Constructing Knowledge Networks in Middle School Classrooms

Sarah E. Irvine  
School of Education  
American University  
United States  
sirvine@american.edu

Teresa Larkin-Hein  
Department of Physics  
American University  
United States  
thein@american.edu

Andrea I. Prejean  
School of Education  
American University  
United States  
aprejea@american.edu

Abstract: Providing opportunities for K - 12 educators to further their use and understanding of current technologies in the classroom has never been more important than it is at present. This paper will explore ways that university faculty members can provide K - 12 educators with relevant information and hands-on experiences to develop and enhance their use of technology in the science classroom. An interactive workshop for 15 middle school science teachers provided an opportunity for participating teachers to experience constructivist teaching and learning strategies first-hand. Throughout the workshop, teams of teachers worked to prepare an integrated, technology-based lesson using materials from science, mathematics, as well as the language arts. Highlights of the curriculum developed for the workshop will be presented. Results of a questionnaire given to the teachers will also be shared.

Introduction

Through a Dwight D. Eisenhower Faculty Development Program award, a team of faculty members and graduate students from American University hosted a workshop on the American University campus for a group of 15 middle school teachers from the District of Columbia Public Schools. Teams of three were identified with most teams including a science teacher, a mathematics teacher, and a language arts teacher. Where possible, teams consisted of teachers from the same school. Resources for the workshop can all be found at http://www.american.edu/IRVINE/ike/. The weeklong, interactive workshop provided an opportunity for participating teachers to experience constructivist teaching and learning strategies first-hand. During the week, the teams of teachers worked to prepare an integrated, technology-based lesson using materials from science, mathematics, and the language arts. In the section that follows, highlights of the many workshop activities are outlined. A table summarizing the workshop events is given in the appendix of this report.

Theoretical Framework

The need for the successful implementation of technology into any educational program, especially the innovations within middle school classrooms, must be build upon a genuine educational pedagogy in order for
authentic learning to occur (Dede, 1999). The constructivist model has emerged from the works of developmental theorists such as Bruner, Piaget, and Vygotsky. The cognitive constructivist theory adopts the works and conclusions of Bruner and Piaget as the foundations of its principles. Within this theory, students construct their knowledge of the world through assimilation and accommodation. Within the field of educational computing, the best-known cognitive constructivist theoretician is Papert (1993), who characterizes behavioral approaches as “clean” teaching, and constructivist approaches as “dirty” teaching. The contrast emphasizes the difference between perspectives that isolate and break down knowledge to be learned (clean) versus approaches that are holistic and integrative (dirty) (Papert & Turkle, 1993). Intertwined together, at some level both “clean” and “dirty” approaches serve as the authentic foundations of the constructivist theory. By considering these approaches together, we can get a clearer understanding of how Internet technology, when integrated into any classroom, can be used to create successful distance learning in educational and corporate environments.

Another example of constructivism in educational technology is outlined by Dede and Sprague in a 1999 article, “If I teach this way am I doing my job?” which appeared in Learning and Leading with Technology. The article is based upon the constructivism theory at work in a traditional classroom. Educational technologists have often stated that an effective way to integrate technology into the teaching and learning processes is to follow a constructivist foundation. In other words, educators may have technical skills, but they may not understand how constructivism translates into effective, “hands on” classroom practice. However, the constructivist theory is in fact one of the best theories to intertwine into the daily classroom lifestyle (Dede & Sprague, 1999).

For an authentic constructivist theory to breed successfully in any classroom, students are expected to be more actively involved than in traditional classrooms. They are required to share ideas, ask questions, discuss concepts, and revise ideas and misconceptions (Dede & Sprague, 1999). In order to successfully ensure that the constructivist theory is in practice while using technology, the educator must in most cases change his or her more traditional beliefs. In the constructivist classroom described by Dede and Sprague there is no evidence of neatly lined desks or a type of “dense” order within the classroom walls. Instead, students work in teams, asking questions and moving about the classroom. In addition, the educator, instead of simply repeating a redundant lecture, is engaging in interactive activities with his or her students. The mission of the constructivist method is centered upon the needs and interests of the student. Any constructivist classroom demonstrates that learning can often times go beyond the content area. The main foundation the constructivist scenario is built upon states that authentic learning must be student-centered and meaningful and must encourage the student to engage in real-world experiences, thus allowing him or her to go further in his or her learning and education (Dede & Sprague, 1999).

