recent educational reform proposes that every student, including ELLs, should have access to high-quality, engaging instruction (National Council of Teachers of Mathematics, 2000). Rather than separating ELLs from mainstream classrooms or instructing them with less demanding mathematics courses, it is considered more equitable to design curricula which would enable ELLs to develop their academic English while receiving high-quality mathematics instruction (Wang & Goldschmidt, 1999). In the province of Ontario, for example, curriculum supporting documents meant to ensure ELLs' access to mathematics learning have begun to be published (Ontario Ministry of Education, 2005). However, because there is a myth that mathematics is a "language-free" subject, less classroom research has been conducted on how language mediates ELLs' access to mathematics content, compared to other subjects (Barwell, 2005; R. Gutiérrez, 2002; Janzen, 2008).

Despite this myth, previous research has demonstrated both intrinsic (i.e., connection between bilingualism and mathematics cognition) and extrinsic (i.e., aspects of culture influencing the development of mathematics cognition) effects of students' linguistic backgrounds on mathematics achievement (Clarkson, 2007; Moschkovich, 2007c; Saxe, 1988). Moreover, language plays a significant role in mathematics classrooms because mathematics knowledge is mostly conveyed through oral language (Veel, 1999). Students participate in a wide range of oral and

written language communication including explaining solution processes, describing conjectures, and presenting their arguments and conclusions to their peers (Moschkovich, 2007a; Zevenbergen, 2000). Therefore, more studies are needed to examine learning opportunities available to ELLs in mathematics classrooms.

How does an ELL experience learning in mainstream, English medium classrooms in North America? My own experience as an ELL, who is participating in academic practices in North America, is echoed through the following story by a Japanese ELL in a Toronto secondary school:

[in a non-ESL class], [y]ou understand the content of the class, but when you have to find a partner and work on a group project, you can't get into a group. (...) You feel like you're gonna be a burden on them. (Kanno & Applebaum, 1995, p. 40).

This story reveals that ELLs can experience difficulty in accessing opportunities to learn, depending on the social context of the classroom.

In this paper, I review empirical research on content classrooms, not limited to, but focusing on mathematics classrooms, by examining organization of classroom-specific activities that are believed to affect ELLs' opportunities to participate. I limit the scope of the review to the micro-interactional dimension of classrooms—and exclude the policy and macro educational system dimensions—in order to highlight teachers' and learners' creation and modification of classroom contexts.

Sociocultural Approaches to Learning, Development and Identity

In this review, I draw on the sociocultural theory of learning, development and identity. Vygotsky (1978) criticized stage theories of development, which conceptualized natural cognitive maturation or development as a precondition for teaching/learning. Stage theorists assert that instruction cannot precede the learners' stage of development and implies that those who have not successfully completed the preceding stages cannot move ahead developmentally to subsequent stages. Instead, Vygotsky claimed that learning does not happen in a vacuum, and it is not merely the result of natural maturation. Through an emphasis on the role of instruction in a learner's future development, Vygotsky proposed the notion of the *Zone of Proximal Development (ZPD)*, which he defined as “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (p. 86). This notion of ZPD suggested that learners could open up to a wider range of potential development if the appropriate environment was organized.

By further advancing the theory of socially organized learning, Lave and Wenger (1991) developed the theory of situated learning and legitimate peripheral participation. From this perspective, mastery of knowledge and skill is considered to be full participation in the socioculturally organized practices of a community. Theorizing learning through the metaphor of participation, Lave and Wenger shed light on the interconnection between learning and the learner's identity. On one level, this means that learning the academic language of mathematics in a particular classroom amounts to the process of changing one's identity through participation in the community where language is used meaningfully. For example, students gradually come to talk or write like a mathematician, while participating in the social and historical communities that use mathematical vocabulary as well as value practices such as abstracting, generalizing, and making precise statements (Pimm, 1987). Thus, learning a language is similar to acquiring how to use a tool, and this process requires a learner to enter specific social and historical practices in order to meaningfully make use of that tool (Brown, Collins, & Duguid, 1989).

