Today’s children have been altered tremendously by the technological revolution, but that same technology has yet to make a significant impact on our educational system. Educators have begun to question how to best educate students who have grown up in a world of instant information. It has been proposed that constructivism could be a guiding philosophy that may be able to transform curriculum in which technology is integrated seamlessly.

Research has shown that environments rich in technology have the potential to bring about dramatic changes in teaching, as well as the physical make-up of a classroom. Computer-based constructivist projects take many forms, both online and off (CSILE, CoVis, Computer Clubhouse, JASPER, WebQuests). The creation of technology rich activities described in this article follow an instructional design process that combines procedures set forth by Bernie Dodge and Tom March (1995).

Here is Edward Bear, coming downstairs now, bump, bump, bump, on the back of his head behind Christopher Robin. It is, as far as he knows, the only way of coming downstairs, but sometimes he feels there really is another way, if only he could stop bumping for a moment and think of it. (Milne, 1996)

The quote from Milne speaks to the way many teachers function in the K-12 arena. There is so much to do and so little time to do it in, they continue to do work in the same way it has been done for decades. Teachers generally
know there may be better methods available, but do not have the time to investigate what they are. As assessments and data-driven instruction become increasingly important, teachers must stop “bumping” down the stairs in order to become more efficient, effective users of the equipment provided for them. Integrating technology into a constructivist learning environment is one way that is currently being advocated as a method that will move more students toward functioning in the real world.

Technology has revolutionized American culture, but while doing so, it has left educators hurrying to catch up. In the last 20 years, electronic technology has penetrated every aspect of our lives. Television has reformed our world and freed us from the limits of text and static graphics. It has become possible for events thousands of miles away to appear in our homes with their intensity intact. Computers allow expansive amounts of information, from airline reservations to the contents of encyclopedias to be made instantly accessible and available for altering. The very nature of work has changed, with an increasing demand for workers who can master new technologies and use them to conduct business that formerly did not require computers (Cuban, 1986).

Most significantly, however, are the changes in our children that have been brought about by the technological revolution. Children have grown up with Nintendo hand held machines and spent more time watching television and videotapes than they have reading. Now, toys talk and interact with children, responding to them in ways teddy bears and hobbyhorses of the past never could. Our children have been raised in a world of instant access to knowledge, a world where vivid images supplement information formerly provided only through text.

The technological changes, however, that have swept through our society have left educational systems largely unchanged. Over the past 20 years, an immense division appeared between the process of teaching and learning in schools and the ways knowledge is obtained. This division has been made more obvious by the fact that the process of teaching has not changed substantially over the past 100 years. The result is an estrangement of children in schools from society as a whole.

Educators now question how we can best educate students raised in a world of instant information, where interactive technologies have led them to believe they can act on the world with the press of a button. What is needed is a guiding philosophy for educational curriculum and effective uses of technology. It has been proposed that this philosophy could be constructivism (von Glaserfeld, 1989).
CONSTRUCTIVISM DEFINED

Constructivism’s central idea is that human learning is constructed, and that learners build new knowledge on the footing of previous learning. In a constructivist atmosphere, the learner constructs knowledge through discovery and exploration in order to solve real world problems with peers. According to Bruner, constructivism is a teacher-facilitated process that places students at the center of active learning, rather than in a passive role. Instead of simply absorbing ideas spoken by teachers, or somehow trying to internalize thoughts through endless, repeated rote practice, constructivism suggests children actually invent their own ideas. They assimilate new information and modify their understanding in light of new data. In the process, their ideas gain in complexity and power, and with appropriate support, children can develop insight into their own thinking processes. Learners apply current understanding, note relevant elements in new learning experiences, judge the consistency of prior and emerging knowledge, and based on that judgment, modify their knowledge (Ernest, 1995; Fosnot, 1996; Vygotsky, 1978).