There are many examples in which the constructivist theory has successfully been implemented with or around technology. Within the model constructed by Egbert, Thomas, and Fischler (2000), the Tigerlake Public School simulation is assessed through substantial research. The model mimics the following concept: if the constructivist theory is successfully implemented with and around technology, students learn authentically. In this situation, student-educators who are the participants in this simulation learn by doing. This simulation offers a way to integrate field experience and alternative technology-based instruction, which combined can help to improve almost any type of student to achieve high levels of competence in technology. The Tigerlake simulation allows the 29 student-educators to interact in a learning environment where “rich” experiences could be achieved. The richer the experience, the richer and more indelible learning takes place. By presenting related practices in learning environments that are simulated, the participants are provided with a set of “experiences” to compare to the current problem or issue. The participants are able to simplify concepts in order to make them understandable, in order to build upon existing understandings of theory and apply it to practice. Again, even among student-educators, the constructivist theory, intertwined with technology, is successful in allowing the participants to gain a better grasp of applying theory to practice (Egbert, Thomas & Fischler, 2000).

**Design**

The basic structure of the workshop involved sharing information and materials with the teachers during the morning sessions. This structure builds on known ideas about infusing technology into the instructional techniques of teachers, as many educators are experiencing a transformation in the ideology of “best-practices” as they once knew it (Balestre, Ehrmann, Ferguson, 1992). Although technology has
influenced methods and practices in almost all-educational institutions (Balestri, Ehrmann, Ferguson, 1992),
traditional pedagogy should still be used as the foundation for all educational practices (Bopry, 1999). The
teams of teachers spent each afternoon in a computer lab learning how to use the internet and world wide web
to create constructivist-based integrated lessons. Each afternoon, the participants met in the McCabe Center for
Computers in Writing, a lab of Windows98 computers with access to the internet and web-design software.
Teachers were given intensive hands-on instruction on educational web design, and created materials and
resources to use in the process of integrate this instructional medium into their teaching in math, science, and
language arts. Thus, the teachers were given a considerable amount of time to work together within their teams
to plan and develop their lessons.

Each morning, the workshop began with a group discussion of the previous day's "reflection
questions." Each day participants were given several questions to ponder after the conclusion of the day's
events and activities. Participants were asked to go home and keep track of their reflections in a journal. The
reflection questions were typically associated with information presented during that day's sessions. The intent
of the reflection questions was to give teachers time to digest information they had received during the day, and
to reflect on how that information might have relevance to them in their daily teaching activities.

Each day, participants engaged in hands-on activities relating constructivist perspectives into
instruction in language arts, mathematics, and science. The participating middle school teachers were engaged
by activities such as how to use a learning style approach in the classroom, reading the web using a critical
literacy perspective, and an interactive, constructivist-based biology laboratory on DNA. Each day following
lunch, participants went to a computer lab facility to work on their team projects. The sessions followed a
teaching/training methodology for instruction in using the computer applications in the lab. First teachers
discussed general principles of educational web design, and then participated in a whole-group training session
on how to use the tools. Then teams were given lab-time to work on their projects with one-on-one assistance
from the session leaders. Thus, participants had ample opportunity to ask questions and receive personal
assistance from the workshop team.

