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Laptop Computers in the Elementary Classroom: Authentic instruction with at-risk students

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This case study investigated the integration of laptop computers into an elementary classroom in a low socio-economic status (SES) school. Specifically, the research examined classroom management techniques and aspects of authentic learning relative to the student projects and activities. A mixed methods approach included classroom observations, interviews with the teacher, interviews with the students, and analysis of student projects. The results provide insight regarding the benefits and challenges of integrating wireless technology in an elementary classroom with at-risk students. In addition, the project resulted in a web site with sample lesson plans (including objectives, required materials, NETS competencies and extension activities), teacher reflections and training tips.

Les ordinateurs portables dans la classe élémentaire: un enseignement authentique avec des élèves 'à risque'
La présente étude de cas porte sur l'intégration des ordinateurs portables dans une classe élémentaire d'une école pour enfants de milieux peu favorisés. La recherche a porté plus particulièrement sur les techniques de gestion de la classe et sur les aspects de l'apprentissage authentique qui sont liés aux projets et aux activités des élèves. L’approche mixte qui a été utilisée a comporté des observations de classes, des entretiens avec le professeur, des entretiens avec les élèves et l’analyse des projets de ces élèves. Les résultats fournissent un éclairage sur les avantages et les défis de l'intégration d’une technologie « sans fil » dans une classe élémentaire avec des élèves « à risque ». Le projet a également abouti à un site Web comportant des plans de leçons (comprenant les objectifs, les matériaux requis, les compétences Réseau et les activités d'extension), les réflexions des professeurs et des « tuyaux » sur la formation.

Laptopcomputer im Grundschulunterricht: Authentische Anweisung für die Arbeit mit belasteten Schülern

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Los ordenadores portátiles en aulas de primaria: una educación auténtica con alumnos de riesgo

Este estudio de caso se basa en una investigación sobre la integración de los ordenadores portátiles en una clase básica dentro de una escuela de bajo nivel socioeconómico. Más específicamente los investigadores examinarán las técnicas de administración del aula y los aspectos de aprendizaje auténtico relacionados con los proyectos y actividades de los alumnos. Con el enfoque sobre una metodología mixta, se pudo incluir observaciones de aulas, entrevistas con el maestro, entrevistas con los alumnos y un análisis de los proyectos de los alumnos. Los resultados ofrecen una comprensión de las ventajas y de los desafíos de la integración de una tecnología inalámbrica dentro de aulas de primaria con alumnos de riesgo. Otro resultado del proyecto fue la creación de un sitio web con ejemplos de planes de lecciones (incluyendo objetivos, materiales requeridos, competencias en redes y actividades de extensión) algunas reflexiones de profesores y informaciones sobre la formación.

Background

As the standards movement in the field of education continues to gain momentum, state legislatures have placed an emphasis on the development of a rigorous curriculum for all students. However, educational researchers concur that the curriculum offered to students from families with low socioeconomic status (SES) is often lacking in cognitively rich tasks that require critical thinking skills (Darling-Hammond, 1997; Haycock, 2001). An analysis of Title I schools (which provide federally funded assistance for economically and educationally disadvantaged students) conducted for the US Department of Education found that fifth grade students performed better in reading and mathematics when teachers spent more time in cognitively rich, exploration activities, such as problem-solving and simulations (US Department of Education, 2001a, b).

Studies have also found stark differences in the use of computers between high and low socioeconomic schools (Becker, 2000; Means & Olson, 1995; Schrum & Bracey, 2003; Wenglinsky, 1998). Far too often, students in low SES schools are expected to passively respond to instruction by simply watching or listening, rather than gaining conceptual understanding through classroom discourse (Haberman, 1991; Padron & Waxman, 1999). When the use of computers varies in relationship to the students’ SES, it facilitates what Haberman (1991) called the ‘pedagogy of poverty’.

Access to technology is another issue that can impact at-risk children. In 1999 the US Department of Commerce defined the digital divide as ‘disparities in access to telephones, personal computers (PCs), and the Internet across certain demographic groups’ (1999, p. 2). Since then initiatives, such as E-rate, have been very effective in equalizing computer access at school and minimizing differential access to computers and connectivity. In fact, for schools with the highest poverty levels, the ratio of students to instructional computers with Internet access has dropped from 16.8:1 in 1998, to 6.8:1 in 2001, to 4.0:1 in 2005 (Wells, Lewis, & Greene, 2006).

