Constructing Knowledge Networks in Middle School Classrooms

Teresa Larkin-Hein, Sarah E. Irvine, Andrea I. Prejean, & Mary Anne Lesiak
American University
Washington, DC

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 work with K - 12 educators with relevant information and hands-on experiences to develop and enhance their use of technology in the middle school classroom. An interactive workshop for 15 middle school teachers provided for a model by which participating teachers could 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 and results of a questionnaire given to the teachers will be shared. Finally, observations made by the workshop leaders will be discussed in order to assist other university faculty interested in modeling a similar program for K-12 teachers.

I. Introduction

Through a Dwight D. Eisenhower Faculty Development Program award, a multidisciplinary 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 during the summer 2000 session. 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. A portion of the resources developed 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, teams of teachers worked to prepare an integrated, technology-based lesson using materials from science, mathematics, and the language arts. Careful attention was given to following the national content-standards developed for each of these areas of the curriculum. In the section that follows, highlights of many of the workshop activities are outlined.

II. Theoretical Framework

The need for the successful implementation of technology into any educational program, especially the innovations within middle school classrooms, must be built upon a genuine educational pedagogy in order for authentic learning to occur[1]. The constructivist model has emerged from the works of developmental theorists such as Bruner, Piaget, and Vygotsky[2]. 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, 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)[3]. 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 environments.

Another example of constructivism in educational technology is outlined by Dede and Sprague[4], who pose the question "If I teach this way am I doing my job?" Their article is based upon the constructivist 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. Furthermore, educators may have technical skills, but they may not understand how constructivism translates into effective, "hands-on" classroom practice. Constructivist theory can be one of the most useful and yet simultaneously difficult to adapt theories in terms of daily classroom activities. However, constructivist theory is well matched to using technology as a medium of presentation and demonstration of knowledge, rather than simply using technology for its own sake.

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[5], 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 some current problem or relevant issue. Participants are also 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 and applied to the content areas, may successfully allow participants to gain a better grasp of how to turn theory into practice.

For an authentic constructivist theory to breed successfully in any classroom, students are expected to be more actively involved than in traditional classrooms[6 - 8]. They are required to share ideas, ask questions, discuss concepts, and revise ideas and misconceptions. 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 are working 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. Thus, the constructivist emphasis of the workshop provided a natural vehicle for the intertwining of technology with the science, mathematics and language arts content areas. The main foundation the constructivist scenario is built upon states that authentic learning must be student-centered and meaningful and must encourage students to engage in real-world experiences, thus allowing them to go further in their learning and education.

III. 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[9]. Appendix I highlights the schedule developed for the workshop activities.

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.

In addition, each day participants engaged in hands-on activities grounded in the constructivist philosophy. To support this philosophy, the participating middle school teachers were engaged in activities such as:

- the examination of learning theories using a learning style approach,
- reading the web from a critical literacy perspective, and
- experiencing an interactive biology laboratory on DNA.

Although technology has influenced methods and practices in almost all-educational institutions, traditional pedagogy should still be used as the foundation for all educational practices[10]. The teams of teachers spent each afternoon session in a computer lab equipped with Windows98 computers learning how to use the Internet and web design tools to create constructivist-based

integrated lessons. 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.

Teachers were given intensive hands-on instruction on educational web design, and created materials and resources to use in the process of integrating this instructional medium into their teaching of mathematics, science, and language arts. Thus, the afternoon sessions were devoted to allowing teachers considerable amount of time to work together within their teams to plan and develop their projects.

The focus of the projects that the teachers created were centered around an integrated lesson that allowed the teachers to build on national standards in his or her 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 an interesting way to meet curricular standards. This integration of curriculum standards helped teachers acknowledge the commonalities that exist between the content areas. In addition, this acknowledgment precipitated the observation 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."

An example model project prepared in advance of the workshop highlighted an integrated lesson on the study of petroglyphs. The model showed how students could learn about something of interest, while still achieving learning standards in mathematics, science, and the language arts. This model examined this interesting field of study through mathematical activities, scientific methods, and the use of language and communication skills to demonstrate their understanding.

