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Using Live Modeling to Train Preservice Teachers to Integrate Technology Into Their Teaching

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BENEFITS AND CHALLENGES OF USING LIVE MODELING TO HELP PRESERVICE TEACHERS TRANSFER TECHNOLOGY INTEGRATION PRINCIPLES

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Abstract

One method underutilized in training teachers to use technology is to use live modeling sessions. This study qualitatively investigates how the use of modeling sessions impacted students. In this study we found that modeling was perceived by most students to be effective at teaching technology skills and ideas for integrating technology as teachers. However, we identified several breakdowns in the ability of students to transfer their understanding of technology integration to their own situations. We explain this difficulty of transfer of learning and describe five situations when these breakdowns were likely to occur. Implications include the benefits of using live modeling if adapted to address students' unique needs, as well as future research into the impact of contextual differences on the transfer of students' learning.

BENEFITS AND CHALLENGES OF USING LIVE MODELING TO HELP PRESERVICE TEACHERS TRANSFER TECHNOLOGY INTEGRATION PRINCIPLES

Purpose of this Study

There are many research studies, such as Kozma and Anderson (2002), Rochelle and colleagues (2000), and others that indicate that the appropriate and reflective use of educational technologies can often have positive effects on learning. However, many researchers feel that teacher preparation programs are not doing enough to prepare their teachers to effectively use technology. Many researchers believe that teachers' abilities to use technology has not kept up to par with the improvements in the kinds of technologies now available within schools (for example, Sandholtz, 2001). Another study reported that less than one-third of students leaving preservice programs felt prepared to use technology (Francis-Pelton, Farragher, & Riecken, 2000). The result is a plethora of teachers who may know the basic functions of some programs (if they participated in an introductory computer course), but who are unprepared to truly integrate these skills into their teaching.

It has been suggested that part of the challenge of educating teachers to use technology effectively is overcoming the poor models of technology integration that they have observed and replace these with good models. This study investigates the impacts of one method of training preservice teachers to use technology—that of live modeling sessions, which help students practice learning and using a new technology while observing how it would be employed in practice. These modeling sessions involve the instructor showing the students how a K-12 teacher could teach with technology, and the students participating in the lesson as if they were K-12 students. Variations of this method have been used at other universities with success

(Brush, Glazewski, Rutowski, Berg, Stromfors, Van-Nest, Stock, & Sutton, 2003; and Doering, Hughes, & Huffman, 2003) and could present one solution to helping preservice teachers learn technology integration principles. This study considers the effectiveness of a variation of the type of modeling discussed by Brush, et al. (2003), adapted to meet the curriculum and learning needs of the students at Brigham Young University, a large, private university in the Midwest that is the context for this study. This research study had two questions. First, we wanted to know what the experiences were of the students in the modeling sessions. We then wanted to know the impact the modeling may be having on preservice teachers' abilities to learn a new technology, as well as to learn effective strategies for integrating the technology into their teaching.

Theoretical Framework

The Importance of Providing Preservice Teachers With Effective Models of Teaching

Teaching is a social activity, where students interact with the instructor and with each other. In addition, preservice teachers have also interacted with all of their former teachers as they progressed through elementary and secondary grades. A key component of social learning theories is the importance of modeling and imitation on learning behavior. Guy Lefrancois (1982) defines a model as "any representation of a pattern for behaving" (p. 291), and Albert Bandura has argued that modeling and imitation comprise a large portion of what we learn and how we behave, and that systematic efforts can be used to modify behaviors through the use of modeling (Bandura, 1969; Bandura & Walters, 1963; Lefrancois, 1982).

Preservice students also learn to teach by imitating models of other teachers. They observe many models of teaching before they themselves become teachers, including their own K-12 teachers, higher education faculty, and teachers they might observe while immersing themselves in the schools. However, many K-12 teachers and higher education faculty do not use technology effectively in their teaching, and so they are not appropriate models for future teachers to emulate. Research shows that many teachers do not integrate technology into their instruction or are unsure about how to use many types of educational technologies. For example, in 2000, a major survey of over 2,000 teachers found that only 50% used technology in their instruction (Barron, Kemker, Harmes, & Kalaydjian, 2003), and, in another study, only about 11% of the teachers surveyed felt they had enough knowledge about technology that they could use it in their daily teaching (Doering et al., 2003).

Even when teachers do understand how to use technology, they struggle to use the technology in a way that meaningfully changes the way they teach or the way students learn. In a qualitative study of 30 teachers (representing two elementary schools, one middle school, and one high school), Bauer and Kenton (2005) found that the teachers, despite being characterized as “tech savvy” did not integrate the technologies very consistently as teaching/learning tools. Eighty percent of these teachers did not use technology even half of the time, and 40% used technology less than 25% of the time, indicating that the technology was fully integrated into their teaching. In their interviews with the instructors, the researchers found several challenges impeding a fuller integration of technology, including hardware and software limitations; lack of time; scheduling difficulties; and some student and teacher skill limitations.

Another problem is the tendency of teachers to use technology mainly for information transfer modes of teaching, and not for student inquiry. In a recent study of teachers just transitioning into the teaching profession from schools of education, Graham, Tripp, and Wentworth (2007) found that only 38% seemed to be involving the students in using the technology to scaffold their learning. Instead the predominant use of the technology was for production of lesson materials (58%) and teacher presentation of content (over 90%).

The problem is not isolated in K-12 instructors as faculty teaching in higher education also struggle to use technology in their teaching. Spotts and Bowman (1995) found that half of the faculty surveyed did not have sufficient knowledge or experience with any educational technology except word processing, and this translated into poor use of available technologies in their teaching. More recent research has found that this is still a problem. “Despite pockets of innovation, most higher educators make little use of instructional technology,” Surry and Land (2000) reported. West, Waddoups & Graham (in press) reported that even with technology as basic as course management system software, there were many technical and pedagogical challenges to encouraging adoption and effective use among faculty, and many faculty were hesitant to use the technology in their instruction even when there seemed to be clear benefits in doing so for their particular needs and instructional goals. In another study with adult educators, Kotrlik and Redmann (2005) found similar low levels of integration, reporting in a descriptive research study that adult educators in their sample were mostly at an exploratory stage with technology integration, and were not very developed in their skills at integrating technology into their instruction for improving learning.