However, as Wenglinsky (2005) points out, ‘society did not eliminate the digital divide where it really matters: in how computers are used’ (p. 82). Simply providing access to computers and the Internet does not guarantee that students will use the computers for
meaningful instructional tasks. Thus, researchers and policy-makers have turned their focus from the issue of access to concern for appropriate and effective use of technology (DiBello, 2005; Judge, Puckett, & Cabuk, 2004). More recently, the digital divide refers to ‘the difference in information technology use based on ethnicity and socioeconomic status’ (Judge et al., 2004, p. 383).

Authentic Instruction

One way to ensure that all students, including those with low SES, benefit from technology is to use it in conjunction with authentic instruction. Authentic instruction is based on the premise that students’ work in the classroom should prepare them for the intellectual tasks that will be demanded of them as adults. In an authentic learning environment, students are conducting research, solving problems, and creating products. The role of the teacher becomes that of a facilitator or coach (Renzulli, Gentry, & Reis, 2004). In 1990, the US Department of Education’s Office of Educational Research and Improvement funded the University of Wisconsin’s Center on Organization and Restructuring of Schools to conduct a five-year study on school restructuring to support authentic learning (Newmann, 1996; Newmann & Wehlage, 1995). The researchers visited over 60 schools across the country and observed students engaged in activities such as creating projects, compiling portfolios, and analyzing data. The researchers recognized and appreciated the active learning in the classrooms but expressed the following concern:

Assuming the central purpose of teaching is to help students to use their minds well, then education reform must involve more than innovation in teaching technique, method, or procedure. The merit of any technique, whether conventional or innovative, must be judged on its capacity to improve the intellectual quality of student performance. (Newmann, Secada, & Wehlage, 1995, p. 3)

In essence, authentic instruction focuses on the student, and is meaningful and relevant to life outside of school (Callison & Lamb, 2004; Newmann, 1996; Renzulli et al., 2004). Teachers are able to move students beyond memorization of facts by creating experiences that demand sustained, disciplined, and critical thinking on topics that have real-life relevance. To help teachers assess the ‘authenticity’ of classroom tasks and experiences, Newmann and Wehlage (1993) formulated five standards. Each standard is considered a continuous construct, usually measured on a scale of one to five. The continuum includes:

1. Lower-order thinking only … Higher-order thinking is central.
2. Knowledge is shallow … Knowledge is deep.
3. No connection beyond the classroom … High connection to the world beyond the classroom.
4. No substantive conversation … High-level substantive conversation.
5. Negative social support for student achievement … Positive social support for student achievement.

Higher Order Thinking Skills

The first standard measures the degree to which students engage in higher order thinking skills. Lower level thinking skills generally involve memorization of facts, recall of information, and
passive learning. Higher order thinking skills are employed when students synthesize information and construct new meaning. For example, an activity that required students to collect data, form a hypothesis, test the hypothesis and present the findings would involve higher order thinking skills.

**Depth of Knowledge**

If students are presented with large amounts of fragmented information, their depth of knowledge will probably be very shallow. On the other hand, if fewer topics are presented in detail, and connections between the topics are highlighted, the students can acquire a deeper understanding of the concepts. With access to resources such as the Internet, students can investigate multiple perspectives to enhance their depth of knowledge related to specific topics.

**Connection Beyond the Classroom**

The third standard deals with the degree to which the activity has value beyond the classroom. Connections beyond the classroom can be enhanced by involving real-world issues that have personal significance for the students and by emphasizing the relationship between classroom activities and larger social contexts. Instructional activities might include integrating experiences in the community (outside school) with activities in the classroom. When students are involved in an activity that has no value beyond measuring their success in school, ‘success in these tasks often carries no adaptive value, because large numbers of students consider school to only be a restricted, even an insignificant, arena of personal experience’ (Newmann, Marks, & Gamoran, 1996, p. 286).

**Level of Substantive Conversation**

Low levels of substantive conversations are characterized by teacher-centered, pre-planned dialogues, wherein students respond in simplistic fashion. High levels of substantive conversation are evident in classrooms when the discourse between the teacher and students is open, dynamic, and extensive. In these classrooms, ‘the talk is about disciplined subject matter and includes indicators of higher-order thinking, such as making distinctions, applying ideas, forming generalizations, raising questions, and not just reporting experiences, facts, definitions, or procedures’ (Newmann & Wehlage, 1993, p. 4).

