Content, Pedagogy, and Technology: Testing a Model of Technology Integration

Abstract

In this paper we introduce our model for faculty development and technology integration that focuses on the complex interplay between content, pedagogy and technology. We exemplify our pedagogic technique for faculty development (called learning by design) that fosters technology integration fluency by having participants design educational technology. We extend our theory by grounding our model in 15 weeks of observations of design-team participants of our faculty development course. Our analysis of this data focuses on using our transactional model to represent conversational data. Our findings show that by designing educational technology, faculty member participants show increasing sensitivity to the complex interplay between content, pedagogy, and technology. Thus this paper makes contributions at multiple levels, pedagogic, pragmatic, theoretical and methodological.

Introduction

Advocates of technology in education often envisage dramatic changes in the process of teaching and learning. However, over the past years it has become clear that merely introducing technology to the educational process is not enough. Technology alone does not lead to change. Rather, it is the way in which future teachers use the technology that has the potential to change education (Carr, Jonassen, Litzinger, Marra, 1998).

One pervasive approach to making technology integration happen in classrooms has resulted in a plethora state and national standards that emphasize an instructor's familiarity with a range of technologies and tools that could be used in educational settings. As a consequence of these initiatives by policy makers, teacher educators and technology enthusiasts, we see a wide range of workshops and teacher education courses about general software tools which have application across content and pedagogical contexts. As we have argued elsewhere (refs omitted for anonymous review), this emphasis on competencies and checklists of things teachers need to know is inherently problematic, for a variety or reasons.

1. Knowing how to use technology is not the same as knowing how to teach with it – there is a divide between how and where skills are learned (e.g., workshops) and where they are to be applied (e.g., classrooms).

2. Most of these general software tools are designed for the world of business, not education – converting these general tools for classroom teaching is neither trivial nor obvious.

3. Context neutral approaches to technology integration encourage generic solutions to the problem of teaching. However, technology use in classrooms is context-bound.

4. Standard checklists of technology skills do not offer recommendations on how to achieve these skills or knowledge.

In summary, we argue that attempts at technology integration have suffered from the lack of theoretical frameworks and models for developing or understanding this process of integration. In contrast, our own experiences with technology integration have lead us to offer a theoretical framework for considering how technology, content, and pedagogy must interact for fruitful technology integration.

Towards a theory of the interaction of content, pedagogy, and technology

Our theory (represented in figure 1), highlights the role of content (the actual subject matter that is to be learned/taught), pedagogy (the process and practice or methods of teaching and learning), and technology (both commonplace ,like chalkboards, and advanced, such as digital computers). More importantly, our framework emphasizes the connections, interactions, affordances, and constraints between and among the content, pedagogy, and technology (References omitted for anonymous review). That is, we make an argument similar to that of Shulman (1986) who argued that knowing a content domain, and general purpose pedagogical techniques was not sufficient – arguing instead for form of context-specific and highly integrated way of knowing that he labeled "pedagogical content knowledge."

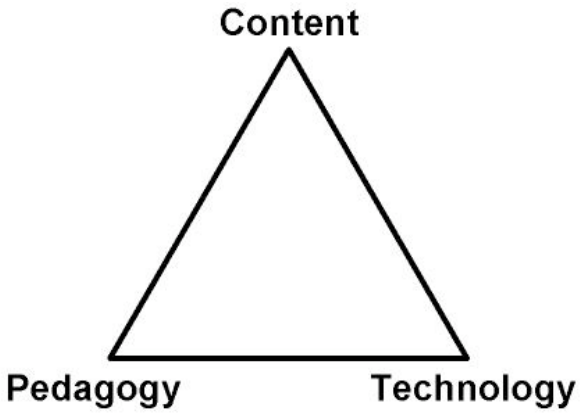

Figure 1. Three components for effective teaching with technology.

Likewise, the addition of technology into a model of teaching requires knowledge about technology, but also knowledge of the complex interplay of content (C), pedagogy (P), and technology (T). Thus, we extend Shulman's argument beyond a sensitivity to pedagogical content knowledge (C-P), but also content-technology knowledge (C-T), pedagogical-technology knowledge (P-T), and even pedagogical-technologicial-content knowledge (C-P-T) (Keating & Evans, 2001). Hence, teaching and learning with technology exist in a dynamic transactional relationship (Bruce, 1997; Dewey & Bentley, 1949; Rosenblatt, 1978) between the three elements.

