

The Use of Metaphor and Technology to Enhance the Instructional Planning of Constructivist Lessons

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Abstract

This paper describes how a teacher educator used a Computer Applications for Educator's preservice education course to teach constructivist lesson planning to students who were in the process of planning lessons. It was hypothesized that by providing scaffolding and coaching during the planning process, preservice teachers could be guided to learn to produce constructivist lessons. This type of learning experience follows Vygotsky's (1978) suggestion that constructivist teaching can be a social activity that involves "problem solving under [teacher] guidance" (p. 86). Because constructivist lesson planning requires creative thought that novice lesson planners often find difficult to do on the spot, the "Interactive Lesson Planner" was developed to provide scaffolding so that students would have speedy access to lesson resources via the Internet (Holt, 2000; Klein, 1997; Mintrop, 2001). Students were also taught how to post their resulting lessons to the Internet. By doing so, students preserved their efforts so that they may be applied in the future to the student-teaching experience and as a way to market themselves online to potential employers. Because this approach follows John Dewey's suggestion that the teaching and learning process should attempt to solve real-world problems, it was hypothesized that this would enhance motivation (Dewey, 1916). Seventy-five percent of students taught with this approach successfully applied constructivist learning theory by completing a constructivist lesson on their own.

It is clear that a major mission of many teacher education programs is to encourage constructivist teaching (see for example <http://www.educ.msstate.edu/EdLead/philosophy.html> and <http://www.educ.cuny.cuny.edu/ncate/full.htm>). However, there is evidence that this mission is often not being fulfilled. Holt (2000) found that prospective teachers might not be leaving teacher education with a good understanding of how to actually teach with a constructivist approach. Klein (1997) noted that when preservice teachers are learning to teach with a constructivist approach, they may use words that represent constructivist teaching, but they often fail to demonstrate the ability to apply the constructivist teaching strategies. Specifically, Mintrop (2001), for example, found that of the 15 students participating in a 3-year effort to learn how to successfully implement an “ambitious constructivist model,” none were able to fully implement the constructivist approach as it was “envisioned by the pedagogy” (p. 208).

Although constructivism has been defined many different ways, Applefield, Huber, and Moallem (2001), in their review of constructivist literature, found the following four central characteristics of constructivist learning: (a) learners construct their own learning; (b) the dependence of new learning on student’s existing understanding; (c) the critical role of social interaction and; (d) the necessity of authentic learning tasks for meaningful learning (p. 38). Because this approach is markedly different than the traditional teaching approach and because teachers tend to teach the way they were taught, it is no wonder that teacher educators are having difficulty teaching their students to use the constructivist approach (Goodlad, 1990; MacKinnon & Scarff-Seatter, 1997; Schifter & Fosnot, 1993).

Some researchers have looked at this problem by investigating the role of using nonconstructivist teacher education practices to promote constructivist teaching approaches in teacher education graduates. For example, Paris and Gespass (2001) noted a problem with using nonconstructivist teaching approaches during the student teaching experience. The authors proposed that the student teaching experience would be enhanced by making the relationship between the student-teacher and the supervising teacher more learner centered and more constructivistic.

Lesson planning is another area where constructivist principles are often not used when instructing preservice teachers. It has been found that teacher educators often attempt to encourage constructivist lesson planning with *non*constructivist teacher education practices (Doyle & Holm, 1998; Cochran-Smith, 1995). This is especially problematic because lesson planning has been found to be a crucial stage in the implementation of good teaching and because teacher educators so often have their preservice students engage in instructional planning as a way to develop teaching skills (Arnold, 1988; Roskos, 1996).

In order to foster the instructional planning of constructivist lessons, some teacher educators, however, *have* attempted to teach lesson planning in a way that would encourage teaching with the above characteristics in mind. For example, Kim and Sharp (2000) found that using a technology-enhanced, constructivist-based teaching model of mathematics instruction enhanced preservice mathematic teachers’ teaching abilities and confidence in their future teaching. Preservice students were provided with real-world problems from video-based, narrative adventures in order to model and demonstrate the basis of a constructivist lesson concerning such mathematical concepts as ratios. The study then evaluated the elementary teachers’ lesson plans for teaching mathematics according to constructivism. While some students were found to demonstrate a constructivist approach to decisions about ratios/proportions, the authors concluded,

“The extent to which the preservice teachers could make plans consistent with constructivism was highly variable” (Kim & Sharp, 2000, p. 328).

