Designing Digital Video Case Resources for Mathematics Teacher Education

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Abstract: Bank Street College of Education is collaborating with the EDC/Center for Children and Technology to develop digital video resources for pre-service and in-service professional development to better prepare teachers for serving students with and without disabilities within a standards-based mathematics curriculum. We are pilot-testing the prototype case materials and learning activities in pre-service and in-service teacher education courses at Bank Street College of Education and elsewhere. As part of this work we are learning how to refine the design of the video case materials and learning activities so that they support teaching and learning about inclusion in a specific content area. The purpose of this presentation is to share our findings and discuss how they helped us to refine the format for the case materials, the production process, as well as the use of the case materials in teacher education courses and workshops.

Introduction

Standards-based reform is bringing increased rigor and quality into mathematics education for *all* students. These reforms, however, have not been fully available to students with physical, developmental, sensory, and learning disabilities because teachers are often not well prepared to implement standards-based mathematics education with heterogeneous groups of students that include students with disabilities. Bank Street College of Education is collaborating with the EDC/Center for Children and Technology to develop digital resources for pre-service and in-service professional development to better prepare teachers for serving students with and without disabilities within a standards-based mathematics curriculum.

Research on inclusion (e.g., Giangreco, Cloninger, & Iverson, 1998; Karp, 2000; Mastropieri, & Scruggs, 1992; Wade & Zone, 2000) has helped to identify key competencies that teachers need to help students with disabilities succeed in a general education setting. Among other things, teachers need to know how children with different kinds of disabilities develop and learn; how to analyze students' needs and strengths; how to use a variety of instructional approaches (e.g., explicit strategy instruction, coaching, cooperative learning, inquiry based learning); how to make decisions about and manage multiple instructional strategies; how to adapt curricula and activities and design effective lessons; how to identify, develop, and utilize appropriate resources and materials; how to formally and informally assess student learning; how to seek assistance and guidance from specialists and other resources; and how to work with specialists and families. The National Council for Accreditation of Teacher Education (NCATE, 1998) acknowledges these competencies by emphasizing that elementary school teachers need to 'understand how elementary students differ in their development and approaches to learning, and create instructional opportunities that are adapted to diverse learners.

The case method is an ideal strategy for teachers to experience and learn about the dynamics and complexities of teaching and learning that exist in mixed-ability classrooms, and to anchor this learning in discipline-specific learning contexts. The case approach usually entails carefully designed case materials along with facilitated

discussions or experiences created around the case (e.g., Miller & Kantrov, 1998). According to Shulman and Mesa-Bains (1993), a case approach can help provide a bridge between a general topic and specific practices by introducing a particular student and teacher, and bringing the world of one classroom to life in all its complexity. Case studies can serve as a vehicle for teachers to question their instructional practices, classroom management strategies, and curricula, as well as for reflecting on their own values, attitudes, and experience (Barnett, 1991; Shifter, 1996). Some cases pose dilemmas and encourage teachers to become problem-solvers who pose questions and examine alternative solutions (Barnett & Sather, 1992). The power of cases is magnified when used by a group as a catalyst for discussion (Miller & Kantrov, 1998). Cases help produce a common focus, and in the company of others, participants can analyze the various problems and perspectives embedded in a case, work to generate and evaluate alternative solutions, and discuss and reflect upon the underlying issues.

A small number of multimedia case materials have already been developed for mathematics teacher education. For instance, drawing on an extensive collection of video and other materials from the 3rd- and 5th-grade classrooms in which they taught, Lampert and Ball (1994) have developed hypermedia environments to support an inquiry-driven approach to teacher education pedagogy. The videos from the Third International Mathematics and Science Study (TIMMS) (Stigler & Hiebert, 1999) are another set of videos used as cases to promote teacher reflection on instructional practices. *Developing Mathematical Ideas (DMI),* (Shifter, Bastable & Russel, 2000) consists of print and video materials organized around classroom episodes. Bowers, Doerr, Masingila, and McClain (1999) have developed multimedia case studies of lesson sequences taught in reform-based classrooms. Seago and Mumme (2000) are currently developing video cases for teacher development in K-12 mathematics. Their case materials, which emphasize complexities in teaching, are intended to help teachers build a language of practice, deepen content knowledge, develop habits of mind, and build a repertoire of teaching strategies. Finally, the Concord Consortium is developing interactive video case studies in conjunction with two online mini-courses to be offered through Teachscape, Inc.