Achieving an understanding of the interplay between content, pedagogy, and technology: Learning technology through design

How are teachers to acquire an understanding of the complex relationships between content, pedagogy, and technology? As we have argued elsewhere (references omitted for anonymous review), one promising avenue of development is the learning by design approach, philosophically related to learning-by-doing approaches, problem-based learning, and collaborative learning frameworks. In the learning by design approach, we emphasize experiences where participants learn about educational technology by designing educational technology. In short, we have argued that design-based activities provide a rich context for learning *and* lend themselves to sustained inquiry and revision that will help designers to come away with the deep understanding needed to apply knowledge in the complex domains of real world practice. This emphasis on design has been informed by long-standing

research on the use of design for learning complex and interrelated ideas (Perkins, 1986; Blumenfeld et. al. 1991; Brown, 1992; Harel & Papert; 1990; Kafai, 1996).

Specifically, the rest of this paper focuses on examining the utility of the CPT framework by examining its utility in understanding one design-based experience in which teams of educational technology masters students, and college faculty worked together to design online courses.

Methodology

During the spring semester of 2002, six faculty and eighteen students participated in an educational technology Masters level course that met once a week for three hours. Students were assigned to groups led by individual faculty members. The group task was to develop an online course, for an Online Master's Program offered by the College, to be taught by the faculty member at a later date. Typically, class time consisted of discussions of outcomes of assignments given by the instructor the previous week, matters pertaining to course administration and any issue or problem encountered by groups while building their online course. While the instructor did not specifically attend to the students' need for (further) training in technology to meet the demands for designing an online course, short tutorials (less than an hour long) were given by the teaching assistant in using Macromedia Dreamweaver, a web design software. A major part of the class time was reserved each week for the groups to discuss and work on the online course they were developing, with the course instructor and teaching assistant on hand to assist with any technological, pedagogical or administrative issues that may arise.

Participants

Data for the study comes from close observations of two of the six groups of faculty and students in the class [NOTE: Due to length limitations, only one of the groups will be written about for the proposal]. Dr. Adam, who led the group, had limited knowledge and experience with technology and saw the course as "an opportunity to explore new ways to think about course content while immersed in a rich context of thinking about technology." Sandra, Mandy, and David (all pseudonyms) worked with Dr. Adams in the "Adams Family" group. At the time, Sandra was in the Master's program in Learning and Teaching with Technology while working as a graphic designer for the School of Criminal Justice Outreach. Mandy

and David were both teachers working on their Master's degrees in Learning and Teaching with Technology.

Data Sources

There were three types of data: detailed notes taken from group discussions both in and out of class, e-mails between members of the groups, and self progress surveys periodically taken throughout the semester. The group meeting notes were collected by the third author (a doctoral student not involved in the teaching of the class), participants agreed to include the doctoral student in their email exchanges, and progress surveys were collected via blackboard quizzes.

The bulk of our analysis focuses on understanding the transactional nature of the group exchanges in their meetings. As noted earlier, much of each class meeting was devoted to group time. During these segments, the doctoral student would observe one of the groups closely, and take detailed notes (including quotes when possible). She divided her time equally as much as possible, so that each group would be observed for at least part of each class meeting.

Measures

Each set of the fifteen weeks' notes were segmented into discourse episodes according to turns in the conversation. This segmentation into discourse episodes was done by consensus by the three researchers. Then each researcher independently analyzed and categorized each discourse episode into the following categories: content (C), pedagogy (P), and technology (T). The coding categories were not mutually exclusive, so, for example, a segment might be about technology and pedagogy (PT). In order to study changes that might have occurred over the semester, we analyzed data on three specific weeks of class for each group, corresponding to an early-, mid-, and late-week in the course with the most observation data. Based on these two criteria we chose weeks 4, 10 and 15 for the Adams Family group. For the chosen weeks, the overall coding agreement was 90%. Disagreements were resolved by consensus.

Results

Figure 2 illustrates the changes in the percentage of coded segments over the early-, mid-, and late-week of the observations for each of the categories: Content-only (C), Pedagogical-only (P), Technology-only (T), joint consideration of Content

and Pedagogy (CP), Content and Technology (CP), Pedagogy and Technology (PT), and Content, Pedagogy, and Technology (CPT).

