A Constructivist Approach for Introducing Pre-Service Teachers to Educational Technology: Online and Classroom Education

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The goals for our preparation of pre-service teacher educators in educational media and technology include the development of pedagogical ability as well as technical knowledge and skills. Pedagogically we adopted the goal of teaching the students to use technology to facilitate a constructivist approach to teaching and learning. We have developed a classroom-based and online courses in which we immerse students in educational media and technology. In this paper we provide accounts of our experiences in the implementation of these constructivist learning environments.

Eastern Michigan University prepares more educational personnel than any other university in the country. Along with cars, the state of Michigan exports teachers to the rest of the country. Standards recently adopted by the state for pre-service teachers state that new teachers should be able to use technology effectively in teaching/learning and as a personal and professional productivity tool. The state's Council for Pre-service Technology has adopted a framework for treacher preparation and educational technology. Carl Levin, U.S. Senator from Michigan, is sponsoring activities aimed at establishing Michigan as a national leader in the infusion of technology into classrooms thoroughout the state.

It was in the midst of this serious discussion of pre-service teacher preparation and technology that we undertook to create a new course for EMU students to address pedagogical and technical skills to use infuse media technology throughout their curriculum as teachers. The guiding principal in the development of the course was that pre-service teachers realize the potential that technology has to facilitate constructivist, student-centered learning environments. It was essential that we create a learning environment for our students to learn about media and technology that would reflect how we hoped they would later use technology to facilitate learning in their own classrooms. In order to achieve that goal we have developed parallel student-centered learning environments, one classroom-based and the other online, in which we immerse students for their training in educational media and technology. The purpose of this paper is to share our experiences in the development and implementation of these constructivist learning environments.

Constructivists believe that the way we learn is by interpreting our experiences based on our prior knowledge, constructing meaning and later revising our understanding by reasoning through new experiences. Knowledge must be constructed, not transmitted (Jonassen, Peck and Wilson, 1999). In a constructivist learning environment, students should be engaged in activities and assignments which are authentic tasks embedded in rich, real world contexts. When possible the audience for those tasks extends beyond the classroom, and assessment is performance-based and reflective. The relationship between the instructor and the students is one of cognitive apprenticeship, in which the instructor models problem solving, engineers learning experiences, provides scaffolding as students attempt tasks, and encourages reflection. Working collaboratively and using original source materials when possible, students constantly confront multiple perspectives on the content being learned: their own, other students' and multiple experts' including the instructor's. Students are encouraged to reflect on their experiences and their learning as it progresses.

To implement these concepts, we designed a new professional education course as part of our elementary and secondary teacher education programs, one focusing on pedagogy of teaching with educational media and technology. Since construction of new knowledge rests on the bed of prior knowledge, prerequisites

include a basic skills computer course and a curriculum methods course. The course itself is a simulation, with each student being hired as a teacher at a specified grade level and in a specified content concentration if the grade level is grade six or above. Tasks require that "teachers" participate on a school-wide committee to create a weeklong, school-wide, thematic unit on a decade of the twentieth century (Sandholtz, Ringstaff, & Dwyer, 1997), to demonstrate instructional planning for technology infusion. At the classroom level, students create a variety of media/technology products such as a PowerPoint presentation and a multimedia, self-instructional lesson. As a member of a district-wide committee, the students confront an ethical issue which arises related to internet usage by students in the district and, working collaboratively, make recommendations about district policy and staff development. Students reflect on their learning in a journal and, using their work from the course, create a professional electronic portfolio documenting their knowledge and skill in using technology in teaching and learning.

The online version of this course (**http://www.emunix.emich.edu/~abednar**) has been taught twice by one of the presenters, with that same presenter teaching the classroom version once. The classroom version has also been offered two more times by the other presenter. By way of comparison, both presenters have taught multiple sections of earlier media and technology courses which were not built on a student-centered constructivist model. We collected data from each of these course formats in order to analyze student products and reflections from the new course and examples of student assignments and course evaluations from the earlier courses. In addition, we have analyzed our personal reflections about the progress of the course and of individual students and groups in which they participate.

The question we are seeking to answer ultimately is whether there is a difference qualitatively in the ways students choose to use technology in the classroom when they learn to use educational technology in a constructivist learning environment. As with many questions in teacher preparation, the answer lies in a long-term study in classrooms of the future when these pre-service teachers mature. Meanwhile we can make observations contrasting their performance in class to that of previous classes. We would not characterize our findings so much to be an endorsement of a particular approach or medium as much as an inquiry into the strengths and weaknesses of a new approach.

