Thomas, J. (2011). Preservice teachers' perceptions of learning science methods through hybridizing asynchronous and traditional experiences. *Contemporary Issues in Technology and Teacher Education*, *11*(3), 271-281.

Preservice Teachers' Perceptions of Learning Science Methods Through Hybridizing Asynchronous and Traditional Experiences

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Abstract

This study addresses preservice teachers' perceptions toward online experiences, specifically, their perceptions about utilizing an online science methods curriculum versus a traditional methods curriculum. Thirty-eight senior level preservice teachers at a midwestern U.S. university completed surveys about their experiences during their methods course that included a module for online content learning, videos of fourth- and fifth-grade elementary student in situ learning, and exploration of pedagogical skills embedded in an electricity module. Survey and focus group data indicate that the preservice teachers valued and wanted more online experiences, but not as a total replacement of traditional methods experiences. Teacher education preparation programs must identify with and address preservice teacher expectations about the value placed upon online experiences. Specifically, online experiences can help focus instruction and enhance student interaction about life in an elementary classroom. Implications of this study help address professional movements for incorporating online experiences for in-service K-12 teachers and schools.

Online learning continues to impact higher education for a number of reasons. It is a way to reach students in lieu of a traditional brick and mortar setting, the students it seeks to help are more comfortable with technology and desire its incorporation in their learning (Wooten & Hancock, 2009), and it allows for pedagogical techniques that are not possible in a traditional classroom.

For teacher educators, online learning also has an impact in that these emerging professionals often imitate the instruction they see modeled. Indeed, online learning is finding its way into K-12 curricula throughout the country as schools struggle with budget concerns. Examples include offering advanced placement courses in rural communities, expanding foreign language offerings, and providing alternatives to the traditional school settings for marginalized students. The unfolding body of research into preservice teacher preparation is, therefore, vital to developing the next generation of teachers and, subsequently, the next body of K-12 learners.

This article helps answer the research question about preservice teachers' perceptions toward online learning after completing an elementary science methods course. Data were collected by surveying and interviewing preservice teachers at the end of a course that was anchored around an electricity module. The module was developed by a curriculum company as part of a National Science Foundation (NSF) grant that investigated the incorporation of online modules in teacher training. The modules included webpages and PDF files describing subject matter on the module's content, embedded videos of elementary students' in situ learning of the module's content, and webpages and PDF files about pedagogical skills seen as best practices in an elementary classroom (i.e., helping identify students' misconceptions, using analogies, and writing effective lesson plans) that are connected to the module's content and videos of elementary student learning.

The desire for and occurrence of online learning will continue to impact the profession of teaching. Many school districts are already using distance education in the professional development programs for practicing teachers as a way to decrease time and distance. As such, they expect preservice teachers to have existing schemata to learn and excel in this type of professional development model. By gathering preservice teachers' perceptions, their voices can be added to the recent growing body of knowledge in exploring the best way to integrate online learning into the training of these emerging professionals (Annetta & Dickerson, 2006; Annetta & Shamansky, 2008; Sawchuk, 2009; Shin & Lee, 2009; Topcu & Ubuz, 2008; Wooten & Hancock, 2009).

Background

The percentage of U.S. universities offering distance education courses has increased dramatically over the last decade. In the 1997-98 academic year 34% of all U.S. universities offered distance education coursework (Lewis, Snow, Farris, & Levin, 1999). By 2001 49% of all U.S. universities provided distance education offerings (Waits & Lewis, 2003). By the end of the 2006-07 academic year 66% of all U.S. universities offered distance education coursework (Parsad & Lewis, 2008). Public 2-year and public 4-year universities led the way with 97% and 89%, respectively, of all such institutions providing distance education offerings in 2006-07. Private 2-year and 4-year nonprofit universities, while offering distance education, currently do not do so to the extent of their public counterparts.

One facet of distance education includes online offerings via the Internet. These types of offerings represent about 75% of all credit-bearing distance education experiences (Parsad & Lewis, 2008). Perhaps the decadal-increased emphasis is due to the fondness of, desire for, and expressed comfort level using technology with today's emerging professionals. Indeed, Prensky (2001) described how today's college students are "natives" when it comes to using technology in their learning.

