



Academic literacy in mathematics for English Learners



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ABSTRACT

This paper uses a sociocultural conceptual framework to provide an integrated view of academic literacy in mathematics for English Learners. The proposed definition of academic literacy in mathematics includes three integrated components: mathematical proficiency, mathematical practices, and mathematical discourse. The paper uses an analysis of a classroom discussion to illustrate how the three components of academic literacy in mathematics are intertwined, how academic literacy in mathematics is situated, and how participants engaged in academic literacy in mathematics use hybrid resources. The paper closes by describing the implications of this integrated view of academic literacy in mathematics for mathematics instruction for English Learners, arguing that it is important that the three components not be separated when designing instruction in general, and it is essential that mathematics instruction for English Learners address these three components simultaneously.

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This paper uses a sociocultural conceptual framework to provide an integrated view of academic literacy in mathematics for English Learners.¹ The proposed definition of academic literacy in mathematics includes three integrated components: mathematical proficiency, mathematical practices, and mathematical discourse. The paper uses an analysis of a classroom discussion and questions adapted from Gee's (1999) questions for Discourse analysis, to illustrate how the three components of academic literacy in mathematics are intertwined, how academic literacy in mathematics is situated, and how participants engaged in academic literacy in mathematics use hybrid resources. The paper closes by describing the implications of this integrated view of academic literacy in mathematics for mathematics instruction, arguing that although these three components are important for all mathematics learners, it is essential that mathematics instruction for ELs include and maintain a simultaneous focus on all three components.

The view of academic literacy in mathematics presented here is different than previous approaches to academic language in several ways. First, the definition includes not only cognitive aspects of mathematical activity—such as mathematical reasoning, thinking, concepts, and metacognition—but also sociocultural aspects—participation in mathematical practices—and discursive aspects—participation in mathematical discourse. A sociocultural perspective of academic literacy in mathematics provides a complex view of mathematical proficiency as participation in discipline-based practices that involve conceptual understanding and mathematical discourse.² Most importantly for ELs, this integrated view, rather than separating

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¹ Although there are many labels used to refer to students who are learning English, I will use the term English Learners, abbreviated as ELs. Research on ELs may also be relevant to bilingual or multilingual mathematics learners, and to students learning a language of instruction other than English.

² The sociocultural perspective of academic literacy in mathematics described here builds on previous work that appeared in several publications where I described a sociocultural view of mathematics learners who are bilingual and/or learning English (Moschkovich, 2002a, 2007b), of mathematical discourse (Moschkovich, 2007c), and of mathematical practices (Moschkovich, 2013a, 2013b). In other publications (Moschkovich, 2008, 2009) I described

academic language from mathematical proficiency or practices, views the three components as working in unison. Separating language from mathematical thinking and practices can have dire consequences for English Learners. First, such a separation can make ELs seem more deficient than they might actually be, since they may not be able to express their mathematical ideas through language, but may still be engaged in correct mathematical thinking and participate in mathematical practices that are less language intensive, for example using objects or drawings to show a result, finding regularity in data, or using gestures to illustrate a mathematical concept.

The sociocultural perspective used here expands academic literacy in mathematics beyond simplified views of language as words. Simplified views of academic language focus on words, assume that meanings are static and given by definitions, separate language from mathematical knowledge and practices, and limit mathematical discourse to formal language. In contrast, the view of academic literacy in mathematics proposed here sees meanings for academic mathematical language as socioculturally situated in mathematical practices and the classroom setting. A complex view of mathematical discourse also means that mathematical discourse draws on hybrid resources and involves not only oral and written text, but also multiple modes, representations (gestures, objects, drawings, tables, graphs, symbols, etc.), and registers (school mathematical language, home languages and the everyday register).

One might assume that English Learners cannot participate in academic literacy in mathematics as defined above because they do not know mathematical vocabulary or they need to learn English first. However, research has documented that ELs can, in fact, participate in mathematical discussions as they are learning English. Research shows that English Learners, even as they are learning English, can participate in discussions where they grapple with important mathematical content³ and participate in mathematical practices. Instruction for this population should not emphasize low-level language skills over opportunities to actively communicate about mathematical ideas. One of the goals of mathematics instruction for students who are learning English should be to support all students, regardless of their proficiency in English, in participating in discussions that focus on important mathematical concepts and engage students in mathematical practices, rather than on low-level linguistic skills. By learning to recognize how English Learners actively use academic literacy in mathematics, teachers can provide opportunities for ELs to participate in all three components of academic literacy in mathematics in integrated ways.

If we want students who are learning English to participate in academic literacy in mathematics as defined here, then we first need to use mathematical tasks that will provide opportunities for students to engage in the full spectrum of mathematical proficiency, in mathematical practices, and in mathematical discourse. For students to participate in academic literacy in mathematics, we need to select tasks that require more than using numbers, computation, or symbol manipulation and organize classroom instruction so that students actively use mathematical concepts and show their conceptual understanding through explaining and justifying.

If students are participating in academic literacy in mathematics as defined here, then we see or hear them engaged in the full spectrum of mathematical proficiency, as they participate in mathematical practices, many of which are discursive. If students are participating in academic literacy in mathematics, we see or hear them actively using concepts and showing their conceptual understanding through explaining and justifying. Since mathematical discourse is multimodal and multi-semiotic (O'Halloran, 1999), opportunities for academic literacy in mathematics include multiple modes of communication, sign systems, and types of inscriptions.

The sociocultural theoretical framework draws on situated perspectives of learning mathematics (Brown, Collins, & Duguid, 1989; Greeno, 1998) as a discursive activity (Forman, 1996) that involves participating in a community of practice (Forman, 1996; Lave & Wenger, 1991; Nasir, 2002), developing classroom socio-mathematical norms (Cobb, Wood, & Yackel, 1993), and using multiple material, linguistic, and social resources (Greeno, 1998). Mathematical activity thus involves not only mathematical knowledge, but also mathematical practices and discourse.

Beyond the assumption that mathematical activity is simultaneously cognitive, social, and cultural, a sociocultural perspective brings two other assumptions to a definition of academic literacy in mathematics. First, the focus is on the potential for progress in what learners say and do, not on learner deficiencies or misconceptions. Second, participants bring multiple perspectives to a situation, representations and utterances have multiple meanings for participants, meanings for words are situated and constructed while participating in practices, and multiple meanings are negotiated through interaction.

Shifting from a simplified view of academic language as words to a view of academic literacy in mathematics that integrates mathematical proficiency and practices is crucial for the education of ELs. Research and policy have repeatedly, clearly, and strongly called for mathematics instruction for this student population to maintain high standards (American Educational Research Association, 2004) and high-cognitive demand (AERA, 2006). In order to accomplish these goals, mathematics instruction for ELs needs to move beyond defining academic literacy in mathematics as low-level language skills (i.e. vocabulary) or mathematical skills (i.e. arithmetic computation) and use an expanded definition of academic literacy in mathematics to describe and prescribe instruction that supports academic literacy in mathematics.

how mathematical discourse is situated, involves coordinated utterances and focus of attention, and combines everyday and academic registers (also in Moschkovich, 2011). The definition of academic literacy in mathematics used here brings together and builds on different aspects of those analyses.

³ For examples of lessons where English Learners participate in a mathematical discussions see Moschkovich (1999, 2008) and Khisty (1995).

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