Interestingly enough, the two faculty teaching the course had rather different experiences with their first teaching of the new professional education course. In the following they will both discuss their experiences and then hypothesize explanations for the differences.

Faculty Member Number One: Anne

I developed both the online and in classroom syllabus for the new course. This semester I taught two sections of the new course (one online and the other in the classroom) and four sections of the older non-constructivist media course. Some of the key constructivist elements, which I tried to include in the new course, were:

- Authentic tasks – assignments based on real world tasks that students will eventually perform as teachers for their classrooms, schools and districts, using technology and software that they may expect to find in state-of-the-art schools technologically.
- Collaborative work groups akin to school committees for curriculum development and problem solving activities.
- Reflective thinking to synthesize readings, individual and group projects, and the perspectives of peers, instructor and various experts.
- The instructor's role as a resource, to structure and guide learning experiences and model task performance.

Of these elements, only the first is in any sense an element of the non-constructivist media course; that is, some of the products that students create in the media course are similar to products assigned in the new course but without the unit context as a focus.

From early in the semester I noted differences in my classroom section of the new constructivist course as compared to the sections of the other media course. The constructivist course met twice weekly, and from

the first day I had them assigned to collaborative work groups; they were representing a committee of teachers in a curriculum development project and were divided into interdisciplinary groups were at the elementary, middle or secondary level. The majority of early class sessions were team meetings either to get started on the unit development project or to assist each other with challenge assignments as they developed new skills with technology. I occasionally did a demonstration in front of the whole class, but more often coached them as they worked to achieve goals as a small group.

In the media classes, the class was taught as a body of the whole; when small groups were used, they were for a single class period only. The dominant pedagogical approach was demonstration while students worked hands-on at their own computer stations to follow along with me. Interspersed with demonstration were mini lectures/discussions to link the technical skills, which were being developed to pedagogical approaches.

At one point, about four weeks into the semester, I used a similar computer-based draw/paint group activity, one involving generation of masters for an overhead transparency and overlay, in all the sections of both courses. I expected the media sections to do better on the project, because I had devoted more direct teach, in-class time to developing draw/paint skills in that course than in the new course. The opposite occurred. The only class to finish the problem was the new course, and all four small groups within that class finished with a high quality product. No group in the media sections finished; they had difficulty figuring out how to start the task, and when faced with a false start they could not adjust but rather needed to start from the beginning again. My interpretation was that the students in the media classes were unable to work independent of my demonstration; they needed to be told each next step to do.

Later, when the homework assignment related to this in-class small group activity was due, all but one of the students in the new course successfully completed the assignment and many were high quality products that I would be pleased to use in a classroom. About a fourth of them also included technically complex graphics at this early point in the semester. In the media course, many more students (4-6 per section) achieved the product only by successive approximation, that is, submitting a product, receiving feedback, and resubmitting the product at least a second time. Out of twice the number of students, only two used complex graphics on their transparencies.

The other characteristic of this product (again, the first assignment of the semester) was that the products turned in by students in the new course were good choices of real ways in which to use transparencies in the instructional process, while often those turned in as part of the media course were the minimum required to meet a passing grade and did not represent materials that most teachers would choose to use in actually teaching the content covered. The students in the new course had been required to create a product, which could be used in the teaching of the interdisciplinary unit they were developing. They had already worked fairly extensively to identify resources for the units and to set the unit goals and objectives. In contrast, the students in the media class had been required to create a transparency with at least one overlay that they might use in teaching a content they might teach in the future. Several of these transparencies from the media course were artificially divided into two parts to meet the requirement of an overlay with little thought about the actual teaching. I credited this difference to the reflections required of students in the new course but not included as part of the media course. In these reflections, both the in-classroom and the online students in the new course were asked to reflect on questions critical to the use of technology in the classroom. We had already discussed in depth the various rationales for use of technology in schools and had developed a decision framework requiring that technology be used only when it enhances learning rather than just for the sake of using technology. As one student reflected: “The teacher must know before hand if the use of technology will boost student learning and achievement. I will approach lesson planning with the most emphasis on what is important for my students to know rather than what video or other use of technology fits into this unit. Assessing student learning will determine if I choose to include this type of technology again.”