As technology availability increased around this time, other researchers in science education began exploring how it could be used in preservice teacher development. Flick

and Bell (2000) outlined guidelines to successfully incorporate technology into the preparation of preservice teachers. College students over the past decade have spent much of their lives using cell phones, computers, and sophisticated gaming systems to occupy their time, education, and leisure.

Students and other professionals similarly not only want but demand this type of experience in their university coursework and professional development (Wooten & Hancock, 2009). Recent studies have highlighted the potential of online experiences to impact preservice and in-service teacher development, such as an ability to learn the same amount of content information as compared to a traditional lecture-based course, participants' expressing a more positive experience, and increasing connections to participants' demands and accommodations to integrate their lifestyle and coursework/professional development (Annetta & Dickerson, 2006; Annetta & Shymansky, 2008; Coffman & Riggs 2006; Kaplan, Rupley, Sparks, & Holcomb, 2007; Shin & Lee 2009; Stephen & Barford, 2005; Topcu & Ubuz, 2008; Veal, Kubasko, & Fullagar, 2002; Wooten & Hancock, 2009).

These and other studies also indicate that the nature of participants' experiences need to be carefully planned and implemented so that a lack of face-to-face time does not have a negative impact upon participants' successes (Bore, 2008; O'Neal, Jones, Miller, Campbell, & Pierce, 2007; Shin & Lee, 2009; Stephen & Barford, 2005; Topcu & Ubuz, 2008).

As the existing demand continues to impact curricular offerings for undergraduate students, ongoing discussions are important about the validity and appropriateness of online offerings as a substitute for traditional hands-on experiences (Sawchuk, 2009). This discussion may be especially significant in the case of the sciences or science teacher training, where the incorporation of hands-on laboratory work is seen as vital for modeling the processes of science as called for by the *National Science Education Standards* (National Research Council, 1996) and Project 2061 (American Association for the Advancement of Science, 1993). Previous studies have shown that elementary preservice teachers in science can successfully utilize video and online learning (Dietz-Uhler & Bishop-Clark, 2001; Li, 2003; Robertson, 2007; Rovai, 2000).

Yerrick, Ross, and Molebash (2005) studied the use of editing software and summarized that preservice teachers can effectively use video to identify students misconceptions while creating digital videos of their teaching. Indeed, much of the current generation is comfortable with technology, and they have been learning on the Internet since they began school and learned to read. This article seeks to present the perceptions of preservice teachers using video vignettes, called video cases, during an online component of their undergraduate elementary science methods course. These perceptions guide the research question about what are preservice teachers' perceptions toward online learning after completing an elementary science methods course.

Organization of the Modules

The video cases were included in modules produced by a curriculum research company in the western United States as part of a NSF grant. The company recruited universities to serve as pilot sites to field test developmental versions of four topical modules. The modules included plants, inquiry, water, and electricity. Each module's basic structure includes a series of preassessments about the science concepts to be learned in a module, embedded PDF files with information about the concepts, online video cases of elementary students exploring activities and being taught the concepts by their classroom

teachers, prompts that require reflections from preservice teachers about the elementary students' learning experiences, and a postassessment about the concepts.

Prior to serving as a pilot site for the NSF study, 25 instructors from across the U.S. were flown to the company's location for training and insight toward using the online modules. Instructors then identified online modules for which they could serve as a pilot site. The group of pilot instructors trained for 3 days in troubleshooting the online module, exploring preservice teachers' preconceptions, and discussing pedagogical strategies that might be useful while incorporating the online modules during the pilot semester(s).

Teacher training videos have often been used to showcase a classroom teacher working with elementary students while teaching a lesson. The purpose often is to model specific teaching methods, assessment strategies, or management techniques. Preservice teachers or other observers, such as practicing teachers, might then be better able to use this modeling to design lessons, prepare for field experiences, and discuss how they might handle specific classroom scenarios. The video cases addressed this modeling using two themes. The first theme explored the content material found in the module. This theme led to the exploration of central concepts about the topic, how elementary students understand and learn these concepts, and strategies for teaching these concepts. These tasks were aided by providing files in PDF format for preservice teachers to read and understand concepts as they explored typical teaching activities associated with the content. Journaling prompts in the module required them to elaborate on their content knowledge and its development before and after exploring the activities.

