. . . Technology provides significant opportunities through which teachers can move from . . . historical conventional instruction . . . to . . . reform instruction.

TECHNOLOGY IN EDUCATION: Building on the Past, Looking to the Future

John D. Parmley

Commenting on the current state of education in this country or predicting future directions for classroom professionals is an challenging endeavor. Some educators suggest that we should examine the past in order to find answers to current and emerging problems. Still others indicate that today's problems are so complex as to have almost no association with past practices. Clearly, the rapidity of change and the intensity of change provide sizable hurdles for everyone involved in the teaching and learning process. At the same time that rapid and intense changes are occurring, the most prolonged and intense examination of education in the history of the country is also in progress. This examination process is made even more difficult because many stake holders, decision makers, and decision implementers are ill prepared to reach conclusions which have extensive impacts on a dynamic system.

But before we leap forward and analyze issues which are influencing our future, this author recommends that we review of some of the earliest stages of the development of public education in this country and thereby establish a foundation from which to examine some of the latest educational issues. While the rapidity of change in mid 1990's may sway our thoughts away from historical bases, it seems reasonable to examine these early building blocks and their impact on contemporary practices.

The setting and some of the underlying forces behind the initial development and growth of public education were characterized by educational historian Melvin L. Barlow as part of the celebration of the nation's bicentennial. He wrote:

> The common school, the basic unit of the American school system, emerged as a response to the conditions of American life during the period 1825–1860. Its origin is related to the play of social forces and ideas agitating the young Republic. Commerce and industry were expanding. Improvements in transportation and communication—roads, canals, and railroads—brought communities closer together, stimulating the exchange of goods and services as well as the growth of cities. In 1820 the United States boasted twelve cities of 10,000 or more; by 1860 over 100. The emergence of the common school also owed much to the growing heterogeneity of the population. In the 1830's, 40's, and 50's came the great tide of European immigration. The common school would be a means of uniting the growing heterogeneous population by giving the immigrants an understanding of American ways. (p. 31)

Thus, we are reminded that common schools, which we would later refer to as K–12 schools, began with a dual mission of delivering content and socializing young people so that they would have a "common" view of what it meant to be an American. While an in-depth examination of the history related to the development of K–12 schooling in this country is beyond the scope of this discourse, it is the conclusion of the author that socialization—how to get along with others, what it means to be responsible or behave like an adult—has continued to be a major focus of the American K–12 school system across a vast expanse of time to contemporary times.

While the early nineteenth century perspective is quite valuable, perhaps additional keys to seemingly locked corridors leading to "meaningful progress" can be found in the consideration of K–12 schooling during the late nineteenth and early twentieth centuries. In a document entitled, *Toward a New Science of Instruction,* Kate Maloy (1993) presented the following synopsis:

> A century ago, in the newly industrializing United States economy, mass education evolved largely to serve the needs of mass production. Most workers were expected to perform isolated tasks within the production process, executing procedures rather than planning or evaluating them, and carrying out assignments rather than asking questions or offering ideas. It was therefore assumed that the majority of children, who would enter work of this nature, needed no more from their education than fundamental competency in reading and computation. Both job knowledge and the knowledge learned in school were conceived as sets of basic skills, applied to the job at hand with no necessary grasp of the larger purposes being served.
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> These larger purposes—the complex responsibilities of business, government, higher education, and the professions—were seen as the proper concerns of a small minority. As a result, a few students were held to higher expectations than the rest. They were encouraged to reach energetically for what today are called "higher-order" skills, which enable students to question and investigate assertions, devise and test hypotheses, analyze and solve problems, and apply knowledge beyond school boundaries. Education of this quality had been around for centuries, but it was reserved for those who would one day manage or govern. (http://www.ed.gov/pubs/InstScience/index.html, October 16, 1996)

Maloy's account of that formative period reveals the beginnings of critical thinking and problem solving skill development made available to the masses. However, communication and mathematic literacy as well as socialization for a laborer career continued to be the dominant missions of K–12 schools

As part of the major focus of schooling, socialization did not encounter formidable and prolonged criticism until the early 1980's. While America's involvement in the race for supremacy in space provided significant encouragement for advancements in math and science, it was not until the educational reform movement was launched that enormous amounts of

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critical attention was given to the all concepts, processes, materials, and groups involved in education. Throughout this prolonged period of examination, many observers have expressed concern about the slow pace of meaningful progress. In one such examination of progress, Means, Blando, Olson, and Middleton (1993) captured some of the prevalent opinions as follows:

> Political leaders, employers, and the public are expressing an unprecedented level of concern with the state of education in America. Since the stark warning in *A Nation at Risk* that the erosion of educational standards "threatens our very future as a Nation and a people", we have seen a proliferation of education reform efforts. Most prevalent during the 1980's were efforts aimed at raising course requirements and scores on standardized achievement tests. Critics have characterized these earlier reform efforts as quantitative rather than qualitative in nature (i.e., "more of the same"). The result was an increase in the number of school courses with advanced academic titles, but the nature of instruction remained unchanged and course content often failed to live up to course titles. Achievement of more advanced skills in subject areas showed no discernible gains. (http://www.ed.gov/pubs/EdReformStudies/TechReforms, October 16, 1996)

Beginning with the appointment of a National Commission on Excellence in Education in 1981 and the 1983 publication of the report, *A Nation at Risk* political and educational leaders began calling for widespread, systemic reform focusing on four major recommendations: 1) a strengthening of graduation requirements, 2) more rigorous and measurable standards, 3) more time in school, and 4) significant improvement of teaching. With these recommendations and the specific goals which were identified to support the recommendations, the United States K–12 educational system was challenged to take gargantuan steps into unknown territory.

While this author recognizes the significance of recommendations one, two and three, the major focus of this paper is the improvement of teaching or the teaching and learning process. While progress related to each of the first three recommendations could be achieved through appropriate deliberation and subsequent action from various policy making groups, "significant improvement of teaching" required action from 2.9 million elementary and secondary teachers (U.S. Department of Education, 1995, http://www.ed.gov/pubs/Prog95/index.html, October 16, 1996).

As part of the examination and reform process, a variety of teaching and learning strategies have received substantial attention. Among these continues to be the use of technology to significantly alter and enhance the classroom learning environment. In their 1993 publication, *Using Technology to Support Education Reform*, Means, Blando, Olson, and Middleton provided initial support for the use of technology in classrooms as they wrote:

> Many critics of American schools see technology as an important tool in bringing about the kind of revolutionary changes called for in these new reform efforts. Having seen the ways in which technology has transformed the workplace, and, indeed, most of our communications and commercial activities, the business community and the public in general are exerting pressure for comparable changes within schools.
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> Thus, support for the use of technology to promote fundamental school reform appears to be reaching a new high. At the same time, we have the opportunity to profit from the experiences of those educational institutions that already have implemented various technological innovations within the context of serious reform efforts. In these cases, technology is viewed as a means of supporting goals related to increased student involvement with complex, authentic tasks and new organizational structures within classrooms and schools. . . . (http://www.ed.gov/pubs/EdReformStudies/TechReforms October 16, 1996)

The authors continue by stating their belief as well as the conclusions drawn by other researchers that "advanced skills of comprehension, reasoning, composition, and experimentation are acquired not through the transmission of facts but through the learner's interaction with content." They further explain that this "constructivist view of learning, with its call for teaching basic skills within authentic contexts (hence more complex problems), for modeling expert thought processes, and for providing for collaboration and external supports to permit students to achieve intellectual accomplishments they could not do on their own. . . ." should provide substantial ideas for meaningful reform efforts.

Following thorough consideration of historical elements and emerging opportunities, this author working in concert with wife and colleague, Dr. Dianna Parmley, began examining a variety of classroom applications of computer technologies. Limiting their attention to *interactive* technologies and applications which require significant involvement from each learner led Parmley and Parmley to a strategy they have labeled Interpretive Learning Experiences.

The concept of interpretive learning experiences is based in part on Bloom's (1964) identification of a cognitive learning domain with six levels listed from simplest to most complex, i.e., knowledge, comprehension, application, analysis, synthesis and evaluation. Another major contributor to this concept is the educational approach utilized by such organizations as the National Park Service as they provide special insight into or interpretations of historical, natural and/or cultural resources for visitors at their sites.

Bloom's Cognitive Domain

Bloom's (1964) landmark work identified levels of complexity in thinking. His lowest level of complexity is termed knowledge. If students are proficient at the knowledge level of this domain they exhibit such learning outcomes as: defining describing, identifying, labeling, listing, matching, naming, outlining, reproducing, selecting and stating. While we have traditionally thought of information gathering or knowledge acquisition activities revolving around printed documents, we may now expand this vision to include opportunities for students to obtain and exchange information through interaction with compact disk (CD-ROM) products electronic networks such as the World Wide Web.