**Social Support**

Strong social support is ‘characterized by high expectations, challenging work, strong effort, mutual respect, and assistance in achievement for almost all students’ (Newmann & Wehlage, 1993, p. 5). Social support between students is also important. Students in classrooms with strong social support can express their opinions or ask questions without fear of being ridiculed or embarrassed.

These five standards related to authentic instruction can be used as research tools for classroom observation, or as a framework for teachers to plan and critique their goals, strategies,
and outcomes. Newmann and Wehlage caution, however, that the standards are not exhaustive; there is no specific hierarchy of importance among the standards; and achieving a high level of performance on all standards in most lessons is ‘probably not possible’ (1993, p. 11).

**Research on Laptop Computers in the Classroom**

Researchers predict that when ‘true universal access’ to portable technologies, such as laptops, is created, ‘the very ways in which we think about teaching, learning, and communicating may change’ (Hill, Reeves, & Heidemeier, 2000, p. 4). In most cases, access to computers in low SES schools has been limited to two or three computers located in the classroom or an occasional visit to a computer lab (Becker, Ravitz, & Wong, 1999; Schrum & Bracey, 2003). However, with decreasing computer prices and the advent of wireless networks, laptops are becoming feasible for schools. Several large-scale implementations, such as Microsoft’s Anytime Anywhere Learning Program and the Maine Learning Technology Initiative are taking place across the country (Cohen, 2002; Muir, Manchester, & Moulton, 2005; Rockman, 2000). In addition, smaller-scale implementations can be seen in schools and districts in several states (Apple Learning Interchange, 2004; Ross, Lowther, & Morrison, 2001; Stevenson, 1999). Based on these initiatives, several research studies have been conducted to assess the educational benefits of laptops in the classroom. These studies have focused on motivation, writing skills, student achievement, absentee rates, perceptions, and other issues. Professional development, technical support and teacher attitude have been identified as key elements in determining project success (Penuel, 2006).

A study that included a specific focus on low-income students took place in the Beaufort County School District in South Carolina. The laptop project began with 300 sixth graders in 1996 and expanded to sixth, seventh and eighth grade students by 1999. Achievement scores on a standardized test (1999 Metropolitan Achievement Test or MAT7) were analyzed to determine if students who used laptops scored significantly better or worse than students who did not participate in the laptop project. The findings indicated that students who were laptop participants for two years and who were on free and reduced lunch benefited most from the project. Overall, participation in the laptop project was associated with less absenteeism and fewer tardies. Students with laptops attended school more regularly and scored better on achievement tests (Stevenson, 1999).

**Research Objectives**

This case study investigated the integration of laptop computers into an elementary classroom in a low SES school. Specifically, the research investigated classroom management techniques and aspects of authentic learning relative to the student projects and activities.

The objectives of this study included:

1. Identify an elementary school where the majority of the students qualify for free and reduced lunches.
2. Implement a one-to-one laptop program that centers on authentic tasks.
3. Collect data through multiple methods to analyze issues related to classroom management, student behavior, and authentic student projects.
4. Create a web site that enables other teachers and administrators to benefit from the lesson plans and teacher reflections related to the study.

**Data Sources**

*School*

Three key factors were involved in the selection of the elementary school for the study. The first factor was school demographics. The school that was selected held Title I status—74% of the students qualified for free and reduced lunch. The composition of ethnic groups in the student population was 21% African-American, 10% Asian/Pacific Islander, 10% Hispanic, 3% Multiracial and 56% Caucasian.

The second factor influencing the selection of the school was flexibility in the school environment, which would allow the researchers to access specific classrooms. A culture existed at the selected school in which visitors were welcome to visit classes and observe the students and teachers. The style of instruction in the classrooms tended to be learner-centered.

The final factor was the reputation of the principal for integrating technology in the school and her understanding of its impact on the students and staff. As the instructional leader of the school, this principal believed that learning should not stop for students to ‘go to the lab’, but that learning should take place wherever the students are located.

*Teacher*

The teacher who participated in the case study had over five years of teaching experience. She was involved with the case study over a two-year period, as the same students were looped from fourth to fifth grade. She had experience in the use of technology, but did not have formal training on the use of specific software programs on the computer. Prior to the study, she was given a laptop computer and trained on various application programs. She was also provided with access to a set of laptop computers for her classroom (enough for each child to have a laptop). Peripherals, such as scanners and digital cameras, were also available in her classroom for student use.