A number of research studies that have been conducted with these materials, attest to the effectiveness of the case method in achieving various learning goals. For instance, Shifter and Bastable (1995) report that when teachers encountered mathematical problems through a student's perspective, they often deepened their content knowledge. As they reflected on students' approaches to problem solving, they began to rethink the mathematics for themselves, often seeing new aspects of familiar content. Barnett (1991) and Shifter (1994) discovered that the process of reflecting on students' thinking and learning through case discussions often resulted in teachers' trying out the ideas or activities from the case in their own classrooms. None of the existing case materials, however, have been developed and used specifically to help teachers learn about inclusion. Little is known about how to design and use multimedia case materials to help teachers develop the specific skills and understandings that help them better support students with diverse abilities and disabilities. These include how to observe individual students and analyze their needs and strengths, to make decisions about instructional resources and strategies, and to learn to adapt existing curricula. The Mathematics for All project is beginning to address these questions.

The Math for All Project

Building on the lesson study approach and utilizing the case method the Math for All Project is developing five modules of digital professional development resources. Each module consists of at least two multimedia case studies of teaching events involving students with disabilities in mathematics classrooms as well as activities that guide users in their interaction with the case materials. Each module focuses on one of the five NCTM content standards (number and operations, algebra, geometry, measurement, data analysis and probability), integrates one or more of the five process standards (problem solving, reasoning and proof, communication, connections, and representation), and highlights key issues that need to be addressed to broaden the preparation of teachers to serve diverse learners. Each of our cases consists of 3-4 hours of real-time digital video, including a math lesson and planning and debriefing conversations with the teachers. The video of each math lesson documents the experiences of two or three focal students who are carefully selected in consultation with the classroom teacher to represent the range of learners in that classroom.

We are pilot-testing the prototype case materials and learning activities in pre-service courses at Bank Street College of Education and in-service workshops around the country. To date we have piloted-tested our materials in 29 different courses with approximately 650 participants, including pre-service and in-service teachers, teacher educators, and administrators. Research methods have included classroom observations, informal interviews and written surveys of course and workshop participants, and analyses of participants' written products. As part of this work we are learning how to refine the design of the case materials and learning activities so that they support teaching and learning about inclusion in specific math content areas. Formative research has been critical in helping us refine the format for the case materials, the production process, as well as the use of the case materials in teacher education courses and workshops.

Findings

Format and Content of the Case Material

Reviews of the video from the lessons and feedback from participants in pre-service and in-service courses in which we used our materials helped us refine the kinds of information we needed to document about the math lessons. Our pilot work affirmed the feasibility and importance of maintaining a focus on the focal students throughout the lesson, and of carefully capturing their work, as well as their interactions with other students and the teacher during the lesson. The extended focus on individual students provides a lens for observation that teachers usually do not have in the classroom, allowing them to better understand the focal students' needs and strengths in relation to specific mathematical tasks. Feedback from course and workshop participants also helped us to recognize the need for additional video footage that focuses on the teacher and the larger classroom context, and the need for still images that document classroom displays, the blackboard, and student work.

Feedback from pre-service and in-service teachers and teacher educators helped to clarify what kinds of contextual information and background materials are necessary for users to make sense of the video materials. The materials requested include: samples of student work, information about the school and the classroom, information about the mathematics of the lesson, information about the mathematical context (what preceded and followed the lesson), a description of the task, the learning goals for the lesson, background information about focal students, the teacher's strategy for addressing all learners, the development of mathematical thinking within the content area featured in the lesson, and what teachers need to know about teaching the specific mathematics content of the lesson to diverse learners, expert reviews of the lesson materials, and more information about the theoretical frameworks that guide users in viewing the materials.

Case Production Process

Our goal is to video-tape authentic math lessons as they naturally unfold. Therefore, our video shoots have to be carefully planned and orchestrated in order to be as un-invasive as possible during shooting. To insure the best quality of the video footage we have found that pre-production visits to the classroom are essential. During these visits we carefully review with the teacher the flow of the lesson, the materials that will be used, the activities that students will be engaged in and where students will be sitting. We also explore the lighting and sound conditions in the classroom as well as the physical placement of furniture and other objects in the classroom. We plan for the positioning of cameras, to eliminate potential problems with lighting, background noise, and physical objects. It also helps the camera persons to anticipate what will be recorded, and to clearly delineate and coordinate what each member of the case development team will be documenting.

In order to minimize students' distraction by the video production, we have found it helpful to bring our equipment to the pre-production visits and to set up the equipment early on the day of the shoot. This provides opportunities for students to explore and satisfy their curiosity about the video cameras. We carefully explain to students that the purpose for the video taping is to help teachers learn about teaching mathematics, and emphasize the need for them to act as naturally as possible. We also tell them that if students act silly or wave it will make the video unusable for us and that we will have to edit those sections out.