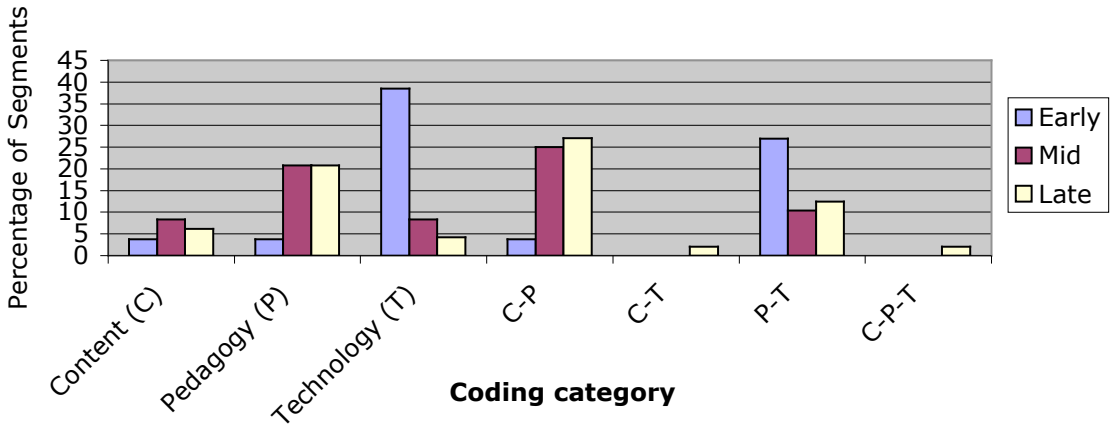

Figure 2. Percentage of Segments by Category and Week

Note the changes in conversational categories as the course progressed – the early week is dominated by statements addressing technology, represented by statements about technology in and of itself (category T, 38.5%) and its' relationship with pedagogy (category PT, 26.9%). The middle and late weeks show a different pattern, in which technology is hardly never talked about in isolation (T, 8.3% middle, 4.2% late), but is present in their conversation when it is addressed jointly with pedagogical concerns (PT, 10.4% middle, 12.5% late). Furthermore, the pattern established by the middle and late weeks is marked by an increased conversation around issues of content and segments that address content and pedagogy jointly In summary, Adams family discussions initially focused on technology and, at times, its' relationship to pedagogy. Somewhere during the middle of the course, however, technology ceased to be treated in isolation and was discussed mainly in relationship to pedagogy. Finally, issues of content and pedagogy (and their joint relationship) become the primary focus for this group. Most importantly, Figure 2 shows a growing tendency for the group to discuss issues of content, pedagogy, and technology in relationship to one another (note the growth CP, CP, CP, & CPT over time).

Figure 3 graphically depicts the three conversations for the Adams Family group, in order to study changes in the nature of the contributions by individuals. Each oval in the figure represents a segment from the transcript (the number across the top indicates the segment number), the letters inside the oval indicate the code

assigned to the segment (C, P, T, CP, CT, PT, CPT or nothing), and lines connect the conversation threads. Ovals that are not connected to a prior segments indicate new or un-related topics.