On another level, learners' social identities can work as gatekeepers for access to knowledge and sociocultural practices (Esmonde, 2009; Nasir, 2007; Toohey, 2000). For example, in the classroom, the socially-constructed identity as an English language learner can result in having access to fewer opportunities to interact with native English speakers due to the social arrangement of the classroom, such as the organization of desks, when ELLs are clustered together (e.g., Toohey, 2000). Thus, learning cannot be separated from how socially-constructed identities play out in the classroom.

Literature Review on the Social Organization of Mathematics Classroom and ELLs' Participation

In this section, drawing from the focus of sociocultural theory on social organization of classroom and learners' participation, I examine three facets of social organization which influence ELLs' participation in content classrooms: (a) language organization, (b) instructional organization, and (c) discourse organization. I first define each term, and then review factors which are thought to be influential for ELLs' access to opportunities to learn in the mathematics classroom.

Overall, regarding ELLs' participation in social practices of content classrooms, previous research has pointed out that ELLs have limited opportunities to interact in English compared to ESL classrooms in both elementary (Iddings, 2005; Toohey, 2000) and secondary (Duff, 2001; Harklau, 2000) content classrooms. However, according to the sociocultural theory of learning, ELLs' participation can be changed depending on the organization of the classroom. As follows, I will review previous research on how ELLs' participation in classroom learning can change depending on the social organization of classrooms.

Language Organization

Under the category of language organization, I examine the literature that highlights instances in which ELLs are allowed or discouraged from using their first language (L1) in content instructions. As Cummins (2007) discussed, when multilingual students' L1 is used as a cognitive and linguistic resource, it can promote students' performance in their second language as well as their identities as competent academic language users. In mathematics educational research, the implications of students' L1 use to ELLs' participation in academic practices have been examined from the perspective of (a) accessing students' existing knowledge of mathematics in their L1 (Enyedy et al., 2008; Moschkovich, 2007a), (b) creating solidarity in the classrooms (Khisty, 1995; Setati, 2005), and (c) enhancing problem solving skills (Clarkson, 2007; Moschkovich, 2007c). This research suggests that if ELLs can use their L1 to demonstrate their existing mathematics knowledge as well as their everyday knowledge, this can promote their participation in mathematics discourse practices. In Moschkovich's (2007a) study, Spanish-English bilingual learners presented their knowledge of mathematics and everyday experiences in Spanish through group work. By highlighting bilingual learners' resources, including their L1, there was more focus on their competencies to communicate mathematically and less focus on the limitations of their target language acquisition.

Much of the research published in mathematics education examining ELLs has been conducted in classrooms where the majority of students were Latino/a, Spanish-English bilingual (e.g., Khisty & Chval, 2002; Moschkovich, 2007a). In the classrooms where students of various L1 backgrounds participate, there is an additional layer of complexity for students' L1 use, compared to classrooms where almost all ELLs share a common L1. For instance, Enyedy et al. (2008) conducted a study in a secondary multilingual mathematics classroom comprised of Spanish-speaking students and African American students who did not speak Spanish. The teacher was concerned not to marginalize the participation of these African American students when conversations were held in Spanish. Thus, multilingual classrooms add complexity to ELLs' L1 use especially in terms of providing equal opportunities to learn for all the students in the classroom.

The practice in multilingual classroom raises many questions, such as: How can teachers create multilingual environments under the assumption that English is the norm within the context of a broader educational system? Regarding this issue, research has shown that teachers' non-essentialized views of learners can lead to effective pedagogical and linguistic organization of the classroom, even when teachers do not share ethnic and linguistic backgrounds with the students (R. Gutiérrez, 2002). In the high school where teachers believed that all students should have access to advanced level of content knowledge, Gutiérrez has shown how Spanish and English bilingual practices were promoted and helped to support mathematical meaning making. Research examining ELLs' opportunity to learn in multilingual classrooms is still limited and therefore further empirical research in this area is necessary to understand the additional complexities in multilingual classroom settings.

Instructional Organization

In this section, I review research that addresses the role of types of tasks and groupings on ELLs' participation in content classrooms. I focus on tasks and groupings because previous studies have indicated that these two aspects of instructional organization influence students' opportunities to learn content and language as well as their identity development.

