The Digital Portfolio in Education: an innovative learning and assessment tool

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ABSTRACT This project, designed in conjunction with two K-12 schools in the Washington DC area of the United States (one private school and one public school) examined the use of digital student portfolios as an instructional, assessment and evaluation tool. The project demonstrates the process through which pre-service and in-service teachers worked with students to create their own digital portfolios using the HyperStudio Authoring Program. These portfolios were then published on CD-ROM and on the Internet on the schools’ web pages. Evaluation of these portfolios showed a significant improvement in student achievement, and teachers found these portfolios to be a valuable tool in monitoring student behavior and communicating future educational goals to parents, administrators, and other teachers.

Introduction

This article discusses how the digital portfolio, be it CD-ROM-based or otherwise, can be a valuable tool in the process of evaluating students’ progress and performance. Clifford Stoll, in his book Silicon Snake Oil (1995), warns that today’s use of technology in the classroom is akin to the use of the filmstrip in previous decades. Stoll suggests that “technophiles” are isolating students at their keyboards and throwing them into the chaos of cyberspace. However, the idea behind the filmstrip is that of a curriculum solution, providing both the medium and the message of instruction. Stoll’s writings suggest that today’s technology will be used as the filmstrip was, rather than be placed in the hands of students as a tool for creativity and production. This project was designed to present a method by which technology in the hands of students could be used to enhance the teaching-learning process, and to combine current theories of evaluation with emerging technologies.

The objectives of this project included:
increasing students' understanding and use of narrative structure in written and oral storytelling;
- the development of an effective teacher training tool for the use of technology in education;
- the design of a technology-mediated assessment tool for evaluating students;
- increasing strategies by which students can better learn to use technology as an artistic and performance outlet.

Recommendations as to how to incorporate electronic student portfolios into school-wide curricula were examined, including a focus on teacher training, accountability to district-wide criteria, and maintenance of the program. Following this research-based project, teachers worked with technical advisors to develop a school-wide portfolio system to support performance-based education in a classroom.

**Theoretical Framework**

The complex task of educating children and youth precludes such simple prescriptions as 'computers improve learning' or 'give technology to teachers first'. There is no one right answer, either in terms of specific technologies or uses of technology or in terms of how to introduce technology into a school. However, it is clear that technology itself is not the answer to today's educational problems. The power of technology will come from its combination with serious educational reform. Schools must first rethink their missions and structure, starting with the needs of the students and a set of instructional principles, before they can understand the way technology will help them (Means, 1994). From this point, schools can restructure to meet the demands of preparing students to act as global citizens in the twenty-first century.

Portfolio assessment and performance-based education are methods by which schools can restructure and use technology in a meaningful way. Portfolios can be described as collections of a student's work over time (see Figure 1). The portfolio is organized so that improvement or growth can be observed. Such as with an album of photographs where a child's physical development can be observed, a academic portfolio displays a student's growth and development in areas such as manuscript, mathematics, or writing. Portfolios can empower students and teachers to reflect upon the teaching and learning process (Herbert, 1992). Performance-based education is education that is based on assessing a student by observing their ability to complete (or perform) a given task. Performance-based education is used to give teachers practical information on student learning and to provide opportunities for school communities to engage in a recursive process of self-reflection, self-critique, self-correction, and self-renewal (Darling-Hammond, 1994). The theory of multiple intelligences presented by
Gardner (1993) states that children may demonstrate different intelligences (musical, spatial, bodily-kinetic) that may be overlooked by traditional assessment and instructional methods. Using Gardner’s theory as a model, schools and school districts across the nation have begun to use portfolios as an assessment tool. Students and teachers can develop portfolios that present a student’s progress over time, and provide more in-depth information than typical testing and grading procedures used in schools. The next step in portfolio assessment involves bringing current and emerging technology into the model, providing a multimedia presentation of the student’s learning and development.