Because most teachers are not using technology, tomorrow’s teachers are not receiving very effective models or examples of how to use technology in lessons, and they need alternative models to observe. Christy Faison in 1996 observed that “teacher educators are failing to consistently model instructional technology use in their professional education courses” (p. 57), and she believed that “the key to producing technologically literate students is modeling technology use and providing opportunities for students to integrate technology into the teaching/learning process” (p. 58). Francis-Pelton, et. al. (2000) also felt that it was crucial to give preservice students adequate models of effective technology use, writing that they believe “one reason for this disparity between the intentions of the teacher education programs and the reality in the schools is that new teachers have had very limited exposure to appropriate models of how the computer can be used in a classroom setting" (p. 178).

While preservice teachers are not receiving effective models of technology integration from their own K-16 instructors, it might be assumed that they would receive effective models in their preservice educational technology course. This is often not the case. Most methods for preparing preservice teachers to integrate technology involve a single instructional technology course that often focuses more on teaching of the tools then on modeling of the methods of integrating these tools into teaching practices (Graham, Culatta, Pratt, & West, 2005). Hargrave and Hsu (2000) conducted a survey of 53 different preservice training programs and found that the majority of these (73%) used an introductory instructional technology course to teach technology integration. At 36 of these institutions, the class followed a lecture and lab format with no basic technology prerequisite. They also reported a growing trend to “focus on computer technology and not … instructional design topics” (p. 313). Often universities following this approach focus on workshop days when the instructor helps preservice teachers acquire new skills in a particular technology. There may be discussion about how the tools could be applied to teaching situations, but the focus often seems to be on learning the tools and not observing applications in practice.

It could be argued that preservice training programs focusing mainly on the acquisition of basic technology skills do so because they feel the students must first have the skills before they can apply technology to effectively improve their teaching. Sandholtz (2001) commented on this pattern, explaining that “much of the training provided to teachers emphasizes fundamental computer operation rather than preparation on how to use technology as a teaching tool and how to integrate it across the curriculum" (p. 350). Sandholtz then agrees that something more needs to be done than simply helping teachers acquire computer literacy, and other researchers have argued that the current systems for training preservice teachers to use technology effectively are not always effective (Francis-Pelton, Farragher, & Riecken, 2000).

This study looks at modeling approach to teaching a preservice instructional technology course that does not view the instruction of pedagogy and of technology skills as mutually exclusive. Rather, this course assumed students had an understanding of basic skills (such as word processing), and instead introduced students to a new technology (such as movie production) in the context of observing how it could be applied in practice, emphasizing the role of pedagogy. Thus, the learning of the technology and the learning of the pedagogy happened simultaneously.

Possible Solutions to Providing More Effective Models for Preservice Teachers

There are three different methods that have been used and described in the literature for providing examples to preservice teachers of how to use technology effectively in their instruction. Albert Bandura and Richard Walters (1963) divided the types of modeling possible as real-life modeling and symbolic modeling, which they further divided into verbal and pictoral modeling. We have chosen slightly different terms for this paper, reflecting the kind of technology usually employed for each type of modeling, and will call the three methods of modeling text modeling, video modeling, and live modeling.

Text-based modeling. The method with the least fidelity in representing real situations, but one that is the easiest to produce and disseminate is to provide text-based models of effective teaching. This usually takes the form of written case studies disseminated through textbooks (such as one published by the International Society for Technology in Education at http://cnets.iste.org/teachers/t_book.html), periodicals, and online venues. Researchers have been increasingly interested in the last two decades in how case-based instruction (CBI) may help preservice teachers transfer a particular kind of knowledge, such as knowledge of how to integrate technology effectively, into their teaching.

Many researchers have found that CBI methods have been effective in preservice contexts (Barksdale-Ladd, Draper, King, Oropallo, & Radencich, 2001; Siegel, 2002); in particular they have found benefits in using this method for contextualizing teaching knowledge for preservice teachers and increasing reflection on their own methods. For example, Dana & Floyd (1993) presented a teaching case to four classes of 20-30 teachers, and asked the teachers to reflect on the situation presented in the case and cooperatively construct concept maps and role play solutions to the problem presented in the case. They found that this method helped teachers examine their beliefs and biases and how these impacted how they perceived novel teaching situations. McWilliam & Snyder (1999) found in a study with 67 graduate students using case methods in a course on families that the students not only learned effectively but were able to transfer this knowledge to the solving of problems in a novel case. Some researchers have also described a benefit from adapting typical CBI with multimedia or web-based delivery technologies (Baker, 2005; Bowers, Kenehan, Sale, & Doerr, 2000; Bronack, Kilbane, Herbert, & McNergney, 1999; Thomas, 1998).

While CBI methods have been useful in some contexts, researchers have also noted that there have been some challenges. For example, the situated knowledge gained from students' prior experiences and their experience with a dilemma-based case can influence their abilities to solve problems and find alternative solutions when presented with a written case (Powell, 2000). Another researcher found that using case studies with seven student elementary teachers fostered reflective thinking but did not necessarily improve the ability of the students to find solutions to teaching problems (Jin, 1996). There are also challenges in that text-based modeling requires the students to visualize the situation being described in the case study, and this extra cognitive load may impede their abilities to transfer the knowledge from these models to live, in-class situations, although this needs to be researched further.

Video modeling. One method commonly employed to teach preservice students techniques for using technology is the use of video cases or video models. The method for using video cases is often to have the students either view the videos in class or on their own, and then reflect and discuss different aspects of the videos, evaluating how well the models used the technology and considering alternative methods (Wetzel, Wilhelm, & Williams, 2004).

The use of video case studies for providing models of effective practice—but not necessarily in the area of technology integration—has been studied since the 1980s. More recently, Beck, King, and Marshall (2002) found that using video cases in preservice programs had the potential of helping student teachers bridge "theory and practice because they present opportunities for applying theoretical, conceptual, and pedagogical knowledge about teaching and learning in real-world classrooms and explicating such knowledge embedded in practice" (p. 346). These researchers explained three reasons why video cases can be effective in training student teachers: (a) video cases are authentic portrayals of realistic situations; (b) students viewing video cases learn by dual coding (Clark & Paivio, 1991), and (c) events and contexts are expressed in ways that are believable and more easily interpretable by the students (p. 347). These authors further explained that the use of video cases allows prospective teachers to vicariously experience the classroom situation through the eyes of the video model, while still being sufficiently removed so that the students can reflect critically.

Beck and colleagues (2002) also considered the negative aspects of video modeling, which included that the modeling has decontextualized elements that may cause students to consider the video case to be less authentic, and overexposure to the same case might cause boredom. Copeland and Decker (1996) cautioned that video cases might not be the most effective way to train teachers, saying, "little empirical evidence has been developed to date concerning the effects of video-based case pedagogy in teacher education. With this, as with many innovations in teacher education, optimism precedes evidence" (p. 467). While using video cases can have some advantages over text-based models because they make it easier for students to visualize the teaching in an authentic instructional setting, they may still be too detached from the students' own experiences, and may employ more passive, rather than active, learning.