Bloom's next level of complexity is termed comprehension. A student who is proficient at the comprehension level would exhibit such learning outcomes as: converting, defending, distinguishing, estimating, explaining, giving examples, predicting, rewriting, and summarizing. The use of text and graphic technologies, individually or in an integrated mode, offer a variety of opportunities for students to provide evidence of their proficiency in comprehending content and concepts.

Bloom follows comprehension with application. A student who is proficient at the application level would exhibit such learning outcomes as: changing, computing, demonstrating, discovering, manipulating, modifying, operating, predicting, relating, solving and using. Again, as the level of complexity increases, the number of creative opportunities to enhance learning also seems to increase. Information technologies provide opportunities to simulate application activities through opportunities to manipulate data and make predictions.

As individuals enter the remaining levels of Bloom's cognitive domain, often referred to as higher order thinking skill levels, the challenges and opportunities become more extensive. We begin with analysis. A student who is proficient at the analysis level would exhibit such learning outcomes as: diagraming, differentiating, discriminating, distinguishing, identifying, illustrating, inferring, selecting, and separating. We next climb to synthesis. A student who is proficient at the synthesis level would exhibit such learning outcomes as: categorizing, combining, compiling, composing, creating, designing, modifying, organizing, revising, and summarizing.

With analysis and synthesis, as with the previous levels, students may utilize a variety of information technologies to enhance their intellectual foundation related to an issue or problem. Of special interest to those working at the analysis and synthesis levels are the opportunities to significantly expand information sources. Through interaction with on-line data bases and electronic communication with informed individuals, one may develop an expanded information base from which to conduct an analysis and construct a synthesis. Without access to the opportunities provided by information technologies, analysis and synthesis activities become more limited in their scope and impact.

Finally we arrive at the top level of Bloom's cognitive domain, evaluation. A student who is proficient at the evaluation level would exhibit such learning outcomes as: appraising, comparing, concluding, contrasting, criticizing, describing, discriminating, explaining, justifying, interpreting, and supporting. Interactive presentation technologies provide opportunities to facilitate evaluation of students' work by other students as well as by the teacher.

Interpretation

While one root of the concept is firmly anchored in the classic work of Bloom and closely associated with school based education, the other root has grown out of the educational missions and strategies utilized by individuals best described as educators in interpretive settings. Such individuals would be found working with visitors at such locations as museums, state and national parks. The work of interpreters has been described by Tilden (1977) as he provided one of the early definitive discussions of this mission.

> The word interpretation as used in this book refers to a public service that has so recently come into our cultural world that a resort to the dictionary for a competent definition is fruitless. Besides a few obsolete meanings, the word has several special implications still in common use: the translation from one language into another by a qualified linguist; the construction placed upon a legal document; even the mystical explanation of dreams and omens.
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> Yet every year millions of Americans visit the national parks and monuments, the state and municipal parks, battlefield areas, historic houses publicly or privately owned, museums great and small—the components of a vast preservation of shrines and treasures in which may be seen and enjoyed the story of our natural and man-made heritage.
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> In most of such places the visitor is exposed, if he chooses, to a kind of elective education that is superior in some respects to that of the classroom, for here he meets the Thing Itself—whether it be a wonder of Nature's work, or the act or work of Man. "To pay a personal visit to a historic shrine is to receive a concept such as no book can supply," someone has said; and surely to stand at the rim of the Grand Canyon of the Colorado is to experience a spiritual elevation that could come from no human description of the colossal chasm.
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> Thousands of naturalists, historians, archeologists and other specialists are engaged in the work of revealing, to such visitors as desire the service, something of the beauty and wonder, the inspiration and spiritual meaning that lie behind what the visitor can with his senses perceive. This function of the custodians of our treasures is called interpretation. (p. 3)

Additional insight into the concept of interpretation is provided by John Veverka in his 1994 publication *Interpretive Master Planning*. He defines interpretation as "a communication process designed to reveal meanings and relationships. . . ." (p. 19) In other words, interpretation is a process of sharing more than just surface information.

What are interpretive learning experience strategies?

Building on our examination of cognitive learning and interpretation, we now begin consideration of interpretive learning experiences. Learning opportunities which feature interpretive learning experience strategies emphasize a unique opportunity for students to develop a multi sensory or multimedia interpretation of the content in question in preparation for sharing such interpretations with classmates, teachers, parents and/or others. By identifying still and motion images, locating or developing sound resources, developing possible text messages and sequencing each resource, students have an opportunity to tie together the processing activities involved in moving from knowledge through comprehension, application, analysis and synthesis. The preparation of such a multimedia interpretation provides an expanded and solid base for individuals or groups to enter into a larger discussion or evaluative conversation about the content.