Young people acquire knowledge and comprehend new concepts through involved interaction with other students, as well as activities that require creativity and analysis. Advocates of constructivist teaching say its practice is vital if America hopes to cultivate and maintain a work force capable of competing globally in the 21st century.

TECHNOLOGY AND CONSTRUCTIVISM

In the last 20 years, the technological revolution has penetrated every area of society. Schools have always mirrored the values of our society, however the technological changes that have swept through society have left the educational system virtually unchanged. It is frightening to note that as our children are growing up, they may not be receiving the instruction and knowledge necessary to function in a technological world. The task of the educational system should be to embrace the future and empower children to learn with the tools available to them. Trying to think up clever ways to use computers in a traditional classroom setting will not do the job. If technology is assigned to a secondary role, which does not fully utilize its potential strengths, we are failing to use it to its fullest potential.

By using technology as part of a constructivist philosophy in the classroom, our children can be given a powerful set of tools. Computers, video,
and other technologies engage children with the immediacy they have become accustomed to in their everyday lives. Technology should be thought of as an integral component of any curriculum. Computers in a constructivist classroom can be used as a writing tool, to complete spreadsheets, to compile databases, for concept mapping, to create multimedia, to author Internet projects, to complete research, and as a mathematical problem-solver. Computers also make it possible to exchange information between classrooms and access online information.

Many computer-based applications encourage constructivist-oriented classroom instruction and learning. For example, computer technologies from CD-ROMs to e-mail and the World Wide Web (WWW or Web) make it possible for students to easily access a variety of information relevant to standards-based curriculum. By asking questions and interacting with others through computer-related technology, students are able to understand more effectively than through traditional static methods such as textbooks and worksheets. Technology can help improve student’s abilities to: (a) solve problems, (b) communicate, (c) work on/as a team, (d) acquire and evaluate information, (e) think creatively, and (f) make decisions (Dwyer, Ringstaff, & Sandholtz, 1990).

Jonassen (1991), Wilson and Cole (1991), Ernest (1995), and Honebein (1996) note that many educators and cognitive psychologists have applied constructivism to the development of learning environments. From these applications, they have isolated a number of important design principles for a learning environment:

- create real-world environments in which learning is relevant;
- focus on solving real-world problems;
- use instructors as a guides;
- provide learner control;
- negotiate instructional goals with students;
- use evaluation as a self-analysis tool;
- provide tools, which help learners interpret multiple perspectives;
- insure that learning is internally controlled and mediated by the learner;
- provide multiple representations of reality; and
- focus on knowledge construction, not reproduction.
Interactive Multimedia

“The introduction of computers into the classroom changes the teachers’ role, leading to decreased teacher-directed activities and a shift from didactic approaches to a constructivist approach” (Schofield & Verban 1988). Research has shown that teaching in classrooms with computers involved more: (a) project work, (b) extensive projects, (c) motivation for the writing process, (d) group work and cooperative learning, (e) interdisciplinary activities, (f) opportunities for students to make choices, and (g) a different philosophy of teaching (Dwyer, Ringstaff, & Sandholtz, 1990). A classroom with a technology rich environment has also been shown to involve less structure and less teacher presentation (Schofield & Verban, 1988). The trick to teaching is to entice and motivate the students’ excitement and interest in the topic, and then to give them the proper tools to reflect, explore, compare, and contrast.

Current interactive multimedia technologies have the potential to represent ideas in almost any form so students view the resources, creating their own meanings and understandings of the information they encounter. Interactive technologies began to be introduced early in the twentieth century to engage students in the learning process (Cuban, 1986). As new theoretical views of learning have developed, it has been recognized that learners should be active participants in their learning (Perkins, 1992). Within this constructivist framework, cognitive tools can help learners organize, restructure, and represent what they know.