The Live Modeling Approach. A third approach to providing models of effective educational technology use is to model, or show by example, correct technology integration principles in the context of actual face-to-face lessons (Brush, Glazewski, Rutowski, Berg, Stromfors, Van-Nest, Stock, & Sutton, 2003; and Doering, et. al., 2003). Live modeling has the potential to "provide substantially more relevant cues with greater clarity" than textual modeling, according to Bandura and Walters (1963), and also more than video modeling since interaction with the model is possible. Thomas Brush, along with other ASU researchers, explored the use of live modeling sessions as part of a Preparing Tomorrow's Teachers to Use Technology (PT3) grant. In this project, they developed a series of activities where the instructor for a technology-for-teachers course taught sample K-12 lessons infused with technology. While these instructors played the role of K-12 teachers, the preservice students participated as if they were K-12 students. By observing effective models from the student point of view, and by then using technology to complete example K-12 assignments, these students were better prepared to use technology in their own teaching (Brush, Glazewski, Rutowski, Berg, Stromfors, Van-Nest, Stock, & Sutton, 2003).

A different attempt to use modeling was reported by Doering and colleagues (2003), who explained a new program being implemented at the University of Minnesota, also as part of a PT3 grant. In their program, instructional technology instructors worked with methods faculty on a 1.5 credit course. In the course, the IT instructors would typically teach a new technology, and the methods faculty would discuss possibilities for using the technology to teach a particular subject. It is difficult to know for sure from their article, but it appears that the methods instructor also occasionally modeled, or showed possible ways to teach with the technology, but it seems that the modeling was not formally organized and taught as a complete K-12 unit of instruction, as was the case with the ASU model, but was more brief and informal.

Our version of providing live, in-class models of K-12 lessons infused with technology attempts to draw from some of the benefits provided by video-based modeling, while accounting for some of its weaknesses. We developed our modeling sessions based on Brush, et al. (2003)'s ideas, as well as on several theoretical frameworks. First, the modeling sessions apply ideas related to situated cognition, or the theory that knowledge is "stolen" by learners as they interact with professionals through authentic practice and attempt to model their behavior after these professionals, who in this case were the instructors (Brown & Duguid, 1993). Situated cognition emphasizes that learning is embodied within the contexts and actions of the participants, and we attempted to capitalize on these attributes by creating a learning environment in class that paralleled the kind of classroom we were hoping the students would create when they were practicing teachers. Second, live modeling follows principles of active learning, which is the belief that students learn better by being actively involved in the learning, instead of passively receiving lectures at the hands of their instructors. It implies that the students will be participating, writing, reflecting, talking, doing, and performing in the classroom. Bonwell and Eison (1991) believed that learning could be made more active through many different methods, including the use of role play, which is similar to the live modeling sessions described in this article. Finally, we designed the live modeling so that students could continue to hone their technology skills by working with technologies as part of the modeling session. This allowed us to meet our dual purpose of helping the students learn the tools, as well as model how to use the tools effectively.

We also designed the modeling sessions with the goal of improving student transfer of the learning to their own future teaching. Transfer of learning, especially high-road transfer, or transfer of non-automatic tasks such as problem-solving (Marini & Genereux, 1995) is often seen as the ultimate goal of education. Simply, instructors hope their students will be able to abstract out the essential elements of what is taught in school and apply it to life outside of school. However, Bransford, Brown, & Cocking (1999) explain that there are many barriers to achieving effective transfer of learning from academic settings to naturalistic ones. They explained that schools emphasize individual work and abstract, mental reasoning; while most practical settings employ contextualized reasoning within groups who have tools available to accomplish the tasks more efficiently. Because of these differences, transferring knowledge from school to life is often difficult for students.

Researchers have found some strategies that can improve teaching for transfer. These strategies include engaging the students in approximations of the desired performance (practice tests or performances), and supporting the abstraction of principles from the context of the classroom and considering other possible applications of these principles (Bransford et al., 1999;

Hunter, 1971). Other strategies are to promote understanding rather than just memorizing of information, engaging students in learning tasks that share cognitive elements with the final performance tasks, and encouraging students to use metacognition in their learning (Bransford et al., 1999; Singley & Anderson, 1989. In our version of live modeling, we attempted to use many of these research-based ideas for promoting transfer, such as group discussions and individual student reflections and online journals to help students abstract out the key and transferable elements of each modeling session. Also, the concept of having students participate in a typical K-12 lesson infused with technology was designed to help the students detach from their roles as university students and see technology integration in typical K-12 lessons so transfer to their own classrooms would be easier.

How we implemented our modeling sessions. Besides the two examples cited from Brush et al. (2003) and Doering et al. (2003), there appears to not be very many instances of live modeling reported in the literature. In our university, instructors of a preservice instructional technology course began using live modeling in Fall 2002. These modeling sessions include three stages. In the first stage, there was an in-class activity where the instructor taught a sample lesson using technology, and the students worked on a project connected with the lesson. The instructor usually asked the students to suspend their disbelief for the duration of the class and to imagine they were observing the lesson through the eyes of K-12 student. The presentation or class activity was usually short, and often included a small tutorial on an aspect of a software program or other technology tool that students would need to use to complete the project. There was often time left for the students to begin to work on their projects while the instructor was available for assistance. The second stage of the modeling session was for the students to work in groups during the week to create a deliverable that demonstrated their understanding of the technology and the subject material. The final stage of the modeling sessions was to help students reflect and apply the knowledge gained from the modeling to their future teaching contexts. Table 1 gives more detail about the six different modeling sessions used in this course.

These modeling sessions were originally developed for elementary education students, which took our course for two credits. We adapted the modeling sessions for secondary education students, who took our course for only one credit, by requiring them to select one modeling session to attend and participate in. We encouraged them to select a modeling session somewhat related to their subject area, and the nature of the work and depth required was adapted to fit in a secondary education context (for example, a future high school math teacher may participate in the same balloon rocket modeling session but be required to show more advanced calculations and graph manipulations in Excel than the elementary education students).

Insert Table 1 about here

Research Methods

This research study had two questions:

1. What are the experiences of the students in the modeling sessions?
2. What was the impact the modeling may or may not have had on preservice teachers' abilities to learn a new technology, as well as to learn effective strategies for integrating the technology into their teaching?