The application of this strategy requires significant changes in the roles of teacher and learner. The teacher assumes the role facilitator who assists students as they identify and seek access to information. Such a role is in stark contrast to the historically defined role of the teacher as distributor of knowledge. At the same time, students must move away from a historic role of absorbing knowledge and toward a role of using information to construct knowledge.

An example of application in a classroom

The interpretive learning experiences concept was originally developed during the authors' work with the staffs of Mesa Verde National Park and Hovenweep National Monument in southwestern Colorado. As previously stated, the concept provides an opportunity for higher order thinking skill development. However, when applied to a set of issues or problems, such as those associated with the early Native American culture preserved within such sites as Mesa Verde and Hovenweep, it also provides opportunities for integration of learning activities from a variety of disciplines to assist students in solving real world problems which involve concepts from many academic disciplines.

The instructional concept as applied to this early Native American culture example provides an opportunity for learners to investigate one or more of the major questions which have remained largely unanswered following the departure of the prehistoric Anasazi or Ancestral Puebloan culture from the American Southwest in the later part of the thirteenth century. Three of these central questions include: How were these people able to make the move from a nomadic existence to a more permanent civilization? What was life like for these people during their stay in the region? Why did over 40,000 people leave the Southwestern Colorado/Southeastern Utah region during the last quarter of the thirteenth century after having lived in the region for approximately 800 years?

According to Parmley, Hutchinson, Hower, Morris, and Parmley, (1995),

The instructional concept provides an opportunity for students to consider a question such as, "What was life like at various time periods in the development of the Ancestral Puebloan or Anasazi culture?" Students then obtain an overview of the culture and the present setting by interacting with the CD product, viewing digital graphic renderings and still photographs, digital video material, traditional printed information, information obtained through electronic interaction with the Mesa Verde staff (or other professionals such as the Hovenweep Staff), and other possible information sources. Next, students begin to **investigate** a number of more specific questions through further interaction with identified data sources. For example, middle-level or junior high students utilize their math and science skills to **analyze** primitive crop production, soil conservation practices in shallow soil, the impact of settlements located at 7,000 feet elevation on a fragile ecosystem. Students use their knowledge of social studies to **analyze** population densities, reasons why groups or clans occupied certain locations, and reasons why the current population in the region is approximately 20,000 individuals (1990, Bureau of Census) as compared to approximately 35,000–40,000 individuals who occupied the region at the height of this prehistoric culture. After analyzing such questions, students **synthesize** information and **draw conclusions.** Next they develop a technology based multimedia **interpretation of their findings and conclusions.** Finally, students present their **interpretation** to their classmates and respond to questions which help them evaluate their own work as well as the efforts of others. (p. 87)

While this paper has focused on one specific strategy for using technology, the author contends that technology provides significant opportunities through which teachers can move from what Means, Blando, Olson and Mlddleton (1993) refer to as historical "Conventional Instruction" and move to what they refer to as "Reform Instruction". The following table summarizes the two approaches.

Comparison of Conventional and Reform Approaches to Instruction*

Conventional Instruction	Reform Instruction
Teacher-directed	Student exploration
Didactic teaching	Interactive modes of instruction
Short block of instruction on single subject	Extended blocks of authentic and multidisciplinary work
Individual work	Collaborative work
Teacher as knowledge dispenser	Teacher as facilitator
Ability groupings	Heterogeneous groupings
Assessment of fact knowledge and discrete skills	Performance-based assessment

*Means, B., et.al. (1993). "Using Technology to Support Education Reform", Washington, D.C. United States Department of Education.

Finally we return to consideration of the concepts of socialization versus advanced content learning in schools and the role of technology in contemporary classroom settings. While much emphasis is being placed on strategies which enhance cognitive learning, this author contends that effective uses of technology and such specific strategies as Interpretive Learning Experiences, feature extensive opportunities for students and teacher(s) to interact. Students working in collaborative teams tend to enhance learning opportunities as well as opportunities for social interaction. The team approach also provides an opportunity to provide and expect additional depth of understanding. When team members assume various responsibilities and subsequently weave information together, test their information and conclusions against the work of other students or authors and finally defend their work, a significantly enhanced learning experience has been created. While the presence of technology is not essential to such an enriched experience, the presence of technology makes such experiences more feasible for students and teachers.

In conclusion,this author believes, as we search for solutions to what are currently referred to as problems associated with education, if we invest time examining the history and development of education we enhance the probability of not only *finding solutions,* but also, *understanding solutions.* Thus we **build** on past efforts while looking to the future.

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