COMPUTER-BASED CONSTRUCTIVIST PROJECTS

Increasingly, researchers and educators are linking constructivism and learning with technology. This is not surprising since many see a strong support for the principles of constructivist philosophy in computer-based learning environments. Computer-based constructivist projects can take many forms, both online and off. They do, however, all have one thing in common; they are based on a problem-solving format. Five examples are detailed below.
Computer-Supported Intentional Learning (CSILE)

CSILE represents a “family of developing systems intended to support the collaborative construction of knowledge in and beyond the classroom” (Bereiter & Scardamalia, 1992, p.41). The CSILE project patterns classrooms after research communities, using a collaborative learning environment and communal database within a multimedia environment that lets students generate nodes. Nodes contain an idea or piece of information relevant to the topic under study and are available for other students to comment upon. This leads to dialogues and an accumulation of knowledge. Students practice writing, when creating nodes; and reading, while accessing nodes generated by others (Scardamalia, Bereiter, McLean, Swallow, & Woodruff, 1989).

CoVis

CoVis or Learning Through Collaborative Visualization Project is “an integrated software environment that incorporates visualization tools for open-ended scientific investigations and communication tools for both synchronous and asynchronous collaboration” (Edelson, Pea, & Gomez, 1996, p.161). This project allows high school students to participate in authentic scientific processes using modified versions of scientists’ tools. Communication and collaboration are the central components of the philosophy behind the project. The philosophy of this project is to involve students, teachers, and scientists in collaborative activities centered on three aspects of atmospheric science. Students access and manipulate data, generate questions, develop plans for identifying and exploring data, and create artifacts that demonstrate their discoveries.

Computer Clubhouse

The Computer Clubhouse is a model learning environment that was founded in 1993 by The Computer Museum in partnership with the MIT Media Lab. Students from under served communities work with computer equipment to develop computer-based projects based on their own ideas. Young people and adult mentors work together on projects, using new technologies to explore and experiment. The main goal of the Computer Clubhouse is to teach learners basic computer techniques and applications. The
goal is for motivated and confident learners to express themselves fluently with new technologies. The participants use leading-edge software to design and create computer-based products such as artwork, simulations, multimedia presentations, virtual worlds, musical creations, Web sites, and robotic constructions. Rather than playing games with computers, students learn how to use professional software for design, exploration, and experimentation outside of a formal school setting (Computer Clubhouse, 2000).

JASPER

In the JASPER project, students are presented with adventures that challenge them to solve complex problems, based on real-world situations. Within a module format, data and teaching strategies are embedded to create situations that help students use available information and work together to solve adventures. Learners are given problems within a real-life context, are challenged to construct knowledge surrounding the issues, collaborate in groups, and come to conclusions regarding the problem. Learning is made more meaningful because students understand when, why, and how to use various procedures, concepts, and skills (Cognition and Technology Group at Vanderbilt, 1992).

WebQuests

A WebQuest is an inquiry-based activity in which some or all of the information that learners interact with comes from resources on the Internet (Dodge, 1995). One of the main features of a WebQuest is that students tackle questions that prompt higher-level thinking. A WebQuest uses scaffolding or prompting to facilitate critical thinking. By breaking the task into meaningful chunks and asking students to undertake specific sub-tasks, a WebQuest guides students through the type of thinking process used by expert learners.

BUILDING CONSTRUCTIVIST WEB-BASED TECHNOLOGY PROJECTS

Many schools are spending hundreds of thousands of dollars on technology, but much of it is not being used efficiently or effectively. The world is changing rapidly and students are leaving schools unprepared for the information age.
Using a Building Block model (Dodge, 2000; March, 1995; March & Reed, 1999) integrated technology projects can be created that will allow students to gather information, use critical thinking skills and communicate. A constructivist technology-integrated lesson plan should be designed to bridge the transition between teacher-led instruction and self-directed learning by students. The hope is that through scaffolding, both teachers and students will gain experience in a learning-centered approach. One way these projects can be created has four steps: (a) determine outcomes, (b) draft the project framework, (c) develop the evaluation tool, and d) design the task.