The focus of the projects that the teachers created were around an integrated lesson that allowed the
teachers to build on national standards in their own curricular area. The point of this focus was to have the
teachers build a series of activities that would not only give their students the opportunity to construct their own
knowledge, but also provide a interesting way to meet curricular standards. This allowed teachers to realize that
alternative methods of assessment could be used to measure student learning, while still meeting the school
district's objectives. Therefore, teachers could still feel they were "doing their jobs" -- in reference to
Christopher Dede and Deborah Sprague's Question. For example, in an integrated lesson on the study of
petroglyphs, students could learn about something of interest, while still achieving learning standards in math,
science, and the language arts. This activity allows students to examine this interesting field of study through
mathematical activities, scientific methods, and using language and communication skills to show what they
learned.
Feedback from Participating Teachers

On the final day of the workshop, feedback was elicited from the workshop participants in the form of a written questionnaire. The questionnaire was used as a substantive portion of the summative assessment of the workshop. A copy of the questionnaire is included in the appendix of this report. The questionnaire includes a summary of all comments given by the workshop participants. A brief summary of the feedback received from workshop participants will now be presented.

Numerical ratings given by the participants ranged from 3.86 to 4.93 (with 5.0 being the highest possible rating). The overall average numerical rating was 4.60. From these ratings it might be concluded that overall, the workshop participants were very satisfied with the workshop. Participants were asked whether they felt the goals of the workshop were achieved. Responses to this question clearly show that most participants felt that the goals and objectives were met, and in many cases, exceeded. In regards to the overall structure of the workshop, one participant commented "This was the 'best' professional development experience I have had in several years."

When asked how they intend to integrate what they've learned in the workshop into their own classrooms, participants indicated a definite eagerness to return to school and begin implementation of the new strategies. Several participants suggested that they planned to make better use of the web in their classrooms. In addition, one participant indicated that they would be making use of the constructivist approach as they work
with and teach other faculty. Thus, the potential exists for other teachers at the participants' schools to benefit from the material shared in the workshop.

Comments from some participants indicated that they did not necessarily feel there was enough time for interactions to occur, especially between teachers from schools other than their own. The teams were structured such that most teachers worked with other teachers from their own schools. This was done to allow teachers to return to their individual schools and continue working together to further enhance what was learned during the workshop. In addition, these teams were encouraged by the workshop leaders to return to their own schools and share what they learned with other teachers.

Overall participants indicated that they felt the workshop was a valuable experience, worthy of being repeated in future summers. Some participants indicated that if the workshop were to be repeated it could even be extended to two weeks because of the amount of material presented.

Summary

Although many educators think that implementing the most high tech tools is the way to maintain successful educational practices, others bow to traditional theories. What is obvious is that many of the constructivist theories can be successfully implemented when intertwined with current Internet technologies. What seems to be needed currently is an understanding that the constructivist approach to learning can be implemented with the Internet, and if done so properly can be highly successful, taking educators and students where they have not been able to go in the past. For example, when teachers and students are actively engaging in Internet technology and implementing projects in such a domain (by building their own environments), they are simultaneously actively engaging in the learning of knowledge, within that domain. Students building artifacts on the web are creating creditable sharable externalization of their knowledge, which provides both motivation and opportunity to exercise meta-cognitive skills. As a result, students gain the ability to learn simply by applying the constructivist theory to their success factors when using the Internet. A passive view of integrating the Internet into education may only support instructions and techno-centrism (Papert & Turkle, 1993). Educational Internet resources will change this approach by allowing students some degree of autonomy in choosing their path of learning via computers. The Internet alone cannot produce “good” learning, however “good” learning can occur through successful implementation of the Internet (Papert & Turkle, 1993).

The goal of the “Constructing Knowledge Networks: Integrating Science, Math, Language, and Technology in the Middle School Classroom” workshop was to provide teachers with hands-on learning experiences and materials related to developing technology-based learning tools for use in Science, Mathematics, and Language Arts classrooms. Based on feedback from participants, the goals and objectives of the workshop were met and exceeded. In addition, participants encouraged workshop leaders to offer similar workshops in the future, focusing on a project-based approach to professional development.

References


**Acknowledgements**

The above study was funded by The U.S. Department of Education under Title II, Part B – Dwight D. Eisenhower Professional Development Program to the District of Columbia. The opinions expressed herein are not necessarily those of the U.S. Department of Education or the District of Columbia.