There were three phases to this research. In the first, 11 former students of the course were interviewed. The second phase was the creation and administration of a survey to former students of the course over six semesters from Fall 2002 to Spring/Summer 2004 (*n*=159). In the final phase of this research, nine additional former students were interviewed.

Collecting and Analyzing Interview Data

Initially, 11 former students of the course were selected for semi-formal interviews about their experiences in the course and with modeling. These students represented many different sections, instructors, and majors, and they were selected because of their active involvement in the course. The interviews followed a narrative format that stressed the importance of allowing the participants to tell their own stories about their class experience. The purpose of these preliminary interviews was primarily to help the research team identify the types of questions that should be asked on the survey, and notice was taken during these early interviews of the kind of language the students used to identify activities (for example, did they call them "modeling sessions" or something else?), what parts of the modeling experience they remembered, and how they described the modeling sessions overall. After collecting and analyzing the survey data, the research team interviewed a new sample of nine former students. These interviews were more focused than the initial interviews and were designed to test emerging theory that was being developed.

To analyze the data gathered from the interviews, the interviewer first wrote a one- to two-page summary after each interview of the major themes of the interview, along with quotes and paraphrased remarks to support those themes. The interviewer then wrote short memos about his ideas and theories regarding what the participants said (Glaser & Strauss, 1967; Hatch, 2002). Constant comparison methods were then used to compare themes within each interview, and then across interviews, to identify patterns in the participants' experiences. After the main themes were identified from the data for further analysis, we analyzed each interview, looking for evidence for and against the themes and patterns that had been identified, and also to discover any other themes that may have been overlooked. Thus, a mixture of inductive/deductive approaches to coding the data, highlighting key phrases to support ideas and writing short phrases to explain the general idea of each category or theme, was used for analysis.

To establish the trustworthiness of the qualitative data, Lincoln and Guba's (1985) standards for increasing the credibility, transferability, dependability, and confirmability of the project were used. These standards were met through many methods including triangulation, or the use of multiple data-gathering methods. The conclusions and research methods were then checked and verified by two qualitative researchers, who served as peer debriefers for the project. Quotes and case studies were verified with each participant to ensure they accurately described the participants' experiences. The research team employed negative case analysis techniques to check subjectivity and also maintained an audit journal of decisions made during the project.

Collecting and Analyzing Survey Data

The survey was created using an online survey management tool so that it would be easier to collect, store, and analyze the surveys. Most of the items for the survey were created based on the themes identified from the analysis of the initial interviews. As much as possible, the same or similar wording used by the interview participants to describe events, situations, feelings, and ideas were used in the survey questions so that they would be easily understandable. Most of the questions were quantitative and included a mix of rating, ranking, and multiple-choice questions. However, there were also a few open-ended questions.

The validity of the survey was evaluated by emailing the survey to a practice sample of several former students and teaching assistants for the course. These students were asked to take the survey and offer suggestions for improvement. The survey was then disseminated to former students of the course for the previous six semesters, and 159 participants responded. This response rate represented a good diversity of students from different majors, instructors, and course sections. Most of the quantitative data were reported as descriptive statistics, percentages, and averages and used to aid the holistic, qualitative analysis of all of the data. The open-ended questions on the survey were extracted from Surveymonkey and analyzed using constant comparison techniques.

Findings and Discussion

In general, live modeling was perceived by the majority of students to be effective at teaching technology skills and ideas for integrating technology as teachers. Students felt that modeling activities were the third most useful class activity, out of six suggested options (see Table 2). This was a much more positive response than that given for video modeling. We had used some video modeling in the course, in addition to live modeling, but students only ranked video modeling as the fifth (out of six) most useful class activity. A large majority of students also indicated that live modeling helped them feel more excited and more confident to use technology as teachers (see Tables 3 and Table 4). Many students said that after the course they would use technology most of the time for various activities (see Table 5).

In the following two sections I will first describe our findings about the effectiveness of using live modeling for teaching technology skills, and second, the effectiveness of the method for teaching technology integration strategies. I will also discuss some of the challenges that some students had, along with a discussion of why they may have had these challenges.

Insert Tables 2, 3, 4, and 5 about here

Live Modeling's Potential for Teaching Technology Skills

The findings indicated that modeling sessions, for the most part, seemed to be useful in helping the students to acquire new technology skills they didn't have before. Most students taking the course tend to have limited experience with technology besides basic use of the Internet, word processing, and sometimes presentation software. Modeling appeared to have three affordances that helped students learn technology: (a) it allowed the students to learn hands-on, by trial and error, (b) there was in-class help as students began to learn the technology, and (c) the learning was contextualized in a teaching scenario.

Learning "hands-on." The most important affordance was that the modeling sessions allowed the students to learn technology skills by actually working with the tools. Eighty-four percent of the students agreed that modeling was enjoyable when they were working with the tools "hands-on" (see Table 6), and learning a technology through hands-on projects was the answer students rated most representative of their modeling experience (see Table 7). Some students felt that they had never had the opportunity to really use technology tools before. For example, one student wrote that "hands-on work with technology taught me the most because I hadn't done a lot of that before the class." Another student commented, "Having us actually do the technology was helpful for us to solidify what we learned in class." A third felt that this participatory style of learning was especially important for kinesthetic or visual learners:

> I think I like the fact that it was hands on. I'm a very visual learner and I retain more when I can actually do the activity. . . . And I think frequently with technology you have to jump in and actually do it, so you notice, okay, there's a glitch here or here's a problem I ran into, how do I work around it?

Finally, one student said that “When I was done with that class, I felt that I had learned so much, I felt very familiar with all the programs we used, and I was no longer intimidated by the advanced technology—as I was before.” The majority of survey respondents (92.5%) agreed by indicating that they felt more confident using technology in their own teaching after the modeling sessions (see Table 2).

Insert Tables 6 and 7 about here

In-class teacher assistance. Many students felt that it was important to be able to struggle on their own, but then to receive help from the professors when they needed it. Many students felt the structure of the class, which usually left time in class for students to begin working on projects while the teacher was still present, was useful, and they wished there had been more opportunities for teacher assistance. One student described her experience as effective because of the help her professor and TA gave:

> He provided plenty of time . . . in class, which was beneficial for those who didn’t quite understand the programs. He would be right there. Our TA would be right there. The other students would be there to help anyone who didn’t understand.

Another student commented that “It really helped me to learn the technology better especially with a professor and TA on hand to help with any questions I came [up] with throughout the activity.”