During the first stage, an educator should decide what it is s/he wants the students to learn and/or do. A well-designed instructional activity should attempt to address all students’ needs. A good starting point for this type of design is with something students are having a difficult time with. An educator should envision the optimal learning outcomes for a particular unit or activity and then compare that to the actual outcomes desired. The learning gap is the difference between the two (optimals and actuals). When writing the outcomes, it is important to use action verbs that are observable and measurable (solve, design, write, compare, decide, draw, persuade, investigate). The instructor should avoid indicator statements that include words such as know, understand, and appreciate because they are difficult, if not impossible, to directly observe or measure.

The second phase of building an integrated technology project is drafting a meaningful framework that is engaging for students. The framework should include four specific areas: (a) subject, (b) student interest area, (c) student role, and (d) audience. The subject area is simply the curriculum area in which the activity will take place. The student interest area defines why the activity will be engaging. The student role will vary depending upon the project, but could include roles such as a publisher, illustrator, detective, historian, ecologist, technologist, and so forth. The audience encompasses anyone who may potentially view the end product.

The third phase in building an integrated technology project is to develop the evaluation tool and/or rubric. A rubric is a scaled set of criteria for evaluating student products or performance and/or the instructional design process. It is used to (a) inform students about what is expected, (b) make the rating of performances and products more consistent, and (c) help students know where they are in relation to where they want to be. When creating a rubric, an educator should first decide on the performance levels (i.e., non-proficient, partially proficient, proficient, advanced). Next, a teacher should determine the four or five categories to be evaluated. Categories should include essential products, skills, and behaviors from the task.
The final step in the creation of the rubric is to write the descriptors for each category and proficiency. In a four-point rubric, the criteria for level three should be written first. It should be the standard of what the students should be able to do.

The final phase of this process is to design the task. The easiest way to think of the learning task is the students’ end product. WebQuest designers suggest that there should be six sections in a constructivist, technology-based activity: (a) introduction, (b) activity, (c) resources, (d) process, (e) learning advice, and (f) conclusion. The introduction should be a short, clear statement describing the activity to the students. The activity section should clearly describe what the end result of the learner’s activities would be. It could be a series of questions to be answered, problem to be solved, or anything that requires the learners to process information they have gathered. Proficiency can be shown through a variety of products (i.e., brochure, crossword puzzle, word search, journal, poem, poster, graph, chart, map, web page, multimedia presentation). The resource section refers to sites on the Internet or physical resources in the classroom/school/community available for learners to accomplish the task. To gather the information, the instructor should use information sources such as the Internet, CD-ROMs, resource books, encyclopedias, and so forth. The process includes the steps the learner should go through to accomplish the task. Learning advice is the section intended to provide guidance on how to organize the information gathered. It could be in the form of flowcharts, tables, Venn diagrams, compare/contrast charts, decision-making grids, concept maps, or other types of graphic organizers. The conclusion will summarize what the student should have accomplished or learned by completing the lesson.

**SUMMARY**

Considering the skill requirements in the emerging global economy, we must enable students to be able to attack problems of greater complexity than teachers have traditionally addressed through a fixed curriculum, memorization of facts, and an emphasis on isolated skills that are not applied to real-world problems. Beacker, 1992, p. 10

The goal for education should not be simply to access information, but to understand and use it to solve real world problems. Technology offers educators the opportunity to move away from instructional strategies that focus on presenting abstract information to a passive learner, to an active process where meaning is developed based on experience. This way of teaching
and learning supports the constructivist point of view where the learner is building an internal representation of knowledge and a personal interpretation of experiences. Technology also offers students the opportunity to communicate and collaborate with millions of worldwide users on the Internet.

Technology has effectively revolutionized American society. An unexpected byproduct of this revolution has been the emergence of a generation of children weaned on multidimensional, interactive media sources, a generation whose understanding and expectations of the world differ profoundly from that of the generations preceding them. We need to give these children the education necessary to succeed in a technological future. We need to build on children’s native learning abilities and technological competence with an instructional model that allows learners to be actively involved and engaged in a real-life arena, which includes technology.

References


