Chapter 10
Math Talk as Discourse Strategy

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ABSTRACT

Mathematical understanding goes beyond grasping numerical values and problem solving. By incorporating visual representation, students can be able to grasp how math can be understood in terms of geometry, which is essentially a visual device. It is important that students be able to incorporate visual representations alongside numerical values to gain meaning from their own knowledge. However, it is also vital that students understand mathematical terminology, via a dialogical-rhetorical pedagogy that now comes under the rubric of “Math Talk,” which in turn is part of a system of teaching known as knowledge building, both of which aim to recapture, in a new way, the Socratic method of dialogical interaction. This chapter explores how knowledge building, as a methodology, can assist in furthering student understanding and how math talk leads to a deeper understanding of mathematical principles.

INTRODUCTION

Knowledge Building researchers have identified pedagogical methods that foster idea improvement among learners (Zhang et al., 2009, Scardamalia et al., 2012) via “collective intelligence” development (Broadbent & Gallotti, 2015), which can be described simply as group-based learning (Knowledge Building Gallery, 2016). Studies have examined the validity of Knowledge Building in the area of mathematics (Moss & Beatty, 2006, Moss & Beatty, 2010, Nason, Brett, & Woodruff, 1996, Nason, Woodruff, & Lesh, 2002, Nason & Woodruff, 2004, Knowledge Building Gallery, 2016) finding a common pattern—namely an increase in learning when a derived technique, known as “Math Talk,” is utilized in group-based learning contexts. This paper aims to contribute to the growing body of research and theory on Knowledge Building and Math Talk, focusing on elementary school learning.

Mathematics is critical for 21st-century skills. As stated in the Ontario Ministry of Education’s document Growing Success (2009), “Education directly influences students’ life chances and life outcomes” (p. 6). Today’s global, knowledge-based economy requires a citizenry with deep understanding of disciplinary knowledge as well as a broad range of what are popularly known as “21st century skills.” In the early grades it is a strong predictor of later academic achievement (Duncan et al., 2007). However,
with cases of mathematical anxiety and avoidance of math within elementary learning environments, it is hard to engage anxious students in particular in math learning, and allow them to retain information and skills for long-term use and application. Such students do not show an ability to transfer mathematical skills; rather, they rely on mechanical formulas, mathematical “tricks” they might have learned, all of which do not contribute to math competence and fluency. Current evidence of this inability can be gleaned from the Province of Ontario’s 2016 EQAO scores, which show only 63% of students meeting the provincial grade three mathematics standards. Bredekamp (2004) argues that educators should examine research and practices on how children actually learn mathematics and develop relevant methods for classroom usage. Knowledge Building pedagogy is grounded in students’ natural curiosity and helps expand innate conceptualization skills through a model of learning that encourages the “community dynamics” of the sort found in knowledge-creating organizations. This form of teaching has been shown to boost achievement in literacy, mathematics, engineering, science, across the curriculum (Chen and Hong, 2016). Knowledge Building is built on interactivity models of psychology, encouraging students to design, revise, discuss and apply ideas developed in community (group-based) contexts and spaces so that they can learn in terms of a collective responsibility for knowledge.

The need for mathematics as a tool for creative work in a technology-rich knowledge society is widely recognized (Wagner & Dintersmith, 2015, Ritchhart, 2015). Mathematics is required for problem solving, reasoning, questioning, computational activities and their creative application, all of which reach beyond the typical well-defined classroom problems characterized by a process of “instructor input→student problem-solving→verification.” There is growing agreement that this instructional approach is ineffective (Towers, 1999, Schunk, 2012, Baroody, 2000), although there is no consensus about developing effective alternatives. However, the claim made here is that Knowledge Building is one such alternative (Scardamalia & Bereiter, 2003) and that Math Talk—its methodological derivative—does indeed allow students to learn mathematics effectively through dialogue, discussion, and other interactive strategies. In effect, dialogue, and its rhetorical structure (analogies, allusions, comparisons, and so on) seems to be the best way to learn—a philosophy of education that goes right back to ancient times.

Fostering mathematical thinking is always the goal of curriculum guidelines and professional development workshops for teachers. The Ontario Mathematics Guidelines, for example, proclaim that learning involves the ability to control the “relevant facts, skills, and procedures” and develop “the ability to apply the processes of mathematics, and acquire a positive attitude towards mathematics” (Ontario Ministry of Education, 2005, p. 3). This document goes on to state that the main strands that constitute math knowledge are as follows: number sense and numeration, measurement, patterning and algebra, data management and probability, and geometry and spatial sense (Ontario Ministry of Education, 2005). This subdivision applies to math education in all grades and provides a framework for the subject matter to be covered during a school year. Leher & Chazan (1998) and Whiteley (1999) decry, however, the fact indicate that geometry is often neglected or considered of lesser value than numeracy and algebra. So, they suggest adding it to the strands so that math fluency can be developed as an integrated system of numeracy and geometry.

Osta (2014) defines a curriculum as “the pedagogical framework or philosophy underlying the teaching practices and materials, training programs for supporting teachers, and guidelines for assessing students’ learning” (p. 417). According to Putnam (2004, p. 33) the educational curriculum is a prescriptive document which dictates an “ordered set of goals in which students are expected to learn, and recommended strategies for teaching material.” Among the ever-emerging collaborative-based pedagogies designed to cater to these objectives those that focus on deep learning, inquiry-based learning, project-based learning,