Learning technology skills in context. Many students also indicated that it was useful to learn a new technology, not in a workshop or tutorial setting, but in the context of a K-12 learning activity. This supported a major theoretical underpinning for the creation of the modeling sessions, which was that the learning would be more useful if it was contextualized. One student said this was an important aspect of the course activities, and discussed how her professor gave examples of how technologies could be used in teaching situations. She said a variety of scenarios were helpful, "I do think the scenarios were important because different scenarios would use the program in different ways." Another student commented that

> I think I like modeling, I'm not sure if I can see a better way to do that because the same time you are modeling you are learning the technology. You get an idea for how to use it, they give you a sample lesson plan for using that technology, integrating it into your lesson

In a different interview, a student said that:

> the pseudo lesson [her term for modeling sessions] is really important because you learn how to do the technology while you're doing the lesson. I think that that's one of the ways that they have to help us learn how to use it.

However, some students did not share these feelings, not because they felt it wasn't useful to learn a technology in context, but because the context of the modeling sessions didn't match their own contexts. This made it difficult for these students to transfer what they learned in the course to their own contexts, but we will discuss this more later in this paper.

Modeling's Potential for Teaching the Integration of Technology in Education

In contrast to the teaching of technology skills, which most students seemed to think the modeling sessions were well-suited to do, there was somewhat greater disparity in their perceptions of the effectiveness of live modeling for teaching technology integration principles. Most students, especially elementary education majors, felt the modeling was very helpful in showing how technology can be used effectively as a teacher. For example, one student said she already had learned most of the needed technology skills before the class, but she still felt the modeling was helpful because it helped her see the application of technology in schools, “I had already known how to do just about everything else in the class to that point, but I was able to learn how to utilize that in lessons in a teaching atmosphere.” Another felt the same way and said:

> I kind of already knew how to do PowerPoint but what it did for me was helped me to discover different ways of incorporating PowerPoint into a lesson plan. I think that’s what one of the biggest focuses of the class was. . . . And that’s what (my instructor) said at the very beginning. It is to teach us how to use the programs but more importantly it’s to teach us how to incorporate them into the classroom setting. I think by giving us the scenarios, it gave us some examples so we could identify situations where those programs would be useful to the students in our own class.

Another student agreed by adding that in her own experience:

> I think the main idea that I got from the class was that technology is not just this thing, oh, let’s go learn technology. It’s something that can be integrated into the rest of the curriculum. You can teach computers while you’re teaching English, while you’re teaching math.

Students also indicated on the surveys that learning how to apply technology to their teaching careers was often a positive impact of the live modeling. For example, 71% of the students agreed that during the modeling, they started thinking about how to apply the technology to their specific context (see Table 6), and 70% felt the modeling applied to their future careers (see Table 3). Most of the former students said a lack of knowledge about how to apply technology to their teaching was one of the least challenging barriers to actually using technology, although this result cannot be directly linked to the modeling sessions alone. However, on another survey question, students ranked highly (rated 3.17 out of 7) the feeling that live modeling helped them brainstorm new ways of using technology in teaching, and helped them want to use technology as teachers (third-highest rated item out of seven, see Table 8). These positive results were all significant because the preservice instructional technology course services students from almost all educational disciplines on campus. Some of these students receive some instruction in using technology in their unique disciplines, but some do not. Many only learn basic tools like webquests, word processing, and PowerPoint (for presentations, not for engaging students in activities). Thus, one of the goals of this instructional technology course was to help a wide-range of students see how different technologies might be applied to teaching many different kinds of subjects and topics.

Insert Table 8 about here

The Problem of Transfer

However, in contrast to these interviews and survey results, there was also evidence that modeling was not effective in helping some students understand how to integrate technology successfully as teachers. Some students felt the modeling showed inappropriate uses of technology, so the examples were poor ones that made it more difficult to understand how to integrate technology appropriately. For example, one student said that “we felt like we were forcing technology on projects that didn't require it and didn't really make it helpful. Do more realistic and applicable projects.” Another suggested that “there were times that technology was thrown into a lesson plan, just for the sake of using technology. Make it all relevant to the topic.”

As we analyzed the responses from those students who benefited the least from the live modeling, we found that these students were most often secondary education students, which meant they represented a wide variety of age levels and subject specialties than did the more homogeneous group of elementary education students. Because there were so many different teaching majors serviced by this instructional technology course, it was impossible to have the course instructor model technology applications in everybody's unique teaching context. What the instructors hoped would happen, however, is that if a modeling session was presented in a context different from that of a particular student, that this students would be able to reflect and consider how the same technology and basic principles for integrating the technology could apply to their future teaching and their own contexts as well.

Bransford, Brown, and Cocking (1999) agree with Byrnes (1996) that transfer can be defined as "the ability to extend what has been learned in one context to new contexts." Essentially, this was what students who seemed to have the best learning experience in the modeling sessions were able to do—they were able to transfer, at least in their minds, the learning from the context of the modeling sesson to their own unique teaching context and situation and apply the principles to their visions and goals for their own future teaching.

An important question is why some students were able to perform this transfer, and why others could not, and what key improvements to the method of live modeling might improve the likelihood that students will be able to make this transfer. Bransford and colleagues felt that there were several characteristics of teaching for transfer, including: teaching for understanding; representing what is being taught in different contexts and different levels of abstraction, and engaging students in active learning that supports reflection, metacognition, and abstraction of learned ideas to other contexts. These researchers also argue learning can sometimes be overly tied to one context, so that students cannot understand how the principles apply to other contexts. This study identified several patterns that may indicate how the modeling sessions were not adequately addressing this point about overly contextualized learning. Many students felt that the modeling sessions were too context-specific, and they struggled to abstract the learning from that context to their own. A specified context for a modeling session was helpful, but only if the context was the same as that of a particular student. Otherwise, a contextualized modeling session was difficult to apply to the student's own teaching careers.

Because the degree of transfer between two different contexts depends upon the match between elements in those two contexts (Bransford et al., 1999), it appears that when the students' teaching context matched that of the modeled context, then transfer was easy for students. While there can be many possible breakdowns in the congruency of contexts, in this study we found five major patterns, or instances, when a breakdown in the similarity of contexts would occur. These contextual breakdowns were differences between:

1. The student teachers' subject or teaching emphasis.
2. The intended age level of the students the teachers plan to work with.
3. Teaching style between the course instructor and the preservice teachers.
4. Student expectations about the course and instructor's expectations.
5. The availability of technology in the course and the students' perceptions of how much technology will be available to them as teachers.