I saw evidence of these contrasts between students in the two courses frequently throughout the semester. For example, when preparing their multimedia lessons near the end of class, quite a few students in both the new course and in the media course found that their scanned images required so much memory that they could not save them on their disk as part of the lesson. Two students from the new course recalled that

I had said JPEG files from the Internet required less memory than other, more dense, graphic formats. Instead of asking the lab assistant how they could solve the problem, they asked for help in saving the scanned image file as a JPEG. At the beginning of the course neither of these students used a computer for anything other than word processing and neither had a home computer. They seemed to take the problem as an opportunity to learn rather than a reason to give up. I did not see this kind of attitude generally in the media class where problems were likely to result in defeat until specific solutions were given.

Another characteristic which is generally different between the classes is the pride which students in the new course, both in the classroom and online, show in their work. At times I tried to discourage fairly lofty goals anticipating problems they would cause along the way. Students in the new course insisted on going ahead, however, and have been extremely proud of their ability to get things they way they wanted in spite of limitations of technology. One several occasions they have commented on using work from our course in another course as well and the success of their work to that extended audience.

Of course there were some excellent students in the media courses and some less capable students in the new course, but generally I was more pleased with performance in the new course. I wondered whether my observations were biased, but a colleague who visited the course several times also noticed the difference between this group and students in my previous media and technology courses he had visited.

Reflecting upon these differences as we moved through the semester I concluded that the students in the new course were: more independent as learners, more confident in their ability to handle challenges while using technology, and more conscious of the applications of the things we were learning in a school context. It occurs to me that two possibilities exist: either EDMT330 has influenced these groups of students to talk about and work with technology and its use in schools in a much more mature way than my other undergraduates, or I have simply had exceptional groups of students (20 in the classroom and 20 online) in this first semester of the course.

Faculty Member Number Two: Mike

I taught the classroom version of this course for the first time this semester as I began my second year of teaching at the university following a decade and a half of teaching in K-6 schools. This semester I taught two sections of the constructivist course (with approximately 20 students in each section), using a syllabus that was developed from and similar to Anne's. Both of these sections were classroom courses (i.e. I did not teach the course online), taught in fifty-minute sessions, one period after another, in a class that met twice each week. I was also teaching much of the same content in an introductory course in our educational media and technology graduate program. I did not teach any sections of the older non-constructivist media or computer courses this semester, so I could not directly compare work between the two courses.

Like Anne, I tried to incorporate key constructivist elements in the new course. An emphasis on authentic tasks meant that assignments were all related to a thematic unit about one of the decades of the 20th Century. Students did much of the work for that unit in collaborative work groups. Opportunities for reflective thinking to synthesize readings, projects, and different perspectives were provided, though not as frequently or with as clear a focus as was the case in the Anne's section of this course. Likewise her emphasis on relating to the students more as a resource, with less of an emphasis on direct instruction was not something that was pursued with the same energy. My focus frankly was more on figuring out how to put together these two courses that had taught separately in a less-constructivist fashion into one course that could be taught successfully in a more-constructivist way.

So perhaps it is not surprising that our experiences in teaching the course were rather different. Anne has described a marked difference in the quality of the work she received from the constructivist course compared to the non-constructivist course. Most notably she found evidence for what some might call more learning with less teaching (Papert, 1993). But I was much more discouraged by my experience in teaching the constructivist course. According to student reflections, they built a stronger bond of community through their group work. But generally speaking, I did not see better quality work from the students in this course.

One of the first warning signs came in the opening weeks of the course. Students were to choose a decade from the 20th Century, and write a list of unit objectives and a content outline that pertained to the content from that decade they decided to teach. The quality of objectives and content outlines that I received varied greatly, with more than a third of the groups receiving very low scores and notes to revise and resubmit their work. Even the revised work was not particularly strong. Students were required to have taken a curriculum course prior to or in conjunction with taking this course, so unit design was not supposed to be new. But for some this did not come easily at all.

As the semester continued, several students made individual appointments with me, asking if they could complete some of the individual assignments for the course (such as software evaluation) apart from their decade. They had not understood that the whole course was structured around the unit despite my instructions. When they began to do materials evaluations of various media and computer programs, they did not want to be limited to looking only for materials that pertained to their decade of the 20th Century. I allowed them to look at other materials that they specified from their own major. In fact I announced that for the software review, they did not have to limit themselves to their decade, since decade-specific software is rather hard to find. But this created a more serious problem that persisted throughout the course. In fact even up to the last class session, as students were working on various assignments such as creating a newsletter or a Hyperstudio presentation, I was asked, "Does this have to relate to our unit?"