*Students*

There were a total of 26 students in this classroom. Of this group, 12 were males and 14 were females. While the majority of students came from low socioeconomic backgrounds, several students in the targeted classroom also had additional challenges, as shown in Table 1.

Prior to this research, the students had very little access to technology. The school did not provide computer labs where the students could work individually on computers. The few computers that were in the classroom were used only occasionally for drill and practice. In addition, very few of the students had access to computers in their homes.

**Method**

The study employed a rigorous blend of research methods to examine how the instructor implemented the laptop computers and how the students used them in the classroom. This
mixed methods approach included the following modes of data collection: classroom observations, assessment of lesson plans and student work, interviews with the students, and interviews with the teacher. The triangulation of multiple sources and types of evidence helped to strengthen the quality of the research.

To effectively understand the instructional process and culture of the classroom in its natural setting, the researchers employed ethnographic methods to gather observational data. A technique often used in ethnographic methods (participant observation) involves the researcher becoming a full participant in the process to develop meanings, constructs, and ideas as events occur in the community. The utilization of participant observation allows the researcher to gain an in-depth understanding of the phenomena from the perspective of the participants (LeCompte & Schensul, 1999).

The laptop computers were initially incorporated into lessons with technology-enhanced projects, generally encompassing an hour or two each day. The teacher created lesson plans with the specific objective of integrating technology into the learning process. Over the two-year period, as the teacher’s comfort and the students’ skills with technology progressed, the laptops were used as a tool throughout the curriculum and throughout the entire school day. The mobility of the laptop computers also enabled curricular activities outside the classroom. For example, several activities took place in the school courtyard and on field trips.

Throughout the study, students used tool-based software (such as word processors, spreadsheets, graphic organizers, and video editors) that provided the opportunity to construct their knowledge and create a product. For example, video-editing software was used to create a movie of relevant images from a web site, and presentation programs were used to communicate concepts. The most common software tool was *AppleWorks* (which included a word processor, spreadsheet, and presentation program). Other software that was useful included *Inspiration, Kidspiration* and *iMovie*.

The laptops were stored in the classroom, and were available on an ‘as-needed’ basis throughout the day. Students did not take the computers home because of concerns for the students’ safety. It was felt (by the school’s administration) that having elementary school students carry the computers back and forth to school in the low socio-economic area might present situations where older children or adults would attempt to overpower the students and take the computers.

**Results**

Researchers documented the implementation of ubiquitous technology with classroom observations, student artifacts, and teacher and student interviews. The classroom observations

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### Table 1. Student special need characteristics

<table>
<thead>
<tr>
<th>Special need category</th>
<th>Number of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language impaired</td>
<td>2</td>
</tr>
<tr>
<td>ESOL</td>
<td>3</td>
</tr>
<tr>
<td>Specific learning disability</td>
<td>3</td>
</tr>
<tr>
<td>ESOL &amp; specific learning disability</td>
<td>1</td>
</tr>
</tbody>
</table>
| Substantially deficient in reading, math and/or writing    | 3                  | (as defined by the district)
and interviews were recorded, cataloged, and archived to enable the review process and enhance the analyses. Student artifacts were evaluated using multiple criteria to determine the level of authentic instruction involved in the lessons. Results from each data source are described in detail.

**Classroom Observations**

Researchers visited the classroom on a regular basis (six–eight hours per week) throughout the two-year period. Digital cameras were used to videotape classroom activity (when the researchers were present) and to document the process of the implementation of laptop computers in the classroom. At the end of the study, the videotapes were numbered and labeled according to lesson and date. As the researchers examined each video, themes began to emerge. One theme was the instructional conversation between the teachers and students relative to the technology. Although laptops were used throughout the curriculum, the instructional conversation was primarily about the lesson and not about the technology. Students learned to use the computers as tools to learning, much as they would use a pencil or paper.

Another theme that emerged was the classroom management of the teacher. Most of the activities that involved the computers were implemented in a very student-centered environment. As the children were working, the teacher moved around the classroom observing their work. She encouraged the students to take the initiative to solve their own computer problems and help each other whenever possible. The teacher modeled careful treatment of the laptops, but did not over-emphasize their value. Consequently, student maltreatment of the computers was not a problem.

