Book Review…

The Importance of "Making Sense" in Mathematics Education

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Making Sense: Teaching and Learning Mathematics with Understanding. (1997). James Hiebert, Thomas P. Carpenter, Elizabeth Fennema, Karen C. Fuson, Diana Wearne, Hanlie Murray, Alwyn Olivier, and Piet Human. Portsmouth, NH: Heinemann. xvii + 184 pp. ISBN 0-435-07132-7 $21.35.

Since the publication of the National Council of Teachers of Mathematics (NCTM) *Professional Standards for Teaching Mathematics* (1991), teachers have been trying to "make sense" of what it means to teach in a way that promotes learning for understanding in mathematics. Replacement units and lesson plans have been designed and substituted for some basal text lessons to help reform classroom instruction. In addition, many districts and national organizations have held workshops and conferences to provide professional development for their teachers. Missing, however, have been models or sets of guidelines grounded in research that teachers could use to restructure their practices—until now.

Making Sense presents a conceptual framework of five dimensions and core features of classrooms that facilitate learning with understanding. The authors contend that "all classrooms can be analyzed along these five dimensions, regardless of the instructional approach" (pp. 2-3). They note that these "five dimensions form a framework both for examining whether a classroom is facilitating the development of understanding, and for guiding those who are trying to move their classrooms toward this goal" (p. 3). In addition, the authors provide classroom stories to further explicate features of this framework for facilitating meaningful learning processes and to demonstrate essential and optional features of these five dimensions.

Making Sense pulls together the individual research findings of a distinguished group of mathematics educators who collaborated in the writing of this book. Because of the synthesis of research findings in the development of the framework of *Making Sense*, it is beneficial to first present an overview of the contributing authors' projects and findings that support the main features of the dimensions presented. Subsequently, we describe each of the five main dimensions that make up the guiding structure and then summarize the classroom stories. Overall, this review is organized into the following five sections: Overview of Contributing Research, The Structure and Framework, The Five Dimensions of Learning with Understanding, The Classroom Vignettes, and Final Remarks.

Overview of Contributing Research

Making Sense developed out of discussions about research findings from the contributing authors' projects focusing on children's understanding of mathematics and how to facilitate learning for understanding. Through these discussions, the authors discovered that common features or elements appeared in the classrooms that promoted learning with understanding. *Making Sense* represents the authors' sharing of their understanding of the essential features of classrooms that promote learning with understanding.

Elizabeth Fennema and Thomas Carpenter, from the University of Wisconsin-Madison, directed the

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Cognitively Guided Instruction (CGI) project, one of four major projects that contributed to the development of *Making Sense*. In the CGI project, participating teachers learned to pay attention to their students' mathematical development and thinking as a means of guiding instruction and informing instructional decisions using the CGI model and framework (Fennema, Carpenter, Franke, Levi, Jacobs & Empson, 1996). *A Day in the Life of One Cognitively Guided Instruction Classroom* (Chapter 7) presents an overview of and classroom vignettes taken from their research.

Two other authors of *Making Sense*, James Hiebert and Diana Wearne, from the University of Delaware, looked at the links between instruction, understanding and performance and the use of alternative teaching strategies vs. textbook-based instruction. Their research focused on student learning using conceptually based instruction (Hiebert & Wearne, 1993). Included in *Making Sense* is a description of a case study by Hiebert and Wearne found in *A Day in the Life of a Conceptually Based Instruction Classroom* (Chapter 8).

Other research was provided by the team of Hanlie Murray, Alwyn Olivier, and Piet Human, from the University of Stellenbosch in South Africa. Using the Problem-Centered Learning approach (PLC), they studied the importance of the social element in the construction of knowledge (Murray, Olivier & Human, 1992). Chapter 9, *Student Talk in a Problem-Centered Classroom*, describes examples from their work.

The final pair of researchers that contributed to this book were Karen Fuson and Diane Briars. Their teaching and learning approach was designed to help students "construct conceptual structures for the mathematically different English named-value system of number words and the positional base-ten system of written marks"(Fuson & Briars, 1990, p. 203). They found that a wide range of students benefited from the use of base-10 blocks and from the overall design of the instruction. A vignette of a classroom taken from their research is provided in Chapter 10, *Snapshots across Two Years in the Life of an Urban Latino Classroom.*

As noted earlier, the convergence of features from classrooms studied in these projects lead to the development of the five dimensions of teaching for understanding and the classroom examples that are presented in this book. The structure of the book and then the framework are presented in the next section.

The Structure and Framework

Making Sense consists of eleven chapters organized into four main sections. The book begins with a forward by Mary Montgomery Lindquist, past-president of the National Council of Teachers of Mathematics, and moves into an introduction and overview section (Chapter 1). The second section (Chapters 2-6) is a presentation of the five dimensions of classroom environments that encourage learning for understanding. Each dimension is described in its own chapter with supporting examples and features noted. The third section of *Making Sense* consists of the classroom vignettes (Chapters 7–10). Each of these chapters presents a vignette from one of the four projects that contributed to the development of the dimensions. These stories allow the reader to see how the dimensions play out in diverse classrooms. The last section of this book is a conclusion and summary that includes a discussion of the five dimensions and the related classroom examples and how they work together (Chapter 11).

The framework, discussions and classroom examples center on five dimensions of classrooms in which students engage in learning with understanding. Within each dimension are features that the authors describe as either crucial or optional for facilitating understanding. These dimensions and their features are presented in five chapters: *The Nature of Classroom Tasks, The Role of the Teacher, Social Culture of the Classroom, Mathematical Tools as Learning Supports,* and *Equity and Accessibility*.