Rather than using technology as Kim and Sharp and others have done by modeling and demonstrating constructivist lessons first and then having preservice education students attempt to plan lessons by emulating the approach later, the present approach promoted constructivist lesson planning while students were in the process of planning the lesson. It was hypothesized that by providing preservice teachers with scaffolding and coaching during the planning process, their thought process would be better guided to produce constructivist lessons. This type of learning experience follows Vygotsky’s (1978) suggestion that constructivist teaching can be a social activity that involves “problem solving under [teacher] guidance or collaboration with more capable peers” (p. 86).

Constructivist lesson planning requires creative thought that novice lesson planners often find difficult to do on the spot (Holt, 2000; Klein, 1997; Mintrop, 2001). Therefore, the Interactive Lesson Planner was developed to provide speedy access to lesson resources via the Internet. Also, because video clips of teachers modeling constructivist teaching can benefit preservice students lesson planning (Kim & Sharp, 2000), the Interactive Lesson Planner housed such clips.

Interactive Lesson Planner

The Interactive Lesson Planner was designed to assist in the teaching of instructional planning. The model used was based on Herbart’s formal steps of instruction and was an extension of Madeline Hunter’s components of a lesson (Hunter, 1984; Ornstein & Levine, 2000). Hunter’s approach was adopted because it was felt the model provided the structure that many preservice education students need to initiate a well-focused lesson. While strictly following or mimicking such a lesson structure can be problematic, it was hypothesized that such a model could be adopted, with the use of the interactive qualities of the Internet and instructional scaffolding, to provide needed guideposts for students while also encouraging constructivism.

The Interactive Lesson Planner provided links to information and activities that were designed to help the preservice students create a constructivist lesson plan that assessed their future students’ current state, grabbed their attention, defined the lesson objective, established teacher input and discussion questions, and outlined the practice, application, and assessment of the lesson. Students were to click on each image representing each component of the lesson to see a definition, substeps, video clips of teachers modeling the constructivist approach, and links to other helpful sites.

The images representing each component of the lesson were arranged in the web page in the form of a metaphor. The use of metaphor was intended to exemplify a constructivist approach by encouraging preservice teachers to build on their own prior knowledge when attempting to plan constructivist lessons. In a previous study, Thomas and McRobbie (2001) used the metaphor “learning is constructing” to encourage students to recognize the “learning processes consistent with constructivism” (p. 222). Although the authors found that the effects of using this metaphor were disappointingly variable, they indicated that there was potential for using metaphor to increase student understanding about constructivism.

From informal observations and conversations with novice teachers, I have found that there is often a misconception among novice teachers that constructivism involves no more than hands-on “construction” of things. Therefore, the current approach used a

metaphor that would avoid the confusion caused by the similarities of the words constructivism and “construction” (often perceived as meaning mere “hands-on learning”). The metaphor of getting someone from “Point A to Point B” was used to describe constructivist teaching. Just as one may build a travel plan by considering how to get from the origin to the destination, so too when teaching in a constructivist mode, one must encourage the student to build upon their prior knowledge (“Point A”) in order to get them to reach the learning objectives (“Point B”).



Figure 1. Screenshot of the online interface used to link students to the resources of the Interactive Lesson Planner.

Figure 1 shows the online interface used to link students to the resources of the lesson planner (found online at <http://www.kings.edu/kdils/InteractiveLessonPlanner/PointAtoPointBIndex.htm>). The images or icons in the interface provide links to information and activities that are designed to help the user create a constructivist lesson plan that assesses their students' current state, grabs their attention, defines the lesson objective, establishes teacher input and discussion questions, and outlines the practice, application, and assessment of the lesson. By clicking on each image, the user is able to see a definition, substeps, and multimedia examples of each component of the lesson. The following section details what is contained in the lesson planner.

Interactive Lesson Planner Contents

The first icon in the Interactive Lesson Planner is Point A, which represents the students' current state. After clicking on this hypertext link, those planning constructivist lessons are prompted to brainstorm about students' interests, abilities, current knowledge, experiences, issues, and misconceptions. The user is then asked to determine things that the students might be interested in that are related to the proposed lesson topic.

The next icon of a bell represents the “Bell Ringer” component of the lesson, or an attention getting job for students to do based on previously learned material (Personal Communication, A.P. Associates, 1999). Those planning constructivist lessons are advised to take the student's Point A (established in Step 1) and give the students a job to do that demonstrates why the students will want to know more about the lesson content. The user of the Interactive Lesson Planner is provided with digital video clips depicting teachers using bell ringers in a constructivist manner. The user can also use a window located in this part of the web site to search the Internet for ideas and resources. It is suggested that by entering key words dealing with the students' Point A and keywords associated with pictures, sounds, songs, video clips, simulations, quotes, charts, facts, etc., the user can provide a job (answer a question, perform a task, etc.) for students to do that would peak their curiosity about the lesson topic.