The prevailing theme from the classroom observations was the authentic instructional methods the teacher implemented with the technology. It was apparent that the lessons were developed to integrate technology as a natural portion of the lesson and to help students construct meaning. The technology became a seamless tool that was used by the students to complete the activities through carefully designed processes (disciplined inquiry). Also, the lessons emulated authentic instruction as the students developed higher order thinking skills to solve real world problems that had value beyond the classroom. For example, in one lesson, students collected real data and calculated ratios to predict how fast they could run. This provided a real world application that allowed students to recognize patterns and relationships by using a spreadsheet to analyze the data.

**Lesson Plans and Assessment of Student Work**

To examine the level of authentic instruction in the class projects, the lesson plans were examined and examples of student work were collected. The teacher had created a ‘filing cabinet’ on her computer for the students to store their digital work; hence, all of the student products were stored in one central location.

The assessment of the student work included an examination of both the process and the product related to the lesson. To ascertain the level of authentic instruction in a lesson, the researchers used the five standards outlined in Newmann and Wehlage (1993). Each lesson was then given a rating of low, medium or high level of authentic instruction (see Table 2).
Although more recent work has presented extended definitions and characteristics of authentic learning, the researchers judged that the foundational work of Newmann and Wehlage (1993) encompassed these additional extensions, and provided the best framework for classification.

**Body length experiment.** An example of a lesson with a medium level of authentic instruction involved using real world data to develop a chart on body lengths. In this lesson, students measured their body parts (such as arms and legs) and entered the information into a spreadsheet. Graphs and charts were then created in a spreadsheet to compare body lengths. A word processor was used to describe the relationship (or lack of one) between body part length and the length of the entire body. This lesson was rated as medium level of authentic instruction because, although it used real world data and had value beyond the classroom, the students used technology to construct knowledge at a low level. See details about the lesson at http://etc.usf.edu/plans/lessons/lp/lp0030.htm.

**Gettysburg movie.** Another example of medium level of authentic instruction was the Gettysburg Address lesson, where students engaged in a variety of activities to learn about the Civil War. The teacher first introduced the Gettysburg Address and explained the meaning behind each piece of the speech. She then grouped the students into pairs and divided the lines of the Gettysburg Address by the number of groups—each group was assigned several lines to study and memorize. After their lines were memorized, each group used a digital video camera to record themselves reciting their part. The individual clips were then imported into video editing software, and the audio tracks were extracted. Students then downloaded copyright-free pictures from a Civil War web site and imported them into their movie. They were tasked with selecting and sequencing an appropriate number of germane pictures to match the length and meaning of their audio portion. Each group produced their own movie, combining the pictures with the performance of their portion of the speech. Once each group had completed their movie, the individual movies were combined to create a single production of the entire Gettysburg Address.

In this lesson, positive social support was encouraged as students worked in groups, and students developed deep knowledge by constructing a movie with images and audio from the Gettysburg Address. However, the connection beyond the classroom was low. For more information about this project, see http://etc.usf.edu/plans/lessons/lp/lp0023ss2.htm.

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Low authentic instruction</th>
<th>Medium authentic instruction</th>
<th>High authentic instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body length experiment</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gettysburg movie</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Olympic housing</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Reading portfolios</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hermit crab race</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Interactive journeys</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Table 2. Level of authentic instruction in lesson plans and student work
Olympic housing. Within an Olympic thematic unit, students were tasked with designing a hotel so that important visitors would have a place to stay. Students were given a grid template and a set of guidelines for designing the property. There were several elements that had to be included in their design, after which they were free to include other elements they thought their guests might enjoy, such as a pool or golf course. In the spreadsheet document, students highlighted the appropriate number of cells corresponding to the size of each piece of the hotel. They then used the paint tools to color each area separately (e.g., cells representing grass were colored green).

After designing their hotel, students used a worksheet to calculate how much it would cost to build their hotel. They counted the number of cells they had designated for each area within the hotel, and made them into fractions representing a portion of the whole hotel. Then they reduced these fractions and converted them into decimals. They were given formulas for cost per square foot for building various elements within a hotel. Using these formulas, students calculated how much it would cost to build the hotel they had designed.

This lesson includes many real world tasks, which places it at the higher end of authentic instruction. The lesson is especially strong in higher-level thinking and shows strong connectedness beyond the classroom. In a problem-based setting, students worked together to analyze the situation, make decisions about elements to include in their hotels, and then made judgments about the impact of their decisions on the overall solution to the problem. As part of a unit on fractions, students used spreadsheets to design a luxury hotel. See lesson details at http://etc.usf.edu/plans/lessons/lp/lp0030.htm.