One place where the difference in our experience came most clearly into view is in the overhead transparency assignment described earlier in this paper. We first did an in-class exercise of using a draw program to create a volcano and using a paint program to create a castle. This activity and its accompanying step-by-step directions were well received by the group. Some of them did not need such specific help and I encouraged them to use their prior knowledge of these programs to complete their work. But in the second session, few of my students were able to complete the draw/paint group activity of preparing a sample multilayered display in class. Then the overhead transparencies turned in as independent work, relating to the unit, again varied greatly in quality. In particular, a number of them (about 4-5 per section) were simply unusable due to either the size of the font or graphics or the way they were constructed. Some of these had to be revised and resubmitted several times in order to receive credit. This is precisely the same experience Anne had with her students…but in the non-constructivist course!

By the end of the course, I was particularly concerned about how well the unit plan idea had worked with our students. I asked for some direct feedback about this aspect of the course, noting that this was my first semester teaching the course and I wanted to improve it in the future. In an electronic bulletin board environment, I asked them to discuss the strengths and weaknesses of using the thematic unit approach to tie together the assignments for the course. I then asked them to suggest any ways that this unit approach could be improved in future offerings of the course.

The reflections of all forty students can be summarized in three points:

- The students really enjoyed working cooperatively in groups for the most part, with the only problem being getting together outside of class in a "commuter" university.
- The assigned decade approach was not so strong because it limited the applicability of the material that they prepared for future use. The decade scenario, though interesting, seemed too unlikely for future use. There was one group in particular, however, who really thought the decade approach worked well; they consistently did among the best work of both classes.
- In the future, allow groups to choose their own unit topics that could relate to other courses they are taking or would relate more closely to topics they will teach in the future.

As the professor in the course, I was honestly pleased at how many of the students, despite their criticisms, also mentioned that they thought the course was very valuable (though labor intensive). My own impressions of the student's experience had not been so positive. I did not realize that the groups seemed to function as well as they did, though this is perhaps in part due to the fact that one group in particular had serious problems that required a great deal of my energy to resolve. Also, this was my first time teaching this course, and I believe that I taught the second section much better than I taught the first section by virtue of simply having a better understanding of the content and pedagogical issues.

There were areas in which I did see better work this semester. In my course, I ask for fewer student reflections than Anne, preferring instead for them to read two articles with divergent views about the promise of educational technology (specifically computers) in the schools (See Oppenheimer, 1997; Starr, 1996). They wrote a summary and response to the arguments of the articles. The papers that I received for this assignment were among the best I have read to date. Many more students understood the subtle points of agreement between these two positions while locating the clear points of departure between the two. In addition, more of the students supported their own responses to the articles with factual statements taken from the text, in contrast to merely stating their own opinions without support.

So in a sense, my students seemed to have a positive experience with at least two of the constructivist elements mentioned initially by Anne: Collaborative work groups and reflective thinking to synthesize readings. They had serious questions about the authenticity of the thematic unit task in the long run, questions that are not without merit. But the most striking difference between our class was in the question of the instructor's relationship to the students. I had occasion to visit Anne's constructivist class section several times during the semester. I was impressed with the level of independence of her students in comparison to other classes that I have taught and in comparison to other classes I have observed her teaching. I vividly recall the day she met me in the hall, noting just how well the students had understood a particular computer application and just how little direct instruction she gave them. Working in groups they solved the problems that came up. As she stated earlier, the students in her course saw problems that came up more as opportunities to learn than reasons to give up.

Ownership and Authentic Tasks

Creating opportunities to learn is a main focus of a constructivist learning environment, and, while we have learned many things this semester, the experience of teaching the constructivist course has resulted in the opportunity for future exploration of many more questions. One of the main questions is that of ownership as it relates to authentic tasks: in whose eyes must the task (in our case, the unit plan) be authentic, the instructor's or the students'. We are exploring ways to maintain the collaborative group structure while devising a way to allow students more freedom in the choice of their unit topic.

The question of ownership has a second side, that of ownership by the instructor of the course they teach. We found clear evidence that the most successful activites in either of our courses were the activities we individually had worked to structure and for which we felt both ownership and commitment, the reflective paper for Mike and the challenge activities which helped reinforce the independence of the students for Anne. The partner issues of authenticity and ownership impact the motivation of students to learn and instructors to teach – two critical elements in any learning environment.

References:

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