Types of Tasks

Research on tasks suggests that ELLs' participation is influenced by: (a) visibility of hierarchy in ability and competence, (b) types of tasks, and (c) relevance of tasks to students' backgrounds. Learners' interaction during their engagement with tasks includes attention to both linguistic forms and content knowledge (Barwell, 2003; Swain, 2001). For example, by examining the discourse in mathematics pair work including ELLs, Barwell (2003) identified three patterns of attention during word problem writing: attention to narrative experiences, to the genre of word problems, and to the mathematical structure of their problems.

Ethnographic research on tasks has suggested that ELLs are often assigned less academically demanding tasks because their language proficiency is still developing (Iddings, 2005; Moll, Estrada, Diaz, & Lopes, 1980). Ethnographic investigation of tasks has also identified the way in which tasks can influence ELLs' identities. For example, Daisey and Jose-Kampfner (2002) conducted a project aiming to expand the range of students' future professional role models. Set in a school where all students were immigrants from Puerto Rico or Mexico, they combined mathematics instruction (i.e., data analysis and statistics) with writing and story telling about successful Latina mathematicians and engineers. This research showed that task organization can offer students a wider range of options in terms of imagining their future identities. Ethnographic studies on tasks are still limited and further research of this type would offer significant insights into how tasks can be embedded in broader classroom pedagogy or what these tasks mean to students' participation in social and historical practices in the classroom.

Grouping

Research on grouping has proposed that the following factors can influence ELLs' participation in academic practices in the classroom: (a) ELLs' status in the classroom, (b) perceived language proficiency, and (c) various aspects of socially-constructed identities (such as gender and race). As one pedagogical strategy to enhance academic and social integration in heterogeneous classrooms, researchers have proposed group work and cooperative learning (e.g., Slavin & Cooper, 1999). While previous research implies that group work can be effective for content classrooms where ELLs are involved (e.g., Dalton-Puffer, 2007; R. Gutiérrez, 2002), relatively little empirical research has been conducted to investigate how ELLs participate in mathematics group work. The findings from the following research on ELLs' participation in group work are not necessarily obtained from mathematics classrooms; however, I believe these findings warrant further investigation of the mathematics classroom contexts where group work is often used.

In secondary social studies classrooms, Bunch, Abram, Lotan, and Valdés (2001) implemented pedagogical intervention based on Complex Instruction (CI) in a California school, where the majority of the students were Latino/a and more than half of the students were classified as ELLs. CI encourages practices such as respecting multiple abilities, assigning group-worthy open-ended tasks, role distribution, and being explicit about students' responsibility (Cohen, Lotan, Scarloss, & Arellano, 1999; Lotan, 2007). Lotan (2007) used multiple-choice pretests and posttests to show that ELLs who experienced CI made academic progress, and used essays written after each unit to show that they also made language progress. Bunch's (2006) empirical study found that ELLs who were limited in academic proficiency accessed the advanced curriculum in group work settings under CI.

Ethnographic studies have provided insights into how various dimensions of ELLs' identities support or hinder participation in group work and access to academic and linguistic resources (Hunter, 1997; Willett, 1995). In a year-long study in a Grade 1 classroom, Willett (1995) investigated four ELLs (three female and one male) and showed that female ELLs were allowed to sit together and as a result were able to demonstrate their competence to the teacher. In contrast, the male student was grouped with two English speaking female students and had limited access to academic help. This type of study suggests important relationships between grouping, ELLs' identities, and their access to academic and linguistic resources.

Further empirical research is crucial to better understand how ELLs participate in group work. For example, there is little research on how group compositions (i.e., racial, linguistic, and academic heterogeneity) affect ELLs' participation and learning achievement in mathematics classrooms (Leonard, 2001). This direction of research is important given that one's opportunity to learn during group work is influenced by the context of group work (Esmonde, 2009).