The Five Dimensions of Learning with Understandi*ng*

The Nature of Classroom Tasks

Hiebert and his colleagues' first dimension of classrooms that promote learning with understanding is described in *The Nature of Classroom Tasks* (Chapter 2). This chapter focuses on the importance of making mathematics problematic by engaging students in meaningful tasks that leave residue, and by encouraging student reflection and communication. This chapter

is informative and engaging; however, certain statements concerning appropriate curriculum are confusing. Hiebert et al. state, “much of the content in current curricula, as presented in popular textbooks, is appropriate *as long as* students are allowed to make the mathematics problematic” (p. 25). They continue, “some tasks that are being proposed as innovative and reform-minded would be inappropriate” (p. 26). Some inexperienced teachers might view these statements as recommendations for basal text teaching. The authors’ important point is that even simple computation problems can be mathematically problematic for students “if they are introduced at the right time and treated appropriately” (p. 26). On the other hand, seemingly clever real world problems may have little mathematical content and leave little residue.

The Role of the Teacher

Chapter 3 focuses on Hiebert and his colleagues’ second dimension, *The Role of the Teacher.* This is an important chapter for clarifying issues concerning specific reform ideas for teachers. Understanding the role of the teacher in the classroom has been of particular concern to some teachers since the release of the NCTM *Professional Standards for Teaching Mathematics* (1991). Again, classroom examples illustrate the authors’ claims. Particularly noteworthy in this chapter is Hiebert et al.’s discussion of the teacher as dilemma manager. The authors provide a helpful discussion of the difficulty of encouraging students to become mathematically powerful and independent in their learning while, at the same time, assisting when necessary. The inclusion of research by Magdalene Lampert, Deborah Ball and John Dewey is helpful in supporting claims made concerning appropriate teacher intervention, guidance and community building.

The Social Culture of the Classroom

The third dimension of learning for understanding described in this book is *The Social Culture of the Classroom.* Chapter 4 presents a nice overview of important issues related to the social aspect of a classroom, such as the idea of creating "cognitive conflict" (p. 46) and a detailed description of how to develop healthy social norms. In addition, a discussion of grouping as being optional or determined by the “preference of the teacher and the needs of the particular class” (p. 51) might be particularly freeing for teachers reading this who feel uncomfortable having students in groups all of the time.

Mathematical Tools as Learning Supports

At first glance, the term tools may bring to mind manipulatives, calculators or computers. However, in Chapter 5, *Mathematical Tools as Learning Supports*, Hiebert and his colleagues define tools to include “oral language, physical materials, written symbols, and skills students already have acquired… as amplifiers of human capacities” (p. 53). An interesting feature of this chapter is the description of using tools to keep records, using tools to communicate, and using tools to think. The authors’ presentation of this view of tools and their potential uses is a rich and thought-provoking section of the book.

Equity and Accessibility

The sixth chapter, titled *Equity and Accessibility*, focuses on issues of equity and how to provide access to important mathematics for all students. Equity is not only defined as "morally just…(but) necessary for this system of instruction to work" (p. 67). The authors contend that “all students must contribute to the learning environment. To the extent that some students are excluded and do not participate, the learning possibilities are diminished for everyone” (p. 67). Using statements such as these provides a strong argument to illustrate the authors’ position, but at times they fall short and do not provide enough rich examples of situations where their dimensions play out in classrooms that have students from many different backgrounds and languages. The authors do refer to Chapter 10, *Snapshots across Two Years in the Life of an Urban Latino Classroom,* for further illustrations of the dimensions applied to minority classrooms. Unfortunately, the authors do not provide the "bumps and glitches of ordinary urban classes" (p. 132) that preservice teachers and teachers struggling with equity issues in their classrooms would benefit from reading.

The Classroom Vignettes

One of the most impressive features of *Making Sense* is its presentation of classroom vignettes. Approximately one-third of *Making Sense* (Chapters 7-10) is devoted to the presentation of these stories that provide the

reader with a set of classroom examples. These vignettes exemplify how the dimensions play out in a diverse set of classrooms and help to illustrate that the system of instruction put forth by the authors is not a "prescription or step-by-step method of teaching, but rather a tightly connected set of principles that identify principal features of instruction" (p. 173).

Although these stories may be particularly powerful for preservice or novice teachers who may not be able to envision how this system of instruction would be implemented in actual classrooms and in diverse settings, they may be less helpful to experienced teachers facing difficulties. More examples with discussions of problems faced by teachers trying to implement instruction with these features might have been more helpful to teachers in these situations. Nonetheless, these chapters do provide examples of the "kinds of classrooms [that] facilitate mathematical understanding" (p. 172) and serve as evidence that reform-based instruction is possible.

Final Remarks

Hiebert and his colleagues have developed a thorough yet flexible framework for teachers who are trying to create classrooms that encourage learning for understanding. The five dimensions outlined are clear and understandable and can guide teachers' reflections on their classrooms as a learning environment. This book is appropriate for preservice, novice and veteran teachers alike, and may be especially useful for those who are struggling with reform efforts in mathematics education at any grade level. Although the stories in Chapters 7-10 are about elementary classrooms, the framework can be used to analyze any mathematics classroom regardless of grade level.

In her introduction to the book, Mary Lindquist rightfully calls *Making Sense* a milestone along a journey of research on teaching and learning. In this book, an elite group of mathematics educators and researchers have joined forces to provide a powerful framework for both designing and analyzing mathematics classroom instruction. As Paulo Freire (1997) wrote about teaching, "we start from what the learner knows in order that he or she can know better, know more and know what he or she does not know yet" (p. 8). Using this book as a guide, teachers can better "make sense" of teaching mathematics for understanding and, as a result, know more about their students' learning processes.

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