The "SWBAT" icon represents the objectives **students will be able to** accomplish by the end of the lesson. Those planning constructivist lessons are to describe their objectives in terms of what observable things students will be able to do. A hypertext link to verbs from Bloom's Taxonomy is made available and students are advised to use these verbs when describing what their future students will be able to do. A link to Pennsylvania state standards for all grades and subjects is provided for guidance in determining appropriate objectives. Also, links to web sites that connect to state standards for all 50 states is provided.

The next icon representing a teacher and student interacting houses the guidelines for developing the input of the lesson. Those planning constructivist lessons are provided with links to online encyclopedias in order to develop outlines of many common topics. They are then asked to decide if they will be using inductive reasoning (going from the specific to the general—e.g., "Let's analyze this specific car and why it is expensive in order to discover general rules about what determines price.") or deductive reasoning (going from the general to the specific—e.g., "Let's learn the general laws of supply and demand and then identify how they are applied to specific situations.") or both. They are also advised to "pepper" their input with questions that deal with their students' Point A and lead them to their Point B (e.g., "What is it about an old, antique car [based on your experience] that makes it more expensive than a new, better equipped car?"). It is suggested that scaffolding (i.e., hints, questions, pictures, modeling, etc.) be worked out in advance in anticipation of what their students will need to engage in a productive discussion. Finally, those planning constructivist lessons are prompted to determine how student's multiple intelligences will be addressed. Once again, students are provided with a link to video clips of teachers modeling input in a constructivist manner and a window to search the Internet for ideas.

The next icon of hands and a brain represents the practice/application component of a lesson. Those planning constructivist lessons are asked to develop a learning activity that is "minds on" as well as hands on (i.e., the activity helps students go from Point A to Point B). It is suggested that activities are best if they require students to figure out (for themselves, with the assistance of instructional scaffolding) the logic or application of a concept. It is also suggested that one determine if using flashcards, handheld models/manipulatives for each student, or technology (e.g., Webquests, Internet simulations, games, chat rooms, etc.) will best help students meet the lesson objectives. Also, it is suggested that one determine if the activity should be done in cooperative learning groups, and if it is, then the number of students in each group and whether they should be heterogeneous or homogeneous. Once again, students are provided with a link to video clips of teachers modeling this approach in a constructivist manner and a window to search the Internet for ideas.

The icon of a thermometer represents the closure of the lesson. The user of the Interactive Lesson Planner is advised that a closure allows the teacher to check for understanding by having the learners summarize their perception of what was taught. Video clips are provided that depict teachers modeling how one might take the objectives and close the lesson by turning them into questions for the students to answer.

Finally, the icon Point B represents the ultimate goal of the lesson. It is advised that the ultimate goal of the lesson should be that students not only learn the stated objectives, but also grasp broader "key take-aways." The key take-aways can be essential principles, or fundamental rules or concepts, that students are to get from the lesson. For example, since it has been said that we study history so that we are not doomed to repeat it, then a history lesson may teach not only the facts of a historical event, but also something that a student should avoid repeating (an essential principle or fundamental rule as what not to

do). Barzun (1981) stated that because an association is the germ of a principle, one should not, for example, teach that Washington, DC, is the capital of the U.S. and leave it at that. More wisely, for a student from another country, one should teach about Washington the person and establish why the U.S. capital has his name (the logic behind the name and, therefore, a principle). One could also teach students to memorize the multiplication tables, but teaching that 4×4 is the same procedure as $4+4+4+4$ (addition, something that the student already knows—their Point A!), points to a principle of mathematics (Barzun, 1981).

Dreamweaver Software

Not only can teacher educators use the Internet to facilitate constructivist lesson planning, but they can also use the Internet to showcase their students' finished lessons. In order to do just that, students were taught to use the Dreamweaver web-authoring software. With the ability to use this software, students were able to post their lessons on the Internet. By doing so, students were given an arena to showcase effort that might otherwise be seen only by the teacher educator (in many cases, years before the students were to use the lessons in an actual classroom). By having preservice teachers post their lessons to the Internet, students were assured that the lessons would be available for use for the student teaching experience, rather than merely turned in for the instructor to grade. Not only would the lessons be accessible online for the student-teaching experience, but they would also be showcased for potential employers. Links to the student's websites could be emailed to principals so that they may inspect student websites via a so-called Virtual Teacher Job Fair. Because this approach follows John Dewey's suggestion that the teaching and learning process should attempt to solve real-world problems during the course, it is hypothesized that preservice teachers would be more likely to put forth a sustained effort in the instructional planning process (Dewey, 1916).