In a way, the context of the modeling session could be visualized as one side of a cliff, while the students' own contexts were on a cliff on the other side of the valley (see Figure 1). Each of the contextual breakdowns could represent a pit, and each might be a different size for each student, depending on their own situation. If the students are only required to cognitively jump across one or two pits, they might still be able to make the cognitive leap. But each new contextual “pit” present would make transfer successively more difficult. How many pits could be “jumped,” and which breakdowns were most crucial, depended on each student.

We will now briefly describe each of the five contextual breakdowns that made transfer of technology integration knowledge difficult for some of the students in the course.

1. Difference in subject or teaching emphasis

A difference in subject or teaching emphasis seemed to be the most difficult contextual break to overcome when attempting to transfer the learning in the modeling sessions. A vivid example of how difficult it was to complete a transfer from one subject to another was described, unknowingly, by one of my initial interviewees. This student was preparing to be a science teacher. When I asked her about the modeling activities, she excitedly described a biological modeling activity where the students identified different trees from pictures they took outside. She felt this type of activity was something she would replicate with her own students:

> One of my favorites was my tree one that is one I would use. . . . It’s good for them to get out and see what is actually in the world around them and then apply it to science. It’s more of a discovery process . . . it’s a good educational tool.

She even admitted that she probably learned more from this and other science modeling sessions, “I probably remember the science ones better because those are the ones I had more interest in.” For this student, modeling sessions such as this one were very useful because they were similar in subject matter to what she was interested in, and thus transfer from the course’s context to her own was easy.

After hearing how positive her experience had been with this modeling session, I was shocked when the interview took an abrupt turn towards the negative, as she described another modeling session, one that focused on English skills by creating digital storybooks:

> The storybook one I was like, yeah right, like I'm ever going to use this because I want to be a science teacher and I don't take the English very seriously. None of my English classes have ever intrigued me.

The ironic twist is that this student felt digital storybooks had no application to science, even though at least one geology professor is currently studying successful ways to use digital storytelling to teach geology (Thompson, Graham, & Bickmore, 2005). She also struggled to cognitively transfer the learning from a social studies modeling session, and she commented that "with the storyboard one I had a hard time finding a way that that would be applicable." She then mentioned that "but if you stretched it you can make anything applicable to any subject," but from her interview it seemed she struggled to do this. As this student reflected with me, I asked her why it was easier to apply the learning from some modeling sessions and not others, and she responded it was due to, "the subject mostly. Some of them were science, and some of them were science-related, like graphing, and others were pure history or English."

2. Intended age level

Each modeling session was targeted towards a specific grade level. When students intended to teach a different age or grade level than that depicted in the modeling session, then it was difficult for them to mentally apply the live models to their own contexts. One student in this situation is now teaching high school physics, and he felt most of the class was unhelpful, mostly because of the elementary style of the modeling sessions. "Being in the students' shoes in that instance didn't really help that much because the activity was very distinct from the type of activity I'd be doing, do you know what I'm saying?" he said. He went on in the interview to explain that the modeling session didn't help him to see how well the technology could be used with high school students because he wouldn't know what challenges using more advanced technology—like he would expect to use in high school—might create.

> In this instance, with elementary, it didn't seem like the subject matter was at all challenging and it didn't seem like the technology was challenging because our application was so limited. I would like to see a modeling session that was on the same level that I was at and then [I could] come up with my own, and if we're not going to do that, they could have explained in five minutes what a sample lesson for an elementary teacher would be and say come up with something specific for your area.

As this student explained, he felt that if the modeling wasn't specific to everyone's context, then the presentation should be shorter ("they could have explained in five minutes"), with more time spent on discussion that could pertain to each unique context.

One student on the survey felt that some of the modeling sessions taught skills very elementary for high school students, which made it more difficult to apply the activity: "I thought the modeling sessions were fun, but as a future high school science teacher they were completely missing the boat. . . . Drawing shapes on a computer is something I assume that all high school students know."

3. Difference in teaching style

Sometimes the difference in the kind of traditional pedagogy used in the live modeling sessions was difficult for students to apply to their own future teaching because they anticipated using different methods. One student remarked that the most difficult thing for her during the modeling sessions was trying to understand how to use the technologies in a very hands-on, kinesthetic environment like music education, where students are clapping, singing, touching, dancing, and moving. That style of teaching is sharply contrasted with the style used for the modeling sessions, which this student characterized as being tied to a classroom setting of desks and chairs. “I wondered occasionally how would I be able to use this [what she learned in the class] for music, and I couldn’t think of very many ways I could use it,” she said, adding later that “the technology stuff that was presented seemed more for a classroom setting where students are sitting in desks or in a computer lab and you’re working together to put this stuff together and not so much in a classroom setting where you’re sitting on the floor in a group sharing music experiences.”

Other students had similar difficulties overcoming this cognitive barrier because they anticipated using different teaching methods for high school students, rather than elementary students, or because they were preparing to teach subjects such as home economics, dance, or theater. Another set of students who seemed to struggle with this type of contextual breakdown were special education teachers. One student said, “I felt like this didn't really apply as much to me, as I am a special ed teacher emphasizing in severe disabilities. It is not beneficial or realistic to do a massive lesson with technology with my students.” Students in these subjects need to use nontraditional methods for engaging their students, and while technology can be used effectively to do this, the modeling sessions focused on more traditional approaches.

4. Students’ expectations for the course and their role in the course

One of the patterns that appeared over and over in the interviews and survey is that the students didn’t understand the dual nature of the course—to teach technology skills and integration principles and ideas. Rather, most students seemed to feel that the only purpose of the class was to teach new technology skills—or if this wasn’t the main purpose, then it should have been. Some students even listed discussion on pedagogy as among their least favorite aspects of the class because they wanted more time spent on learning the technology. We learned that a difference in the students' and faculty's expectations about what the class was, or should be, primarily concerned with was, in fact, a hindrance to students being able to cognitively transfer pedagogical learning. For example, one student struggled to even discuss learning pedagogy from the modeling sessions—in her mind, that was not their purpose. She kept repeating thoughts that the focus of the class was to "make all these projects, not really how to teach with technology." Because of this, modeling sessions that dealt with tools she already knew she did not perceive to be useful: "I don't want to go and sit and learn how to use things that I already know." She made this comment after admitting that she didn't know yet the methods or pedagogy for integrating technology into schools effectively. But despite being deficient in her understanding of methods, she felt there was nothing to learn from a modeling session dealing with a familiar technology. It almost seemed as though she, and students like her, had a blind spot and couldn't see the usefulness of any activity that didn't teach a new technology skill.