Discourse Organization

Discourse is a useful analytical tool to examine what kinds of interactions are afforded in a given environment and hence what types of participation become available. The term "discourse," is defined differently depending on the field of inquiry; for the current review, I use the term, *discourse* to refer to patterns of language use and language forms characteristic of the content classroom (Dalton-Puffer, 2007). I also use the term, discourse, by extending its meaning to "Discourse" with a capital "D" (Gee, 2005, p. 33), which highlights the fact that linguistic information is only a part of meaning making in classroom interaction and also affects how socially-constructed identities (i.e., gender, class, race) are connected with particular discourses. For instance, Lubienski (2007) showed how students' socioeconomic status (SES) could shape students' responses to open-ended mathematics discussions. Higher SES students tended to perceive open-ended discussions as the opportunity to be exposed to various mathematics ideas and participate in analyzing mathematics ideas. In contrast, lower SES students tended to think of their roles as obtaining or giving right answers even during discussions. Most of the lower SES students preferred a more teacher-directed approach, where they could reach the right answers more quickly. As seen in this research, discourse is not only limited to language but also includes ways of thinking, feeling, knowing, and believing, which are all connected with socially-constructed identity.

In content classrooms, researchers of second language acquisition have focused on the fact that ELLs receive minimum explicit second language instructions or modified input in content classrooms (Pica, 2002; Short, 2002). However, given that language serves as a tool for mathematics practices in the classroom, it is impossible to clearly separate second language and mathematics language. Researchers focusing on mathematics academic language practices have shown that teachers' modifications of discourse enhanced ELLs' level of participation in mathematics classrooms (Enyedy et al., 2008; Khisty, 1995; Khisty & Chval, 2002; Moschkovich, 2007b; Wong-Fillmore, 2007). For example, in Spanish-English bilingual Grade 2 math classrooms, Khisty (1995) highlighted teacher's consistent and explicit mathematics language instruction to draw ELL students' attention to key mathematics vocabulary. A subsequent study conducted in Spanish-English bilingual Grade 5 math classrooms confirmed students' improvement in the fluency of their mathematics talk in the classroom and was attributed to teachers' use of explicit mathematics language instruction (Khisty & Chval, 2002).

Explicit instruction regarding mathematics language is important, but can be risky if there is too much focus on it. The risks include positioning ELLs as inferior or hindering ELLs' participation in mathematics discussions (Adler, 1999; Moschkovich, 2007a). Instead of merely focusing on mathematics vocabulary instruction, Moschkovich showed that teachers can enhance ELLs' participation in mathematics discourse by teaching strategies such as establishing and modeling consistent norms for discussions, rephrasing student contributions, building on what students said, and probing what students meant. Through these discourse strategies, teachers in her study effectively built on ELLs' resources, including their first languages and gestures, to facilitate learners' participation in mathematics discourse.

Summary

In the discussion above, I have provided a review of the literature on how language, instructional, and discourse organizations can influence ELLs' access to opportunities to learn academic language in mathematics/content classrooms. Overall, there is still limited research that theorizes learning as one's changing participation in sociocultural practices. The participation model is important for an ecologically valid account of learning (Cole, 1996). While the classroom is a dynamic and multidimensional place, there has been limited research examining opportunities to learn across multiple classroom contexts (e.g., Esmonde, 2009; Goldman & McDermott, 2007). Comparative investigation across contexts is important for examining learning trajectories across multiple communities of practice, in which one is participating (K. Gutiérrez & Rogoff, 2003). For example, ELLs

marginalized in one community of practice dominated by native English speakers can participate in a parallel community where ELLs can draw on their repertoires of practices (Iddings, 2005).

Educational Implications

Mathematics plays a gate-keeping role in students' academic careers and is treated as a significant indicator of learning achievement, even from earlier stages of students' school lives. For example, in the province of Ontario, Canada, students are required to write standardized mathematics assessments (Grades 3, 6, and 9) in addition to literacy assessments (i.e., English reading and writing). Thus, making mathematics learning accessible to all students, including ELLs, is a significant pedagogical issue. As previously mentioned, there is still a belief that mathematics is a language free subject and therefore it is surmised that there continues to be a limited amount of research on ELLs' mathematics learning. Teachers and educational stakeholders will benefit from further research examining ELLs' learning trajectories in mathematics classrooms.

In this review, by emphasizing the relationship between social organization and ELLs' learning, I suggest that researchers can challenge the deficit view of ELLs, which perceives a particular cultural group being beneath a dominant group (K. Gutiérrez & Orellana, 2006). By closely examining the social organization of classrooms, we can highlight when and in which contexts ELLs' existing resources are acknowledged, including their L1s. Thus, further investigation of the social organization of classrooms can aid in creating pedagogical opportunities to foster ELLs' content learning.

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