Classroom Use

The Interactive Lesson Planner was used in a preservice education course entitled, Computer Applications for Educators. The course enrolled eight sophomore elementary education students and nine sophomore secondary education students. The only prior education class the students had was an introductory foundations of education class.

During the course, students were asked to build lessons to meet hypothetical lesson objectives presented by the instructor. The students were instructed to use the Interactive Lesson Planner in order to quickly generate ideas. The students were to view video clips modeling lesson components and to synthesize the ideas they gathered into their own constructivist lesson. All the way, the instructor circulated the classroom activating prior knowledge and stimulating the constructivist approach by asking how their planned approach might activate their future students' prior knowledge. The instructor challenged the preservice student to articulate what student responses they were planning to get and then provided hypothetical responses that their future students might have to the lesson.

Beyond this classroom exercise, students were also assigned to produce nine lessons to be housed at their website. These lessons were to be inspired by a *New York Times* article and to contain the components of a lesson as described by the Interactive Lesson Planner. Students were given one 50-minute class period a week for 9 weeks to work on eight of their nine web-based lessons so the instructor could scaffold the instructional planning process. Students were encouraged to research and find resources for their lessons outside of class. Students were also encouraged to reflect and to refine and improve their lessons outside of class. At the end of the semester, students were to teach a 20-minute

class for their fellow students. In order to assess student application of constructivist theory, this lesson was to be the ninth lesson produced *without* instructor scaffolding, but was to be produced with the use of the Interactive Lesson Planner. These lessons were analyzed for the following section.

Results and Discussion

The analysis of the lesson plans was conducted by the author and guided by the four central characteristics of constructivist learning as identified by Applefield, Huber, and Moallem (2001). The four central characteristics were converted into the following questions:

1. Were learners able to construct their own learning?
2. Did the new learning build on student's existing understanding?
3. Did social interaction play a critical role?
4. Did authentic learning tasks provide for meaningful learning? If the answer was "yes" to all of the above questions when I observed the teaching of the Internet-based lesson, then the lesson was judged to be constructivist in approach.

The lessons were taught during classroom presentations to fellow teacher education candidates.

Approximately 75% of the lessons created and presented were judged to be constructivist in approach. These lessons can be found online at <http://www.kings.edu/kdils/StudentWebsites.htm>. For example, one lesson plan that exhibited a constructivist approach suggested that the lesson begin with a QuickTime video clip of a forest fire and Smokey the Bear warning, "Only you can prevent forest fires." As you page down the website, pictures of a raging forest fire and deer running away from the fire appear. As you continue down the web page, the words "Bell Ringer" appear followed by the prompt "When viewing the above pictures, write down all of the good and bad things that come to mind. After writing the answers down, students are then to be asked if they are having a difficult time writing down many good things. Why is that?" The next thing to appear on the website is "Objective/Purpose: SWBAT discuss the benefits and problems there are with forest fires. SWBAT identify the causes of forest fires as well as environmental conditions that favor fires." The lesson plan then outlines "Lecture/Discussion (questions to be answered and explained)" and included the following:

1. Where do forest fires occur most often?
2. What is the cause of most forest fires?
3. What happens to the animals during forest fires?
4. Do forest fires have any benefits?
5. Why do people rush and try to put forest fires out as soon as possible?

As you page down the website, the "Practice/Application" section of the lesson provides links to evidence that ashes from forest fires have soil enriching qualities and evidence that forests have the ability to regenerate themselves. Also, links are provided to sites depicting the benefits of human prevention of forest fires. Finally, a link to a forest fire simulation depicting the relation of dry weather and the spread of fire was made available for each student to use.

This lesson plan was used successfully to spur a constructivist learning experience. The questions were focused on examining the essential principle that nature, in general (and

forest fires, in particular), does not necessarily require human intervention. The questions were planned and then used in the classroom in a way that spurred student reactions. There was enough flexibility in the plan for the teacher to adjust to student responses (which was also demonstrated during the lesson taught to fellow students). The learning activities engaged the students and helped them investigate the essential principle of the lesson. It was apparent that this lesson and others like it exemplified the essence of the metaphor of getting students from Point A to Point B, used authentic resources found on the World Wide Web via the Interactive Lesson Planner, followed the video clip models of constructivist teaching found on the Interactive Lesson Planner, and reflected thinking shaped by instructional scaffolding provided during the planning process.