Reading portfolios. This activity represented a lesson at the lower end of authentic instruction. On the first day of school, students set goals as to how many books they would read in the semester. For each book they read (at home or at school), students wrote a paragraph including a summary of the book, what the book reminded them of, and how they responded to the book. Their summaries were entered into a timeline program that helped them track progress toward their reading goal. As another element in the portfolio, students recorded themselves reading selections from these books, and imported their audio files into the timeline program.

This lesson was strongest in providing connections beyond the classroom. By responding to the book and discussing what the book reminded them of, students were provided the opportunity to make a connection to the rest of their world, and to practice meta-cognitive skills. While higher-order thinking skills may have been tapped, they were not required. The use of substantive conversations was relatively low in this lesson. See lesson details at http://etc.usf.edu/plans/lessons/lp/lp0044.htm.

Hermit crab races. This activity was ranked at the high level of authentic instruction. Students were involved in conducting an experiment about speed and rate. They started by measuring the lengths of various hermit crabs. They then observed the crabs and recorded how far the crabs could move in five seconds. The students then measured each other, entered their data into a spreadsheet to calculate ratios and predict how fast they could run. They then went outside and ran for five seconds, recording the distance they were able to run in that time period. They used spreadsheet templates to perform calculations to compare their speeds to
the speeds they had predicted. This lesson required that students use disciplined inquiry (an experiment) to construct meaning from the data they gathered and analyzed. By completing the various steps of an experiment, students engaged in a process that is widely applicable to other areas. The use of real data and student involvement helped increase the apparent value beyond the classroom. See lesson details at http://etc.usf.edu/plans/lessons/lp/lp0026s2.htm.

Interactive journeys. This example of medium authentic instruction built on a field trip to an aquarium. Teachers went to the aquarium ahead of time to take pictures and videos that they used to create a scavenger hunt. On the day of the field trip, students completed the scavenger hunt by answering questions about the various animals. Some students had digital video and still cameras that they used throughout the day. Students were asked to choose and conduct research on one animal or fish they had encountered. They were given a template to use in recording their research information.

Once back in the classroom, students used the information they had collected on their chosen animal or fish to make movies, write stories and reports, and create books. Multiple outcomes from this lesson contributed toward its authenticity. Students were guided through disciplined inquiry in the form of a scavenger hunt. This was followed by a more in-depth effort of constructing meaning through the focused research on a particular animal. Students then synthesized the information they had collected and learned to produce various products that had personal meaning to them. See lesson details at http://etc.usf.edu/plans/lessons/lp/lp0028.htm.

Throughout all of the lessons, the teacher made a conscious effort to incorporate high-level activities that required substantial knowledge of the content. Her customary classroom discourse encouraged ongoing communication, interaction, and support among the students and the instructor. Whenever feasible, she integrated real-world concepts and ideas that had connection beyond the classroom.

Student Interviews

At the end of the second year (fifth grade), the teacher conducted a series of informal semi-structured interviews with the students. Questions were designed to encourage the students to talk about their experiences using laptops in their schoolwork. While the students were describing the projects, the teacher asked follow-up questions such as, ‘So, did you like it?’ or ‘What did you like about it?’ The interviews were taped and saved in digital format, and then transcribed. The student responses were analyzed to find predominant characteristics.

Although evaluation regarding the level of authentic instruction in a lesson is generally assessed on the basis of classroom observation, there were many elements from the student interviews that provided evidence that higher levels of authentic instruction were occurring. For example, student responses, such as we ‘chose pictures and put them together with sound to make a movie’ and ‘had to be like architects and try to make houses’ indicated students’ engagement in constructing knowledge and meaning. Comments that illustrated the value of these lessons beyond the classroom included ‘when it’s finished we’ll put it on the Internet’ and ‘we got to exercise while we were doing hermit crab races’.
Three themes that emerged from the student interviews may have particular importance in a classroom comprised largely of at-risk students. These themes include: physical movement, active engagement, and goal setting (Payne, 2005). Physical movement was incorporated into some activities as an essential element (such as running for five seconds) and helped to hold the students’ attention, while contributing an important aspect of the lesson. Research has demonstrated that at-risk students prefer more kinesthetic sensation and physical movement in their learning than their peers (Nunn & Miller, 2000). Students were also actively engaged in the activities, from going on the Internet and selecting pictures to creating concept maps. Children in poverty benefit from ‘strategies like graphic organizers and multiple approaches to learning about a concept’ (Bohn, 2006, p. 4). For lower socioeconomic students, it is especially helpful to set attainable goals. Goal setting ‘provides direction, coherence and meaning to life, elements often lacking in low SES students, and can also enable these students to transcend the dictates of their environment’ (Pellino, 2006, p. 5). This was brought out by several students who were proud of having a final color printout of their finished hotels, and others who boasted about the culminating movie from the Gettysburg Address.