After trying several different alternative options, we found that wireless microphones provided us with the best possible solution to record good quality sound within the classroom. Our goal was to achieve maximum sound quality without drawing too much attention to the video production process. We felt that using directional microphones on booms was not an option because it would have doubled the amount of adults that would need

to be in the classroom and would likely be distracting to the students. We found that directional microphones attached to the camera and built-in microphones sometimes did not carefully record what a focal student was saying. We also tried out tabletop microphones but found that the use of mathematics manipulatives created too much background noise for them to pick up the sound well. We are currently using omi-directional wireless microphones to record focal students as well as other students that are in close proximity to them. We explain to focal students that they have been selected to serve as the microphone carriers for their class, a responsibility that they take very seriously. We carefully plan with the teacher prior to the shoot where focal students will sit during whole group meetings and small group work to insure that the voices of all children will be recorded and to avoid sound interference. For recording the teacher, we have found that a directional microphone attached to the camera works well.

Formative feedback from teacher educators and workshop and course participants also helped us to refine our editing techniques. For instance, it helped to clarify how we need to combine video footage and sound tracks from multiple cameras for parts of the lessons during which the whole class meets. We also learned where and how to insert still images to insure the readability of the white boards and displays used in the lesson and to provide visual illustrations for ideas and objects discussed in the video. Further, in our efforts to create video materials that are universally accessible, including visually and hearing impaired audiences, we have incorporated both captions and video descriptions into the footage. Based on feedback from pilot uses, we have clarified where to best place captions on the screen, how to insure their readability against differently lighted and colored backgrounds, and how to time the captions. We have worked with the Media Access group at WGBH to develop skill in writing and recording video descriptions of the footage. We continue to work in this area in order to offer sufficient auditory descriptions that inform viewers of the classroom set up, the materials, the lesson participants, the activities and how students engage in them. We have also tried out a variety of video compression techniques and storage options. Our goal is to maintain an acceptable viewing quality while minimizing storage space.

Development of Learning Experiences and Their Implementation

Pilot testing of different kinds of learning experiences helped us to understand how they integrate into different course and workshop contexts and how they need to be refined. We found that the learning experiences flexibly fit into a variety of different courses and workshops. We were able to integrate and use the same set of materials and learning activities within mathematics methods courses, special education courses, as well as foundation courses.

During the first year of the project we have developed and tested two different types of learning experiences that focus on observing students. One engages participants in carefully observing and discussing individual students and the second has participants analyze the demands of the mathematical task portrayed in the lessons. For these two different types of learning experiences we have found that two or three five to ten minute video clips are usually sufficient for a two-hour long facilitated learning experience. The type of video segments we have found useful to show as part of the two types of learning experiences piloted so far include: 1. a video segment of the focal student at work at one or more points during the lesson, 2. a video segment of the teacher explaining the task to the class, and 3. a video segment of the teacher describing the plans for the lesson and the focal students' strengths and weaknesses.

We also gained valuable insight into how the learning experiences needed to be facilitated and how to structure workshop participants' interactions with the case materials. We found that without guidance, participants had a tendency to focus on criticizing the teachers in the video segments rather than to focus on observing the focal student. We therefore developed special instructions to redirect course and workshop participants' focus on observing students. Participants raised a number of questions about the larger context of the lesson (e.g., when it took place, what came before and what came after, what students were asked to accomplish, as well as the students in the classroom (number, grade level, range of abilities and disabilities). Participants' questions helped us to refine what kinds of contextual information we need to provide in conjunction with specific learning experiences. We also found that opportunities for course and workshop participants to directly interact with the video materials helped to deepen their learning experience. Opportunities for direct interaction with the video materials were provided by making computers available to individual or small groups of participants making it possible for them control viewing and play back of the video on their own. Alternatively, we also had

participants use QuickTime Pro to isolate video clips and incorporate them in a Microsoft Word or PowerPoint document and annotate them to create video papers.

Summary

In summary, our formative research provides support for the feasibility of developing multimedia materials that capture authentic math lessons and that document the experience of individual learners. Parts of these multimedia materials were used successfully within facilitated learning experiences designed to enhance teachers' skill at observing individual students and understanding their needs and strengths. The learning experiences were successfully integrated into a variety of pre-service and in-service teacher education courses, including mathematics education, special education, and child development courses.

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