Approximately 25% of the lessons created and presented by the students were not constructivist in the approach. A typical lesson that was not consistently constructivist in its approach had the same lesson components as a successful lesson, but was often missing the focus that would bring about the appropriate student responses. For example, one lesson plan suggested that the lesson begin with a picture of a weather map. Students were to be asked if they knew what the picture was and "what it tells us." The teacher was to then ask the students if the study of weather is a science. Students were to explain why they thought it was a science or why they did not think it was a science. The lesson followed by explaining that students were to be able to examine the weather through newspaper reports. The lesson outline prompted the teacher to describe that meteorology is the study of the weather and that "unlike other areas of science, which can be manipulated by humans, weather can't be changed by scientists and that they can only predict it from what they know."

The teacher was then to ask the students to "share a story when you heard weather forecasts that weren't very accurate." The teacher next planned for students to go to the weather section of a local online newspaper and find and define some of the following terms: front, high and low pressure, wind velocity, precipitation, relative humidity, pollution levels, and sunrise and sunset. This activity was to end by having students find an example of at least three of those terms and explain what it means. To close the lesson, the teacher planned that "from now on students will look at the paper each morning and find some important terms and then check the weather outside with that day's forecast." Also, webquests dealing with weather terms tacked on at the end of the lesson.

When this lesson was taught, it appeared that the teacher failed to build effectively on the student's existing prior knowledge concerning science and how it might be applied to weather forecasting. The teacher was unable to get the answers she wanted, and she did not have responses to refocus student attention in order to get usable answers. Unsuccessful lessons like this one seemed to reflect the student's unfamiliarity with the content. During teaching, students were often unable to build a logical progression of facts and illustrations built around an essential principle, concept, or theme. Because of this fundamental flaw, it was not surprising that these beginning teachers often took the topic and asked general, vague questions. It was also not surprising that they did not plan scaffolding, or hints, for situations when they did not get their predicted answer.

Conclusions

It is being proposed that teacher educators assist in the development of constructivist teaching by providing preservice teachers with such technology tools as the Interactive Lesson Planner and coaching during the instructional planning process. This approach appears (in many instances) to help preservice education students focus their attention on how to engage their future students' prior knowledge and how to elicit responses from

their future students. This approach, in other words, encourages preservice teachers to plan by organizing experiences (web-based pictures, video clips, songs, statistics, simulations, etc.) and questions about those experiences that will likely lead students to construct an understanding of an essential principle, concept, or theme.

Doyle and Holm (1998) asserted that preservice teachers do not teach with the constructivist approach because they are taught linear lesson planning. When discussing the findings of Borko and Livingston (1998) they asserted,

Students using the traditional lesson plan did not anticipate learners' reactions and responses to their lessons and were not able to make adjustments when needed in their efforts to stick to the plan. The experienced teachers, in contrast, kept to a more general vision of their plans in their heads and were able to make needed adjustments as they taught in response to learners' reactions during the teaching episode. (p. 69)

Borko and Livingston (1998) critiqued "linear, scripted plans" by observing that they do not necessarily encourage lessons that spur student reactions and enable teachers to adjust to those reactions. It is the author's view that the problem, however, may be due less to the linear lesson plans and more to the lack of planning to elicit student's responses. After witnessing students planning with the Interactive Lesson Planner and with coaching from the instructor and then teaching their lessons to their fellow students, it seemed evident that this type of linear lesson planning can prepare education students to implement constructivist lessons.

It appears that those who were unsuccessful at planning and teaching constructivist lessons knew that their task was to activate prior knowledge and to spur student reaction. However, because of their lack of familiarity with the content and because of their lack of focused questions, they were unable to spur appropriate student reactions and then were unable to adjust to those reactions. It appears that these preservice education students need more familiarity with the content matter. Once the content knowledge is more thoroughly understood, then more coaching concerning possible student reactions and more planning to adjust and respond to those reactions is needed. Therefore, students taking this course in the future will be asked to do more reading and research in the content area prior to the lesson planning. When the planning process does begin, students in the future will not only be asked to outline the components of a lesson, but will also be asked to outline their prediction of how students will react and possible ways they will respond to those reactions. These added features (intended for the teachers' planning purposes only and not to be visible during the teaching of the lesson) can also be put in the online lesson plan, as they can be effectively hidden from student view by putting this information on another web page and linked to the lesson.

In conclusion, using the Interactive Lesson Planner and instructional scaffolding during the planning process can enhance the planning and teaching of constructivist lessons. While this analysis concluded that approximately 75% of students using this approach successfully completed a constructivist lesson, the focus provided by the additional tasks outlined above may increase the percentage of preservice teachers successfully planning constructivist lessons.

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