It is interesting to note that across the entire set of interviews, specific pieces of software were only mentioned twice. One student mentioned that he used Kidspiration to make a chart, and another student mentioned ‘putting pictures into an iMovie’. After the teacher had asked a student to describe what they did on the computers, most students began to describe the projects and activities, instead of the specific actions performed on the computers. The teacher would follow up by asking ‘What did you do on the computer?’ to which most students responded by continuing to explain individual pieces of the activity, such as selecting pictures or adding sound to a movie. Responses commonly included the phrase ‘on the computer’ but students did not get more specific than that. Their responses suggest that they saw the computer as a tool for completing the task at hand, as opposed to something they needed to learn how to use.

Teacher Interviews

On a daily basis, the teacher recorded personal reflections regarding the success and/or challenges of specific lessons. At the end of each week, discussions took place between the researchers and the teacher. These discussions focused on potential lesson plans and techniques for integrating the laptops into the curriculum. In addition, formal interviews with the teacher were conducted and videotaped at the end of each year.

At the end of each year, the researchers conducted interviews with the teacher. The interviews were conducted informally in her classroom, using a protocol with a semi-structured set of questions. Each interview was recorded and saved in digital format. The first step involved synthesizing and classifying information from notes taken during the interviews. The second step was to review the audio recordings from the interviews, identifying topics and synthesizing the information into categories. The final step was a member check of the data summarization, in which the interpretations of the conversations were sent to the teacher for verification.

Initial data reduction resulted in a matrix containing categories of interest, including both rewarding themes and challenging themes. Overall, the resulting matrix provides a vivid
picture of issues the teacher noted throughout the process. The information gleaned from the interviews with the teacher is summarized for five major areas: classroom management issues, individual learning styles of students, wireless technology, software programs and hardware issues (see Table 3).

In general, the teacher was extremely positive about the experience. She saw her role as structuring the lessons (in advance), ensuring that the students had the requisite skills, then acting as a facilitator by answering questions and trouble-shooting with the students as they went.