The second theme in the module explored elementary students' expressed understanding of the topic. This was accomplished by requiring preservice teachers to reflect on observations from video cases of classroom teachers teaching the concepts, elementary students' verbalized answers to questions during the recorded lessons, and elementary students' answers to questions during interviews about the concept being explored. To bind the two themes together the modules require that preservice teachers investigate, explore, and reflect upon (a) teaching techniques modeled to teach the science concepts and (b) ways elementary students' expressed understanding can be analyzed by the technique(s). Examples include writing focus questions to ignite a lesson, using analogies while teaching concepts, and using effective questioning techniques. Preservice teachers completed reflective online journals about these strategies as well.

Method

To address the research question about preservice teachers' perceptions toward online learning after completing an elementary science methods course, this study utilized and analyzed an end-of-term survey and focus group answers. The survey was given and focus group conducted at the end of a semester that incorporated an online module about electricity. The preservice teachers were a convenience sample selected because their experience was related to selection of this site as a pilot for the larger NSF study previously described. The end-of-term survey was not part of the NSF study, but followed institutional protocol and IRB approval. The electricity module was used for two semesters before the data was gathered in the study described here. As part of the larger NSF study, preservice teachers' answers to questions, prompts, and content-based assessments were simultaneously collected by the curriculum research company, and anonymous surveys about the experience were collected by a third-party assessor for a blind review about preservice teachers' perceptions of the electricity module. Therefore, the survey was used as the instrument for the study described here.

In this study preservice teachers worked with the electricity module because it integrated well into the program curriculum they were completing. The science methods course is targeted to teaching grades 4 through 6. It utilizes a Full Option Science System (FOSS) electricity kit. The online electricity module contained lessons targeted to, video cases from, and reflective prompts centering on learning in grades 4 and 5 elementary students. Therefore, the two curriculum pieces coincided with one another. The electricity module was divided into folders that explored (a) series and parallel circuits, (b) conductors and insulators, (c) switches and bulbs, (d) building science lessons, and (e) assessing students and their learning. During the online module implementation (10 weeks in the sections of science methods) preservice teachers' reflections into the video cases were assessed for insight about elementary students' concept development and thinking while learning as part of their semester grade.

The 38 preservice teachers in this study were in two difference sections of courses (20 in Section 1 and 18 in Section 2), had been accepted to a Department of Teacher Education program accredited by the National Council for Accreditation of Teacher Education in the midwest United States, and were in the last academic year of their undergraduate program. To be accepted by the program they must have passed the Praxis I examination meeting state cutoff scores, possessed a 2.75 GPA, passed a criminal background check, and successfully completed all coursework applying toward their degree with at least a C or better. Approximately 50% of the preservice teachers participated in a full semester practicum (often called student teaching) in the subsequent semester. The remaining 50% completed their full semester practicum in the second semester following their participation in the course in which this study occurred. The course seeks to emphasize the inquiry-based practices of the basic and integrated process skills promoted by science education professional organizations. Modeling of inquiry-based science through FOSS teaching kits, cognitive discourse, and practical strategies for elementary classrooms are emphasized.

The general format for teaching the module was that users completed a preassessment on the concepts found in the module to allow them to better understand what they knew and did not know about the concepts before reporting to class, where they then explored an activity from the FOSS kit addressing the concepts. The prompts were open ended in nature and not used for measuring preservice teacher achievement. In the interval between the activity and the following class period users were given an assignment to watch the video cases of classroom teachers teaching the same or similar lessons to elementary students and answer reflective prompts about elementary student learning and observations of the teachers' performances. Prompts focused on issues such as teacher-student interaction, student expression of content knowledge, and strategies to teach content knowledge.

Examples include (a) how elementary students expressed content knowledge of the flow of electricity (preservice teachers identified whether students expressed knowledge correctly or expressed misconceptions in the video cases), (b) strategies utilized by teachers to help elementary students learn content of circuits (using visuals, using analogies, and pedagogical techniques for asking questions to students), and (c) strategies utilized by teachers to plan inquiry-based science instruction (developing focus questions and asking probing questions). In the next class meeting preservice teachers discussed the video cases of elementary students' learning while comparing their online responses to the reflective prompts with one another. The creators of the modules produced the electricity module under the premise that the entire module could be completed without any in-class communication or participation.

At the end of the module a survey was administered that included nine Likert-scale questions and three open-ended responses to collect information about their perceptions of the experience. The survey used a 4-point scale (1 = *strongly disagree*, 2 = *disagree*, 3 = *agree*, 4 = *strongly agree*). Additionally, preservice teachers were matched with a number from one through 38 and a random number selector was used to select six participants for an interview group. This group provided additional feedback about the end-of-term survey and overall semester experience. The interview, along with the data collected from the survey, helped provide insight into the perceptions of preservice teachers toward online learning after completing the electricity module and methods course. Results from the Likert-scale, open-ended questions, and interview group follow.

Results

Results (see tables 1 and 2) indicate relatively high agreement that the modules were easy to use and well organized, with averages of 3.5 and 3.4 on questions 1 and 2, respectively. Note that perceptions of these two items may have been enhanced by the fact students could ask questions during face-to-face class sessions. A scavenger hunt activity was completed to begin the module to explore its layout as well. Preservice teachers said that online learning was beneficial (3.7 on Question 3) and realistic to them (3.7 on Question 4). A notable perception of students is observable in questions 5 and 6. Students recognized the differences (2.9 on Question 5) in the types of reflective prompts the module utilized to support its themes versus the traditional ones they often complete about their observations of a typical classroom environment.

Table 1
Average Score for Each Question About Online Module Learning in an Elementary Science Methods Course

Survey Question	Average Score[a] *n* = 38
1. The online modules were easy to use.	3.5
2. The online modules were well organized.	3.4
3. The online modules were beneficial to my learning.	3.7
4. The online module video cases provided realistic versions of classroom life.	3.7
5. The online reflective prompts were similar to offline reflections that I complete in other college level courses.	2.9
6. The online reflection prompts were beneficial to my learning.	3.8
7. Overall, I would prefer more online learning as part of my traditional methods courses.	3.7
8. Overall, I would prefer more online learning in place of my university courses.	3.8
9. Overall, I would prefer more online learning in place of my traditional methods courses.	3.0
[a] 1 = *strongly disagree*, 2 = *disagree*, 3 = *agree*, 4 = *strongly agree*	

Table 2
Top Three Responses for Open-Ended Survey Questions

Survey Question	Most Frequent Responses *n* = 38
10. What were the strengths of the online module and why?	1. To have opportunity to watch a teacher teach a lesson and then discuss this teaching and elementary students' answers with other preservice teachers during the following class meeting. 2. Completing their journals online versus traditional paper/print. 3. Seeing that actual teachers make mistakes.
11. What were the weaknesses of the online module and why?	1. Much of the information was repeated. 2. The modules were too lengthy. 3. Occasionally there were technical glitches that prevented them from completing their work.
12. If you were redesigning the online module what changes would you make?	1. Reduce the amount of redundant information. 2. Omit the preassessment and postassessment quizzes. The process and incorporation of them became burdensome, repetitive, and unhelpful. 3. Decrease the amount of information over the entire module and focus on targeted areas for learning.

Importantly, they believed the prompts were beneficial in their learning (3.8 on Question 6). Results indicate a desire for inclusion of more online delivery as part of their methods coursework (3.7 on Question 7) and as part of their university coursework (3.8 on Question 8). However, they were somewhat less likely to view online experience as a replacement for their traditional methods courses (3.0 score on Question 9).

Conclusions and Implications

An inference can be drawn that preservice teachers still appreciated the opportunity to talk with one another about what they were experiencing during their science methods course. In addition to completing the module, preservice teachers were also completing a traditional field experience where they were traveling to a local school and teaching lessons to elementary students. Perhaps the positive expression for a traditional methods experience is attributable to the fact that most of the preservice teachers were scheduled to become student teachers the following semester.

The immediacy of student teaching may have influenced a desire to discuss learning with peers because they would be standing in front of elementary students in a couple of months. The video cases allowed the same point of reference for discussion, and preservice teachers were able to use this point of reference to unify discussion and learning. To this extent they support findings of Robertson (2007) that preservice teachers value the shared perspective of others to benefit from online learning.

One interesting finding arose from the focus group as the group reflected upon the dissimilarity between the module's reflective prompts and the traditional prompts preservice teachers typically answer in their program's courses (questions 5 and 10). During the interview preservice teachers explained that the traditional prompts they often answer are basic and ask them to reflect about what went well and what did not go well. The traditional prompts might also report about the physical layout of a classroom or on some type of classroom management or discipline issue.

The reflective prompts in the module often focused on what elementary students expressed knowing about a concept. As preservice teachers discussed what elementary students expressed knowing, they said that the reflective prompts helped them better verbalize and grasp what they did or did not comprehend about content they might be teaching in the future. Using the video cases made improved comprehension possible because all preservice teachers could watch the same learning experience. Further, preservice teachers valued observing that in-service teachers can rush and make mistakes (Question 10) in addressing student learning, as was sometimes highlighted in the videos. The interview group repeatedly stated that it was helpful for all of them to observe the same learning experience through the video cases. This common focal point among all preservice teachers would not likely be possible in a traditional field experience, where each preservice teacher is assigned to a different location.

Preservice teacher field experiences come in several varieties. A methods course may be taught concurrently along with its own field experience. Many universities have moved to a model that requires preservice teachers to participate in fewer but deeper field experiences. These field experiences are often connected with a course or set of courses. Sometimes the course is methods based, and sometimes it is linked to a more general course, like classroom management. The result is that some methods courses' linkages with field experiences might be diminished. In such setups, some teacher development programs may view video cases as a way to supplement this loss.

For programs able to maintain the linkage, video cases may be viewed as a way to enhance and support the experiences of preservice teachers. They can discuss how the elementary classroom environments and elementary students' learning experiences are similar to and different from what they are observing in field experiences in which are participating.

Online video cases will likely continue to provide instructors with the ability tangentially to capture elementary classroom learning environments and elementary student learning while working with preservice teachers. Online access and journal prompting may cause university programs to consider yielding to preservice teacher demand for more online learning. If so, then a hybrid methods course delivery may be applicable. When integrated appropriately the video cases allow instructors to create learning environments centered upon traditional curricular issues found in a science methods course (using probing questions, identifying misconceptions, and structuring lessons). However, with this gain is a potential loss for methods courses that explore the nature of science by linking class time between hands-on exploration of science and science concept development.

This study supports the findings of Dietz-Uhler and Bishop-Clark (2001), Li (2003), and Rovai (2000) that an effective use for the incorporation and use of video cases can be made as a pre-instructional tool for subsequent class meetings. I have taught the science methods course for about 10 years and offer the following qualitative statement. During the semester of this study, observations of preservice teacher interactions when discussing elementary student learning seemed to indicate that class was more purposeful and effective than in semesters where the video cases were not utilized. Because preservice teachers had all watched the video cases and posted their responses as evidence of this, they appeared better prepared for in-class activities.

Future studies might incorporate the use of techniques to explore validation of this statement. With their background preparation more apparent, the opportunity to focus learning more quickly on in-class objectives is possible. Students have a better common experience (their online work) for initiation of concept discussion and elementary classroom application. The alternative that many instructors know all too well is to assign a reading with the hope that preservice teachers complete the exercise.

Although this article focused on the perceptions of using video cases with preservice teachers, their use with practicing teachers is already being implemented in professional development centers across the nation. Continued research into their impact upon pedagogical and content knowledge is needed. For now, user perception from this study indicates that they are enthusiastically desired.

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