Another student added that

> I think maybe the teachers have this timeline that students might not be considering. The teachers know they're teaching for the sake of our teaching. Their sight may be broader than ours. Ours is we don't know as much as we want to, and we want to know it all before we get into the schools and have to teach it. . . . The fear of what you don't know [which technologies you don't know] is kind of scary.

This student went on to explain that now that she is in the elementary education program, she understands better the importance of learning how to use technology teaching methods, even though that was not perhaps her first priority when she took the course.

The challenges that some students had with misunderstanding the focus of the course probably stems from a couple of causes. First, a new faculty member had recently redesigned the course with a new emphasis on technology integration and teaching pedagogy. Previously, the course had consisted of lectures in a large classroom about integration principles, and small workshops where students learned technologies (Graham, et al., 2004). In this version of the course, most of the emphasis was on the workshops, and that is what most of the students remembered about the course. Thus, even when instructors described the course as focusing on integration strategies and pedagogy, students still remembered what they had heard about the previous version of the course, and misunderstood the course to be about technology only. Secondly, the course is taught by the instructors from the Instructional Psychology and Technology department, rather than by methods instructors, adding more to the confusion.

5. Technology availability/complexity

A final contextual breakdown that we were able to establish from the data was a breakdown in how ubiquitous the technology was in the course, and the students' perceived expectation of how much technology they will actually have available to them as teachers. Our preservice instructional technology course was taught either in a computer lab or with carts of laptops, and there was usually a one-to-one ratio of computers to students. In contrast, most students felt they will not have access to very much technology as teachers. When asked on the survey what they perceived the greatest impediment to using technology as teachers to be, the top response was a lack of technology at their school (see Table 9). One student explained that not only would technology not be as available in real schools, she also felt it would play a less significant role. "I don't think it (modeling sessions) seemed really realistic because they won't have that much technology in front of them. Technology in a real classroom will be supplementary." Other students felt that the technology used in the modeling sessions was also unrealistic because they were not convinced young children would be able to use technology that "advanced."

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Insert Table 9 about here

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Conclusions

While it may seem from the previous section that these contextual breakdowns might make live modeling an ineffective method, the positive feedback indicates that the live modeling method of training preservice teachers is effective for most students. Despite challenges faced by some students in cognitively transferring to their own unique contexts, modeling was perceived by the majority of students to be effective at teaching technology skills and ideas for integrating technology as teachers. Even with the challenges to transfer that we have described in this paper, most students (79%) indicated that it was somewhat easy or extremely easy to apply what they learned in modeling sessions to their future teaching (see Table 10).

Insert Table 10 about here

These findings lead us to the obvious question: If most of the students felt live modeling effectively prepared them to use technology as teachers, why was this not the case for all students? Why did some students have an entirely opposite experience and perception of the modeling sessions? In the interviews, we found that most of the students with positive experiences in the modeling sessions tended to be elementary education majors whose contexts were most similar to those of the modeling sessions. Thus, the core theory suggested by the data in this thesis is that modeling can be very effective in helping students to visualize how to use technology effectively when it is used in a homogenous group of students with similar teaching experiences and contexts. The more variety (including variety in teaching emphasis, career expectations, etc.) existing in the makeup of a class, the more the modeling sessions will grow progressively more difficult and less effective for the students.

In relation to this core theory, a sub theory generated by this research is that there are many different ways that students can vary from each other in their preparation for an instructional technology course, and that the five biggest potential pitfalls, or barriers, to students profiting from a modeling session are (a) a difference in subject or teaching emphasis, (b) a difference in the age level of the students that the teacher intends to teach, (c) the teaching style of the student teacher, (d) the student teacher's expectations of the course and perceived role in the course, and (e) how much technology the student teacher expected to be available at their future teaching post. These barriers can be considered contextual breakdowns and can be overcome by students, but the more barriers existing for students will make it progressively more difficult for those students to complete a transfer of what they learn in a modeling session to their own future teaching context.

Because of some of the challenges identified in this study, the course has continued to evolve in an attempt to better address the needs of students from different teaching disciplines and contexts. In another iteration of the course, students in similar disciplines were placed in groups and each student developed a lesson using technology for their own subject material that they modeled for the other members of their group. Web technologies were also used to link students from similar disciplines together so they could discuss online how concepts discussed in class applied to their specific situations. Further research would be needed to determine if these changes have been able to address the problems of transfer discussed in this paper.

Future research in this area could benefit from studying the effects from blending live modeling with other methods of providing models of effective teaching (such as video modeling and textual modeling). It would also be useful to further investigate the process of transfer and why some students fail to make the mental transfer from what is experienced in their instructional technology course to what they perceive their own teaching experience to be. It would be interesting to follow these students into their teaching, to determine whether their ability to make a mental transfer of what they have learned led to a full transfer as they applied and actually implemented technology integration in their teaching.

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Tables

Table 1

A Description of Six Different Modeling Sessions.

Subject	Activity
Math/Social	Students collect survey data about the demographical makeup of the class and create charts in Excel
Science/Math	Students conduct an experiment by measuring the distance balloon rockets travel when inflated to a variety of sizes
Social Science	Students take pictures of trees and identify them using the Internet
Math	Students take pictures of shapes in everyday surroundings and use drawing tools to identify the shapes in the pictures
Social Science	Students research the civil rights era on the Internet and create a documentary in iMovie
Language Arts	Students think of rhymes using Inspiration (concept-mapping software) and then create a digital storybook with their rhymes and clipart using PowerPoint.

Table 2

*Rankings of IPT 286 activities in order of how helpful the students perceived them to be in preparing them to use technology effectively. The students ranked these items from 1 to 6 with 1 representing the activity that was most helpful. (*n*=159).*

	Rank
Creating a lesson plan that would use technology.	2.53
Workshop days when the professor taught us how to use a new technology.	2.67
Modeling lessons (where the instructor taught a sample lesson as an example.	2.75
Class discussion about technology integration.	3.83
Watching videos of teachers using technology.	4.28
Reflection/writing activities.	4.82

Table 3

*The percentage of students who indicated that after most of the modeling lesson activities, they felt: (*n*=159)*

	Response Percent
Very confident in my ability to use technology as a teacher	26.7%
Somewhat more confident in my ability to use technology as a teacher	61.7%
Somewhat less confident in my ability to use technology as a teacher	5.0%
Not confident at all in my ability to use technology as a teacher	2.5%

Table 4

*Percentage of students who responded that each statement accurately represented how they felt after most of the modeling sessions (*n*=159).*

	Response Percent
Very excited to use technology as a teacher	26.7%
Somewhat more excited to use technology as a teacher	60.8%
Somewhat less excited to use technology as a teacher	0.5%
Not excited at all to use technology as a teacher	7.5%