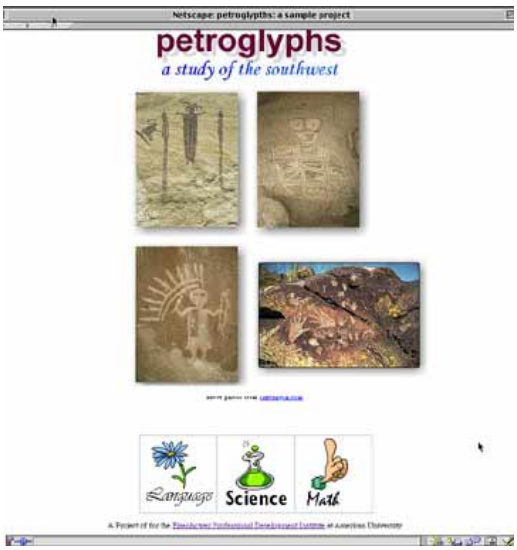

Figure 1: A sample constructivist learning project on the study of petroglyphs

IV. 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 brief summary of the feedback received from workshop participants will now be shared.

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 showed that most participants felt that the goals and objectives were met, and in many cases, exceeded. In regard 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 intended to integrate what they'd learned in the workshop into their own classrooms, participants indicated a definite eagerness to return to school and begin the implementation of the new strategies. Several participants suggested that they planned to make better use of the web in their classrooms. In addition, participants indicated that they would be making use of the constructivist approach as they worked with and helped other faculty interested in adapting the approach.

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 in such a way that most teachers worked with 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 and to provide each other with needed support once back at their school sites. 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, its length could even be extended an additional because of the amount of valuable material to be shared.

V. Observations of Workshop Leaders

Workshop leaders observed that each of the workshop participants brought with them different amounts of knowledge and experience related to the use of technology in the classroom. Thus, a considerable amount of time was needed during the afternoon sessions to provide participants with the baseline tools needed for successful completion of their projects. Given this, workshop leaders indicated that a brief but intensive training session on general applications of technology prior to the workshop might be useful if similar workshops were conducted in the future. This

training session could enhance both the level and the depth of sophistication of the projects developed and produced by the teachers.

Presentations and activities coordinated by the workshop leaders carefully modeled the constructivist approach to teaching and learning. Participants were given numerous opportunities to "construct" knowledge via making valuable connections to their own lives and world views. Through feedback given by participants and observations made by workshop leaders, the overall impression of the workshop was that it was very effective in terms of sharing and applying constructivist theories to actual classroom activities.

VI. 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 constructivist theory can be successfully implemented when intertwined with current Internet technologies and various content areas. What seems to be needed currently is an understanding that the constructivist approach to learning can be implemented with the Internet. Furthermore, if this implementation is handled properly, it can be highly successful, taking educators and students to levels that they have not been able to achieve in the past. For example, when teachers and students are actively engaged in the application of Internet technology and implement projects in such a domain (by building their own environments), they are simultaneously actively engaged in the acquisition of new and relevant knowledge within that domain.

Students building artifacts on the web are creating a creditable and 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. 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[11].

The need for professional development opportunities related to the emergence of new technologies is well documented[12 - 17]. Furthermore, it is imperative that technology be grounded using a "scholarly" approach to teaching[18]. Within this "scholarly" approach is the need to understand the different ways people learn as well as differences in their learning styles[19 - 25]. The over-riding 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.

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TERESA LARKIN-HEIN
Teresa Larkin-Hein is an Assistant Professor of Physics Education at American University. Dr. Larkin-Hein received her B.S. and M.S. degrees in Engineering Physics from South Dakota State University in Brookings, SD in 1982 and 1985, respectively. She received her Ph.D. in Curriculum and Instruction with special emphasis in Physics and Science Education from Kansas State University in Manhattan, KS in 1997. Dr. Larkin-Hein's research interests primarily involve the assessment of student learning in introductory physics courses. She has made use of writing as a learning as well as an assessment tool for understanding how non-majors learn physics. Dr. Larkin-Hein's research further involves strong learning style components. In addition, her research involves studying the role of technology as an assessment and learning tool. Dr. Larkin-Hein has been an active member of ASEE for more than 13 years. In 1998 she received the *Distinguished Educator and Service Award* from the Physics and Engineering Physics Division. Dr. Larkin-Hein served on the Board of Directors for ASEE from 1997 - 1999 as Chair of Professional Interest Council III (PIC III) and as Vice President of Professional Interest Councils. In April 2000 Dr. Larkin-Hein was awarded the *Outstanding Teaching in the General Education Award* from American University. Dr. Larkin-Hein can be reached at: American University, Department of Physics, 4400 Massachusetts Ave. NW, Washington, DC 20016-8058. [thein@american.edu]