Standardized tests have been used for some time in schools, and educators are familiar with the different aspects of this type of testing. School systems publish the schools’ standardized scores in local newspapers. The school board then goes into the schools that rank the highest to see what programming is being used to achieve the high scores. This allows schools and teachers to re-evaluate what they are doing and make the necessary changes. Some middle schools and high schools have developed classes to specifically meet these needs. Teachers in the state of Maryland in the
United States have used standardized test results to group students in math and reading, although much of the time, the test and the instructional program do not coincide. Standardized tests are generally used once every three years. They test students' long-term progress; however, the small increments of a student’s growth often go unnoticed. Standardized tests examine singular problems that call for particular, circumscribed elements of knowledge and problem-solving skills (Resnick & Resnick, 1992; Means, 1994).

The use of standardized assessments can cause great anxiety on the part of teachers and students alike. Standardized tests are normally given at the beginning and the end of each academic year, and often students spend a great deal of time ‘practicing’ for these tests. Teachers may have great concern for their students’ performance on these tests, as their merit pay increase may be based on the students’ scores. Standardized tests alone cannot be used to evaluate students. A multifaceted approach to assessment is needed to encourage creativity on the part of teachers, and should include criterion or classroom-based assessment, observation, and individualized testing.

Performance Assessments (sometimes referred to as authentic or alternative assessments) differ from traditional short-answer paper-and-pencil assessments in a number of ways. They take as the object of the assessment the actual work of the students (or teachers) (Means, 1994). They measure incremental (or short-term) progress, enabling teachers to look at a student’s specific learning problems, strengths, and weaknesses. Performance assessments have brought out the fact that a change in curriculum could be necessary. Instead of facts and figures, teachers are stressing opinions and thought-provoking ‘why’ questions. Like tasks or activities that individuals carry out in the real world, the performance tasks to be assessed are expected to encompass extended activities that allow for multiple approaches and a range of acceptable products and results. A performance assessment allows students to work as individuals and in groups. It further encourages the motivation and challenges that go along with working in a group. Performance assessment tasks may also require students to write investigative reports and debate conclusions (as history/social science assessments in the California Learning Assessment do) or to carry out inquiry projects in a chosen subject and create exhibitions that culminate in assessments, in which students describe and defend their projects to an audience (Collins et al, 1990; Hawkins et al, 1990; McDonald, 1993; Means, 1994). The evaluation criteria for performance assessments have to be developed according to expected outcomes. Students must be aware of the objectives for the criteria, and educators must help to foster the learning surrounding objectives. Performance assessments must provide evidence about students’ learning and performance in relation to established standards. It is this evaluative perspective on student performance that
makes assessments particularly powerful vehicles for learning as well as sources of information for students, teachers, and other audiences (Means, 1994). Many school districts and states are beginning to develop these criteria and have had a chance to reflect and evaluate the criteria along actual work done by students. California is one state that is currently developing standards for its performance-based assessment system. State assessment guidelines for students' mathematical problem solving include such factors as producing clear and coherent diagrams and explanations, communicating effectively, understanding important mathematical ideas and processes, and presenting strong arguments that include effective examples and counter examples (California State Department of Education, 1989; Means, 1994).

HyperStudio (Roger Wagner Publishing, 1996) is a software package available for Windows and Macintosh computers that allows the user to manipulate text, graphics, sounds, and animation. The elements of the program and other authoring programs such as Macromedia Director and HyperCard allow it to be used as an individualized and interactive system for instruction. Instructional units to address content areas or deficiencies can be designed for and by students. The program has the potential to be a useful tool for educators who need to customize or create their own applications. Improved focus and attention from students are definite advantages gained when instructors use hypermedia in a lesson. The teacher can also appreciate the subsequent data modification capabilities that this type of software application affords and the easy material storage of charts, maps, or graphs. For example, HyperStudio can enhance a lesson plan on the interpretation of bar graphs and the conclusions that can be drawn from the information in bar graphs, by providing examples of such graphs and computer graphics of the sources from which the data are taken. HyperStudio material can be designed specifically for classroom uses. For example, other researchers have used HyperStudio stacks with laser discs and CD-ROM discs to allow students to have access to information on the discs. As teachers designed customized stacks for their own students, they found increased success in their students and felt better about using computers in the classroom.