Table 5

*On a scale of 1-5 from never to always, the percentage of students who responded that they always or most of the time use technology to help them accomplish each of these purposes (*n*=159).*

	Percentage
To make yourself more efficient	58%
To improve your presentation to the students	54%
To add variety to your instruction	51%
To help your students learn more effectively	45%
To help your students learn in new ways	39%

Table 6

*Percentage of students that completely agreed or generally agreed with each statement about their experiences with the in-class portion of the modeling assignments. (*n*=159)*

	Percentage Agreed
I enjoyed it because I was doing something hands-on	84%
I felt the activity was fun and useful	73%
During the activity, I started thinking how I could change this lesson so it could work in my own teaching	71%
I struggled because there were too many students with questions and not enough teachers/TAs	39%
I felt the activity was forced and artificial	35%
I struggled to focus on both the subject matter and the technology	28%

Table 7

Student rankings representing how well each answer represented their experiences in the modeling sessions (lowest numbers are for statements that are MOST representative of their experiences). (n=159)

	Average Rank
They helped me learn a technology through hands-on projects.	3.15
They helped me brainstorm ways of using technology in my teaching.	3.17
They helped me want to use technology in my own teaching.	3.47
They helped me learn a new technology in the context of a lesson plan.	3.51
They helped me understand how using technology in schools really works	4.58
They helped me understand the students' perspectives using technology	4.84
They helped me see how students react to using technology	5.40

Table 8

Rankings of different barriers to integrating technology into their teaching after leaving the instructional technology course. The students ranked these statements from 1 to 4, with 1 representing the barrier that was most challenging.

	Rank
There is a lack of technology at my school	1.96
I'm not sure how to use technology and handle class management issues	2.60
There is a lack of administrator/cooperating teacher support	2.70
I'm not sure how to use technology in my specific discipline	2.82

Table 9

*Rankings of how well each answer represented the students' experiences in the modeling sessions. The students ranked these items from 1-7 with 1 representing the answer that most represented their experience. (*n*=159)*

Modeling sessions helped me …	Rank
Learn a technology through hands-on projects.	3.15
Brainstorm new ways of using technology in my teaching.	3.17
Want to use technology in my own teaching.	3.47
Learn a new technology in the context of a lesson plan.	3.51
Understand how using technology in schools really works.	4.58
Understand the students' perspectives using technology.	4.84
See how students react to using technology.	5.40

Table 10

*Percentage of students responding to the following question: Please rate how easy, overall, it was to APPLY or TRANSFER what you learned from the modeling sessions to your own future teaching—if you are not yet teaching in a school setting, please answer according to what you anticipate will be true once you start teaching (*n*=159).*

	Percentage
Extremely easy to apply what I learned	17%
Somewhat easy to apply what I learned	62%
Not very easy to apply what I learned	17%
Not at all easy to apply what I learned	4%

Figures

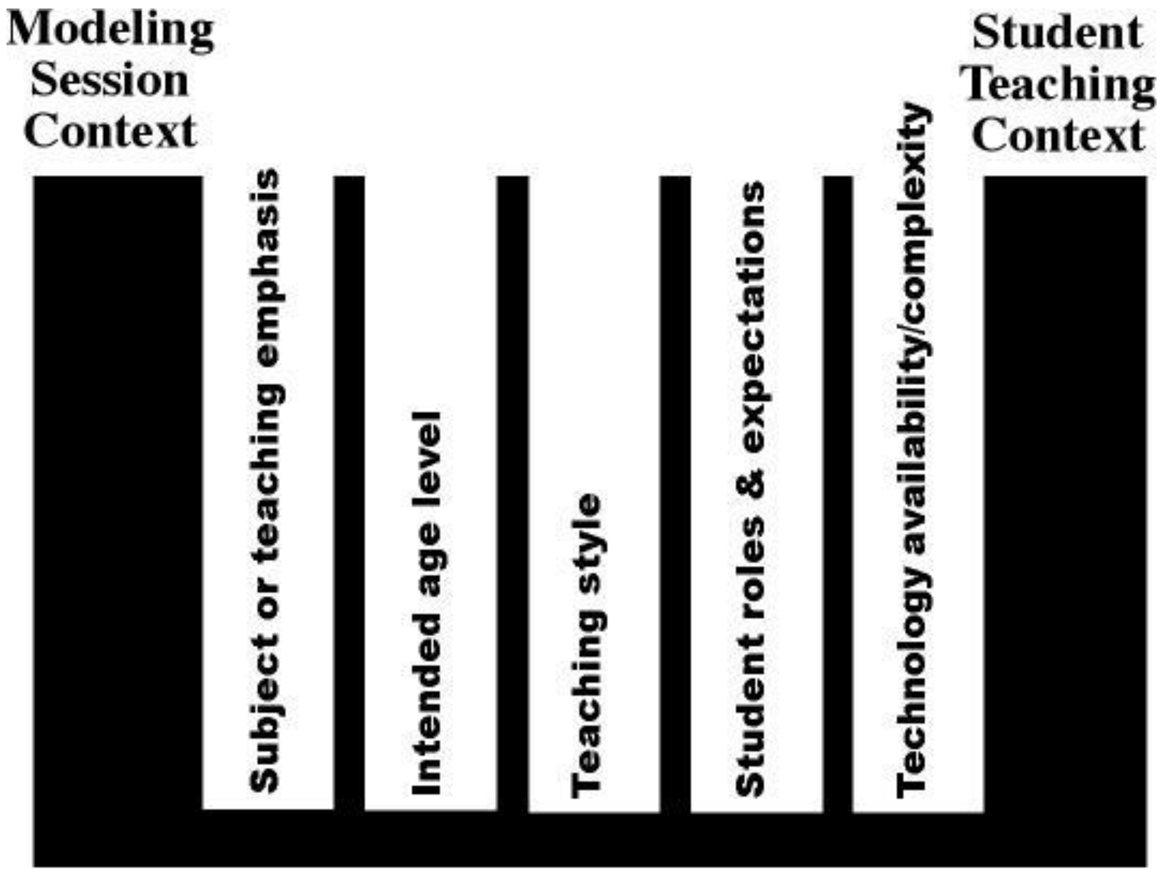

Figure 1. A representation of the difficulty some students had transferring their learning from the context of the modeling sessions to their own future teaching. These barriers, or contextual breakdowns, acted as valleys, and the more that existed for any particular student, the wider the cognitive leap required to transfer the learning to that student's own context.