Table 3. Rewarding and challenging themes from interviews

<table>
<thead>
<tr>
<th>Major areas</th>
<th>Rewarding themes</th>
<th>Challenging themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom management issues</td>
<td>Teacher became facilitator of the lessons</td>
<td>It was too noisy to teach outside</td>
</tr>
<tr>
<td></td>
<td>Classroom became very student-centered</td>
<td>Lessons must be structured prior to going outside</td>
</tr>
<tr>
<td></td>
<td>Setting up digital templates in advance was very beneficial</td>
<td>Insects can be an issue outside</td>
</tr>
<tr>
<td></td>
<td>Students collaborated well with laptops and helped each other</td>
<td>Some projects were too ambitious</td>
</tr>
<tr>
<td></td>
<td>Students respected the technology—little damage occurred</td>
<td>Had difficulty finding other teachers to collaborate with</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A great deal of structure and pre-planning was required to keep students on task</td>
</tr>
<tr>
<td>Individual learning styles of students</td>
<td>Shy students became more extroverted</td>
<td>Many ESOL and language impaired students required additional time to understand directions</td>
</tr>
<tr>
<td></td>
<td>Students with low reading/writing ability did well with cameras and iMovie</td>
<td>Some students did not have the verbal skills to reflect on projects</td>
</tr>
<tr>
<td></td>
<td>Techie students gained self confidence by helping others</td>
<td>Learning disabled students had trouble with logic and organizing projects/portfolios</td>
</tr>
<tr>
<td></td>
<td>Bright students were challenged to perfect projects and add enhanced features</td>
<td></td>
</tr>
<tr>
<td>Wireless technology</td>
<td>Laptops became integrated throughout curriculum</td>
<td>Students lacked fine motor ability to use trackpad</td>
</tr>
<tr>
<td></td>
<td>Technology was extremely motivating for the students</td>
<td>Students lacked typing skills</td>
</tr>
<tr>
<td></td>
<td>Allowed learning to take place outside, at beach, etc</td>
<td>Keeping batteries charged can be an issue</td>
</tr>
<tr>
<td></td>
<td>Eliminated hassle with cords, plugs, etc</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Facilitated collaboration, both physically and electronically</td>
<td></td>
</tr>
<tr>
<td>Tool-based applications</td>
<td>MapMaker was very versatile</td>
<td>Word processing—too many fonts that distract students</td>
</tr>
<tr>
<td></td>
<td>iMovie was great for higher-level thinking skills</td>
<td>PowerPoint—very one-dimensional</td>
</tr>
<tr>
<td></td>
<td>AlphaSmarts—great mobility and limited fonts kept students on task</td>
<td>Spreadsheets—difficult for students to grasp</td>
</tr>
<tr>
<td></td>
<td>Kidspiration—great tool for brainstorming</td>
<td>Spreadsheet templates embedded in word processing worked best</td>
</tr>
<tr>
<td>Hardware issues</td>
<td>Scanners are great tools—resulted in more accurate images</td>
<td>Inexpensive digital cameras (still-photo) were not reliable</td>
</tr>
<tr>
<td></td>
<td>Shared folder on teacher’s computer worked beautifully</td>
<td>Filesize of digital movies created storage problems</td>
</tr>
</tbody>
</table>
worked on the activities. She sought to help the students become independent learners, and enjoyed the opportunity to work with individual students to meet their learning needs.

There were also many ‘lessons learned’ during the year. The teacher found that teaching new concepts outside the classroom was almost impossible, and quickly learned to structure the lesson for the students prior to leaving the classroom. With the proper structure and guidance, the students worked extremely well outside, stayed on task, and collaborated with each other. Students’ lack of fine motor skills was also an issue. Although the students adapted very quickly to using the computers, they lacked the fine motor skills needed to use the trackpad effectively, and they did not have the typing skills to be efficient in word processing.

Although there was no control group for an empirical comparison, the teacher felt strongly that the infusion of laptop technology in her classroom resulted in increased achievement by the students. She felt that the laptops ‘enhanced the lessons a lot’ and that the ‘wireless part of the technology [made] all the difference’. Using the computers as tools for writing, data analysis, communication, and research encouraged students to read, write and solve problems more effectively.

Summary

There was a convergence of the evidence across data sources (classroom observations, student work, student interviews, and teacher interviews) to suggest that authentic instruction was taking place in this classroom through lessons that integrated laptop computers. Further, evidence from all data sources indicates that the high levels on the five standards were achieved in many of the lessons.

The results show that authentic tasks and technology are a feasible combination for at-risk students in elementary school. Although this case study was limited to one classroom and one teacher, the implications are tremendous. There were no issues with maltreatment of the computers; the enthusiasm of the students was very high; and the teacher became a true advocate for the effective integration of technology. At the end of the study, the students’ parents or guardians were invited to view the final portfolios. It was clear that, in most cases, the students’ expertise with computers far exceeded that of their parents.

Educational Significance

The results of the project were used to develop a web site with sample lessons, teacher reflections, and strategies. This web site, titled ‘No Strings Attached’ (Florida Center for Instructional Technology, 2006) provides dozens of sample lessons, each complete with lists of objectives, materials, relevant NETS competencies, extension activities and templates (see Figure 1). In addition, it offers practical classroom ideas, training tips and reflections by teachers and students. This web site is available to provide guidance for teachers who are considering implementation of mobile laptops in elementary school classrooms.

Laptop initiatives are taking place throughout the country. As the laptop computer becomes a regular tool in the classroom, a new model for assessing the use of technology in the curriculum with low SES students must be developed. Ringstaff and Kelley (2002) proposed that research move beyond the question of whether or not computers are worth the cost to questions such as, ‘Under what conditions do computers have the most benefit for
There are significant gaps in research concerning the use of the laptop computer as a cognitive tool for instruction with low socioeconomic students. This research serves as an initial step in demonstrating the feasibility and benefits of integrating laptop computers into an elementary classroom to produce authentic outcomes with at-risk students.

References