SARAH E. IRVINE
Dr. Sarah E. Irvine, who earned Arizona State University with a Ph.D. in Curriculum and Instruction in 1995, specializes in integrating technology in effective instruction. Dr. Irvine is presently Project Director of SCALE 2000, an Internet training and tools development grant supported by the United States Department of Education. Her research activities focus on infusing effective components of instructional design with emerging technology in education, and in particularly in special education. In addition to extensive use of computer-mediated instruction in her teacher preparation courses, Dr. Irvine directs several school-based projects examining implementation of high technology, telecommunications and international networking in the classroom. Dr. Irvine has trained preservice and inservice teachers in the area of electronic communication and technology integration. She serves as consultant to schools and business on design, implementation, and analysis of technology-based solutions to instruction and application development. Through field-based research, she has successfully worked to integrate Internet-based activities into educational programs for urban, rural, and at-risk K-12 students. Dr. Irvine has taught numerous courses and workshops devoted to evaluation and assessment of the impact of technology on education. She has developed and delivered courses and training addressing research design, methodology, and evaluation, placing emphasis on evaluating the summative and formative impacts of technology on the teaching learning process. Dr. Irvine can be reached at: American University, School of Education, 4400 Massachusetts Ave. NW, Washington, DC 20016-8030. [sirvine@american.edu]

ANDREA I. PREJEAN
Andrea I. Prejean is an Assistant Professor of Mathematics Education at American University. She earned her doctorate from the University of Central Florida in Curriculum and Instruction in 1996. Dr. Prejean taught in the public schools for 10 years and was a mathematics specialist for the Florida Department of Education, providing professional development for K-12 mathematics teachers. Her research interests include teacher belief systems and how they affect students' interest and achievement in mathematics and the use of action research in changing teachers' practices in the classroom. Dr. Prejean is chair of the membership committee for the Association of Mathematics Teacher Educators (AMTE) and a member of the Instructional Issues Advisory Committee (IIAC) for the National Council of Teachers of Mathematics (NCTM). She co-edits a column in NCTM's journal Teaching Children Mathematics and her most recent publication, Reflections on China: Implications for Gifted Education was published in Gifted Education Press Quarterly. Dr. Prejean can be reached at American University, School of Education, 4400 Massachusetts Ave. NW, Washington, DC 20016-8030. [aprejea@american.edu]

MARY ANNE LESIAK
Mary Anne Lesiak is an eighth grade Social Studies teacher at Ronald H. Brown Middle School in the District of Columbia Public School System. Ms. Lesiak received her B.A. in Government and Politics from the University of Maryland at College Park and her Master of Arts in Teaching from American University. In addition, Ms. Lesiak teaches computer applications to at risk youth in an after-school program and is interested in developing programs designed to bridge the digital divide. Ms. Lesiak can be reached at Ronald H. Brown Middle School, 4800 Meade Street NE, Washington DC, 20019. [mrslesiak@hotmail.com]

Appendix I

Summer Institute Schedule
July 17 -21, 2000

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Introductions. What is constructivism and how does it work in Science, Math, Language Arts, & with Technology? Learning styles discussion.	Reading the web: A critical literacy perspective. The goods, bads, and uglies of using the web as a resource.	Use DNA labs as content and examples of web resource issues. Science, math, and writing - issues and commonalities, & use of Physics-based content/labs as content and illustration of writing.	Advanced web design - bringing it all together. Technology resources for use in the classroom.	Work on completing projects.
Lunch Conversation & Reflection Time.	Lunch Conversation & Reflection Time.	Lunch Conversation & Reflection Time.	Lunch Conversation & Reflection Time.	Lunch Conversation & Reflection Time.
Define the projects due on Friday (Use the wetlands conservation project as an example).	Introduction to web design basics.	Using internet tools (what's out there for teaching Math, Science, etc).	Making middle school math effective and relevant. What is prealgebra and how can we use technology to teach it?	Final presentation of projects and Awards Ceremony.