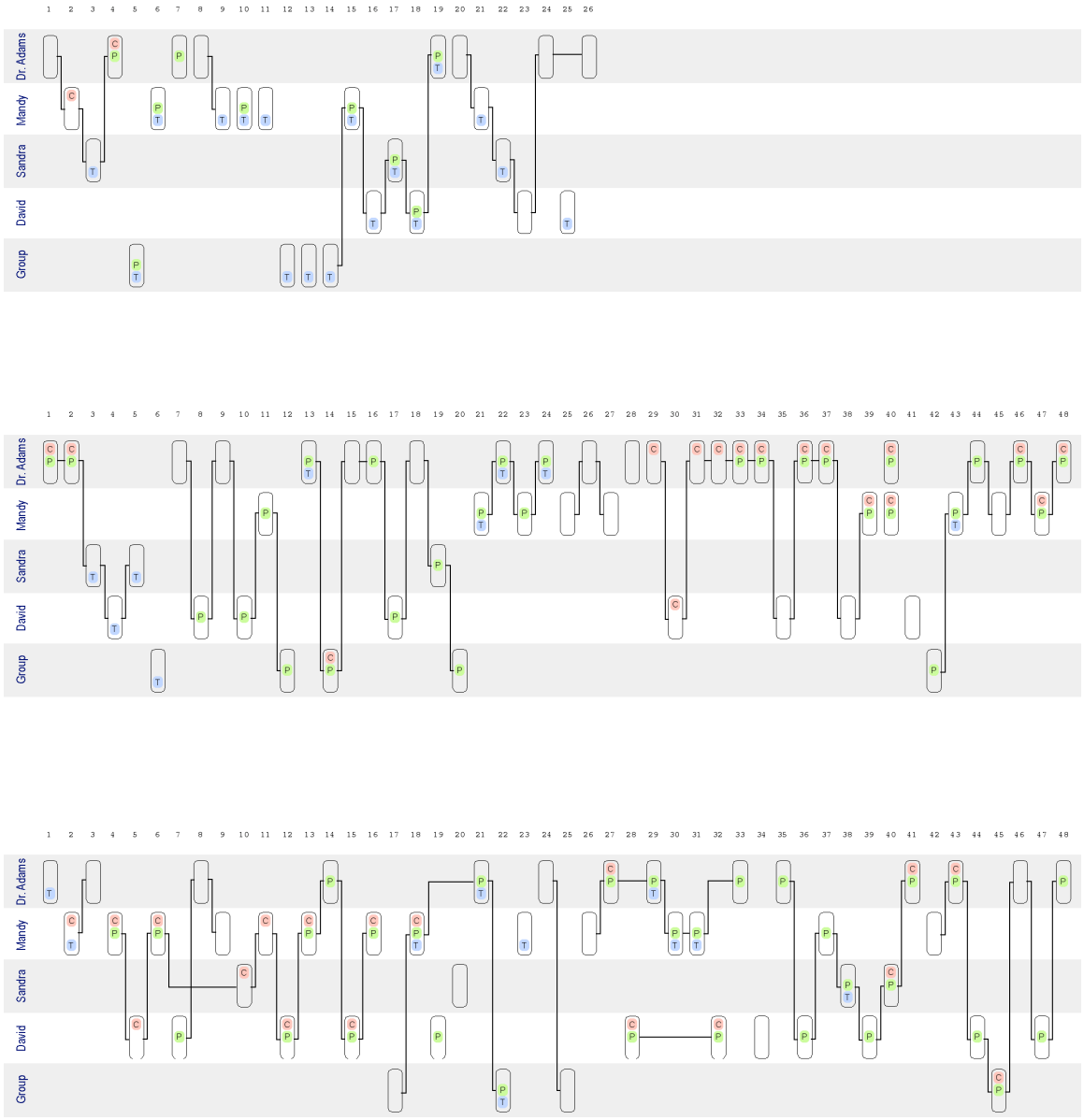

Figure 3. Representation of the coded conversations for weeks 4, 10, and 15 of the course for Adams Family. Line segments represent topical threads.

For the early week and still in the middle week, conversations (threads) are initiated by Dr. Adams and in some cases the Group. In contrast, by the late week of the course, conversations are started via many group members. Also of note, the

conversational threads seem to become longer, and more sustained. This is interesting because this indicates that the first phase of the course was driven more by the faculty member. However, the influence of the faculty member reduced over time as other members began to feel comfortable initiating new ideas (and thus threads of conversations).

It also seems that early on in the course, and to a lesser extent during the middle of the course, that certain topics of conversation are associated with particular individuals. For example, content issues are raised primarily by Dr. Adams, both in the early and middle weeks. This is not surprising, given that the faculty member clearly was the "content expert." In contrast, concerns about technology are most often raised by students. This changes with time, so that in later weeks, the distribution of content (C), pedagogy (P), and technology (T) is spread out evenly across the members of the group. In other words, these three components seem to be not only more integrated at a group level, but also within the individuals.

Conclusion

By introducing a model of technology that considers how the components of content, pedagogy, and technology co-constrain and intertwine, we have offered both a theoretical model as well as a potential analytical one for studying changes in educators' knowledge about successful teaching with technology. In the data we presented here, we found that given opportunities to thoughtfully engage around the design of an online course, faculty and students alike showed tremendous growth in their sensitivity to the complex interactions between content, pedagogy, and technology – an important step for any faculty member about to enter the world of online teaching.

In addition, we have offered a way to conduct research on the conversations of teams involved in doing design work. Oftentimes, analysis of group discussions focuses on the nature of control and evolution of group dynamics. However, by using a lens suggested by our model, focus was directed instead to what is truly important – a coherent and nuanced understanding of technological-pedagogical-content knowledge.

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