Chapter 12
Preparing Qualified Elementary School Teachers:
Connecting Mathematics and Science by Integrating Data Collection Technology into Methods Courses

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ABSTRACT

This chapter describes a process for the implementation of data collection technology that the authors introduced into the science and mathematics methods courses for preservice elementary-school teachers in a public, urban college. The curriculum of the methods courses was developed to include inquiry-based lab activities that utilize probeware and various data collection interfaces. The lesson plans and the reflections that the authors collected from the 124 preservice teachers over three semesters show that the courses not only exposed them to a variety of data collection instruments, but also changed their attitudes and confidence levels about using such technology in the classroom. The results of this project suggest that preservice teachers perceive data collection technology as a tool for the clear demonstration of otherwise hard to teach science and mathematics concepts to their students. After using data collection technology in their method courses, preservice teachers were able to create their own inquiry-based activities, in which their students were involved in collecting real time data, generating hypotheses, analyzing data, and drawing conclusions. The data collected from the preservice teachers also showed that they needed more experience and practice to better understand the benefits of this type of technology for their future students as well as for their own learning.

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INTRODUCTION

Our technology-based society is advancing at such a rapid pace that universities are struggling to prepare students with the technology skills they need for today. Millions of dollars are being poured into the purchase of technological equipment for today's classrooms, but the hardware is worthless if school faculty members are unfamiliar with its function and educational application (Association for the Advancement of Computing in Education, 2003). Over the last two decades, many government agencies have set up relevant curriculum standards to direct the implementation of educational technology, including the International Society for Technology in Education (2008). Further, non-government organizations such as the Society for Information Technology and Teacher Education (http://site.aace.org/), founded in 1990, promote research and practice in the use of technology in teacher education.

There is, however, an ongoing debate regarding how teacher education programs can most effectively prepare teachers to use technology in their teaching. Kay (2006) recently completed a meta-analysis of sixty-eight refereed journal articles that suggested various strategies on how to incorporate technology into preservice teacher education. The following ten strategies for the incorporation of technology emerged from his review: 1) Delivering a single technology course; 2) Offering mini-workshops; 3) Integrating technology in all courses; 4) Modeling how to use technology (i.e. faculty using technology in their own teaching practice); 5) Using multimedia (i.e. technology case studies, online courses, electronic portfolios); 6) Collaboration (i.e. establishing partnerships among universities, colleges and K to 12 schools to create technology-rich learning experiences); 7) Mentor teachers (i.e. continuous professional development); 8) Practicing technology in the field (i.e. actively support the production and delivery of technology-based lessons by preservice teachers); 9) Focusing on education faculty (i.e. faculty development); and 10) Improving access to software, hardware and/or support (i.e. laptop programs).

Teacher Knowledge as it Relates to Technology

Though research about teachers has examined the complex and ill-defined concept of *teacher knowledge* (Carter, 1990; Cochran-Smith & Lytle, 1999; Fenstermacher, 1994; Munby, Russell, & Martin, 2001), only recently have education researchers started to examine teacher knowledge as it relates to technology. Knowledge is essential because teachers use it to determine their actions in the classroom. Thus, it is strategic to identify the relevant knowledge base that teachers draw upon and develop when they learn to teach with technology. It is widely accepted in the education community that teacher knowledge has three components– Content Knowledge, Pedagogical Knowledge, and Pedagogical Content Knowledge (Grossman, 1988; Shulman, 1987). When teachers integrate technology with their professional knowledge they yield four types of knowledge related specifically to technology (Hughes, 2000, 2005; Hughes & Scharber, 2008): Technology Knowledge (TK), Technology Pedagogical Knowledge (TPK), Technology Content Knowledge (TCK) and Technological Pedagogical And Content Knowledge (TPACK). TPACK describes that body of knowledge that teachers need for teaching with and about technology in their assigned subject areas and grade levels. TPACK is depicted as knowledge that relies on the interconnection and intersection of content, pedagogy (teaching and student learning), and technology (Margerum-Leys and Marx, 2002; Mishra, and Koehler, 2006; Niess, 2005; Pierson, 2001; Zhao, 2003). Based on research both with preservice (Niess, 2005) and in-service (Niess, Suharwoto, Lee, & Sadri, 2006) mathematics teachers, Niess further clarified these central components of TPACK as the knowledge and beliefs that a teacher demonstrates that are consistent with: