Chapter 15

A Framework for Supporting In-Service Teachers to Use Domain-Specific Technologies for Instruction

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ABSTRACT

Domain-specific technologies, which are used for analysis, representation, and production in real-world contexts, differ from basic technologies, such as word processing software and Internet search tools. They cannot be used effectively without adequate command of fundamental domain-specific content knowledge. They can be used to deepen students' understanding of content, but these technologies bring distinct classroom-integration challenges. This chapter presents a framework for supporting in-service teachers to integrate these technologies. The research team derived this framework from data collected during an extended TPACK-style (Technological Pedagogical Content Knowledge) workshop that engaged 13 life science community college instructors in integrating bioinformatics technologies into courses. This chapter presents a case study about the challenges community college teachers faced in implementing these tools—and the strategies they used to address them. Challenges included activity translation, problem definition, implementation, and assessment.

INTRODUCTION

Technology has become a ubiquitous tool in most domains in academia and industry, and has raised the degree of professional judgment and skill expected in the workplace (Autor, Levy, & Murnane, 2003). Domain-specific technologies include tools for data visualization and data analytics in the physical and life sciences, rapid prototyping tools in engineering, schematic tools in manufacturing, and animation and sound manipulation tools in the arts. This class of tools not only has the potential

to enhance student learning through real-world application but also presents distinct classroom integration challenges. The central concern is that domain-specific technologies fundamentally differ from basic productivity technologies, such as word processing software and Internet search tools. Thus, teachers cannot use them effectively without adequate command of essential domain-specific content knowledge. This prerequisite means that teachers face a series of challenges to use such technologies for teaching fundamental knowledge in any given field.

The promise of domain-specific technologies cannot be realized without addressing the usual concerns associated with integrating any type of classroom technology: lack of teacher awareness of the rapid technological advances (O'Bannon & Thomas, 2014; Oh & Reeves, 2014), doubts about students' capacity to learn with technology (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012), and lack of support for shifting classroom pedagogy from traditional instruction to more student-driven inquiry with real-world problems (Ertmer & Ottenbreit-Leftwich, 2013; Lawless & Pellegrino, 2007; Webb & Cox, 2004).

To address the issues about the use of domain-specific technologies, this chapter has the following objectives: (a) present the background about the unique challenges of domain-specific technology use; (b) offer some solution approaches that refine the TPACK framework (Technological Pedagogical Content Knowledge) for supporting in-service community college teachers to use domain-specific technologies; (c) illustrate how the classroom use of domain-specific technologies involved a new set of teacher concerns with technology integration that the research team observed during a case study; and (d) discuss the implications for and refinements of the new domain-specific technology integration framework for designing and delivering in-service professional development.

BACKGROUND

The following section describes past research into basic technology integration and identifies the context factors that drive integration of domain-specific technologies into classrooms, an analysis of the skills needed by teachers to support such integration, and a framework describing the added features needed in current systems for organizing teacher professional development programs around domain-specific technology integration.

A Review of Perspectives on Faculty Integration of Technology

To understand the challenges of integrating domain-specific technologies, it is helpful to review what research has said about the conditions that support the integration of *basic* technologies. Research indicates that effectively using technology in the classroom depends on three factors of a teacher's work life: context, skills, and social support.

Teacher Context and Classroom Technology Integration

Context drives teachers' decisions about how to incorporate any learning material into the classroom. Instructional decision-making theory (Lattuca & Stark, 2011) illustrates the wide range of contextual influences: teaching experience, instructional approach, knowledge of the content domain, perceptions of student characteristics, and other local matters such as institutional priorities. While all of these influences are relevant to K–12 teachers, domain content and student characteristics figure most prominently for college instructors (Stark, 2000). In the early years of integrating the Internet into the classroom, Cuban (2001) and Sandholtz, Ringstaff, and Dwyer (1997) observed that technologies were not integrated into the

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