**Method**

In this project, pre-service and in-service teachers worked to facilitate the design and development of the students' digital portfolios. As an instructional technique, the teachers created their own digital portfolios and used these tools to model the use of hardware and software for the students. Teachers investigated portfolios as a tool for assessment and evaluation of learning outcomes, and documented the process of developing such a teaching tool. Each in-service and pre-service teacher was expected to
contribute his or her own expertise in content areas of the project, as well as in the creation of personal portfolios. Teachers were expected to gain the skills and strategies needed to continue to develop both teaching and technology methods.

Forty elementary students of ages nine to 11, four in-service teachers, and two pre-service teachers from a teacher training program at a local university were participants in the project. The focus group of in-service and pre-service teachers in the project was given initial computer aptitude and attitude surveys, and then trained to use the HyperStudio software. The students were given a standardized test of oral and written language, a computer attitude and aptitude survey and a oral evaluation of their storytelling/ narrative structure skills by one of the in-service teachers.

The program was conducted in a series of phases over 6 weeks during the summer of 1996. The program began with oral storytelling activities, with the in-service teachers and pre-service teachers serving as models. Using Macintosh computers, students were encouraged to develop characters and tell an oral story about them. Students were then trained in the use of HyperStudio to tell stories and incorporate sound, animation, video and digital images into their stories. HyperStudio was also used as a presentation tool for the students to share their work.

All students worked with the teachers to create individual portfolios that included all electronic stories. These portfolios were then pressed to CD-ROMs and uploaded to the schools' web sites. The portfolios were evaluated by the in-service and pre-service teachers for the development of narrative structure, storytelling strategies, and writing skills such as sentence structure and punctuation. Following the instructional component of the program, students were given a post-intervention standardized test, an attitude and aptitude survey, and a follow-up evaluation of oral communication skills. Teachers also completed an attitude and aptitude survey of computer skills after the completion of the program. This multitude of tests and surveys allowed the researchers to measure the overall effectiveness of this project from many perspectives.

The CD-ROM-based portfolios contained all of the students' work from the course of the 6-week program. Each portfolio contained a series of the projects that the student had created. For example, one portfolio begins with a “gallery” where the user can click and then go to a story or an art project created by that student. In the course of evaluating the portfolios, teachers examined the students' writing by reading the text of the stories, focusing particularly on the growth of the student over the 6-week period. The teachers used an assessment instrument, similar to the Test of Written Language (Hammill & Larsen, 1983), to evaluate the students' written communication and technical writing skills. Stories that were written at the beginning of the program were compared with those written at the end of the program, and improvements or changes in writing skills were noted.
Results

In each case employing quasi-experimental statistical procedures, a probability level for rejection of the null hypothesis was set at .05. All statistical tests examined type III sums of squares. Instances in which more stringent testing was applied have been noted. To initially investigate the main effects of the treatment variables, the ANOVA procedure was used. Gain scores were calculated for each of the assessment tools for each of the subjects in the program. Differences between pre- and post-test scores on the tests and surveys were used as the basis for this calculation.

Teacher Gain Scores

For teacher gains, there was a significant main effect for the computer attitude and aptitude test (F > 5.16, MSE = 40.63).

Student Gain Scores

Gain scores were calculated for each student on each of the assessment tools. Significant main effects were found for the standardized test of oral and written language (F > 6.84, MSE = 39.85) and the oral communication assessment (F > 9.19, MSE = 53.44), as well as the computer attitude and aptitude survey (F > 6.34, MSE = 36.87).

As students and teachers became more adept at using both teaching and technology techniques, modules created by the students became more sophisticated, and used more in-depth, advanced features. By carefully monitoring all participants' progress (students, teachers, and trainers), it was possible to make accurate statements regarding the effectiveness of the project. This work provided teachers and teacher educators with a model program in which collaboration, student-centered learning and technology can come together in a profound way.

As teachers used these available technologies, a significant positive relationship was found between student-developed computer-based instruction and skill mastery. This relation was considered through various perspectives including mastery of objectives, consultant feedback and direction, and portfolio assessment. The students themselves indicated that the instruction in HyperStudio was valuable to them and they felt confident in their ability to create useful and innovative lessons. In addition, students appeared to value the opportunity to develop their computer skills via the HyperStudio system.
Conclusions

Technology has become a large part of students’ lives in and out of the classroom. New technology in the workplace includes the continuing development of hardware and software for the future. This technology has helped to automate many aspects of students’ lives, such as family banking and grocery shopping. Computers and the use of the Internet have become prevalent and widespread. Schools have begun to incorporate technology and, based on positive results, will more than likely continue to incorporate it. School media centers are using computers with encyclopedias on CD-ROM as well as the encyclopedias on the shelves. Technology can significantly broaden students’ involvement in challenging, extended activities that require students’ active participation and application of knowledge (Sheingold, 1991; Means, 1994). Based on these facts and ever-expanding computer technology, traditional assessment practices, such as the text-based standardized tests discussed above, may not be appropriate. Instead, performance-based assessments, which do not rely solely on writing and text, could be more realistic.

When performance-based assessment is employed, students can use and present the work they have done in a variety of formats, including technological ones. They can use spreadsheets, graphing tools, word processing and sound, and have access to the world through the World Wide Web and email. Interactive multimedia such as videotape, film and laserdisc can integrate many forms of information on one disk, and will become increasingly valuable for creating portfolios of students’ work in multiple media. Thus, technology permits assessments of products and processes that are not limited to text and writing (Means, 1994). Students’ horizons and self-esteem can be expanded by giving them the chance to publish their work on the Internet for the world to see.

Future directions for the use of technology as an assessment tool include creating school-wide portfolio assessment tools. Large databases of student information are already in place in many schools, however these databases are neither accessible nor useful to the current classroom teacher. As schools become connected to the Internet, many are building internal, campus-wide networks that connect all computers together. This internal network can be used by teachers and students to communicate from classroom to classroom. For example, some rural schools are using district-wide networking as a means to deliver instruction and provide for interaction among students (Goff, 1994). Email and video conferencing equipment are useful in encouraging this classroom-to-classroom communication. However, the use of these campus-wide networks could be used to allow teachers to share information about particular students in a meaningful, organized way. The creation of network-based portfolios can be
used by teachers as they collaborate to assess student progress and development. The networked portfolios would include more information than current school- and district-wide databases. These portfolios can be designed to include examples of students’ work, including pictures or products that may be scanned in or created using the computer. Videos of students working together on an academic activity could be digitized and placed in this portfolio. Classroom teachers could work with physical education teachers to document a student’s physical and emotional development. Art and music teachers can work together with reading teachers to present information on a student’s communication skills. Students themselves can assemble and present their own perspectives on what they have learned. The value of a network-based portfolio is that it can be developed over time, and with the proper network security, these developing portfolios can be shared with parents through the Internet. This use of Internet technology can enhance the educational process for students as they present and reflect on what they have learned, as they are learning. CD-ROMs can be sent home with the child, and parents can access students’ projects through the Internet, which may create a stronger relationship between home and school.

In addition, as technology becomes more advanced, educators can provide new methods of instruction which reach beyond what is currently possible. Global technologies offer mobility, multiple modes of communication, translation, and other opportunities to all students, despite the geographic location or age of the learner. Students can create their own learning environments, thus matching their own learning styles. As research in technology-based education progresses, further uses are certain to be discovered.

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