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The Use of an Interactive Whiteboard in Promoting Interactive Teaching and Learning

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In today's society both children in educational settings and adults in workplaces are exposed to a wide assortment of information technology that allows learning and production of knowledge to take place in a variety of ways. Walter McKenzie (2002), former instructional technology coordinator for Arlington Public Schools, asks:

> With the Information Age evolving so rapidly, how do schools adopt a new model of thinking and learning that adequately parallels society's demands? The change is already taking place in classrooms across the country. But, if we as teachers tend to teach in the same ways that we ourselves were taught, how then do we break away from the standardized, homogeneous approach to schooling that we knew as students? (p. 5).

McKenzie claims that the Information Age requires workers to have the ability to access information and manipulate information in a variety of ways using digital tools, allowing them to evaluate information using critical-thinking strategies and problem-solving skills in ways that allow them to interact with colleagues to complete complex tasks and present information and ideas in novel or unique ways.

It appears then that two issues face teachers of today. The first issue is the need to recognize that the Information Age has brought new demands on how we teach our students within classroom settings. Many students come to school already exposed to technology that allows them to learn in a variety of ways at home such as the use of computer game software, interactive learning web sites, television with DVD's, and talking books to name just a few examples. The second issue is how we, as educators, make changes in the ways we were traditionally taught and make better use of technology so that we help our students develop the information, literacy, problem-solving, collaboration and creativity skills they need to be successful in today's workplace.

In March 2004, we (two second grade teachers and the technology resource teacher at Deer Park Elementary School in Centreville, VA) attended several sessions on the use of interactive whiteboards in the elementary school setting at the Virginia Society for Technology in Education (VSTE) Conference in Roanoke, VA. In particular, we saw demonstrated an ACTIVboard that uses a computer connected to a projector and a touch-sensitive whiteboard. The projector displays images from the computer, and the computer is controlled by touching the board with an electronic pen. Teachers can display Internet web sites, run educational software, show live video, and give multimedia presentations, all in an effort to engage students

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in interactive learning (Fernandez & Luftglass, 2003).

Intrigued by the claims of the presenters at the VSTE Conference that the use of this technology promotes interactive teaching and learning, we asked our school's principal to purchase an ACTIVboard (produced by Promethean, Inc.) for our school. Our principal suggested that we "field-test" the use of this interactive tool with a group of students and conduct a year-long study of its effects on promoting interactive teaching and learning before he purchased other ACTIVboards for use throughout the school. He allocated a resource room close to the second grade classrooms to house the ACTIVboard, and we promptly dubbed the room "The Board Room." He also bought a laptop and a projector that were dedicated for use with the ACTIVboard. In addition, we obtained an Impact II Teacher-Researcher Grant from our school system to support our year-long study. We used the grant funds to purchase ACTIVotes, hand-held voting devices used by the students to record their individual responses to questions asked during the whiteboard lessons. After voting to indicate choices to questions, the students' responses are shown as bar graphs on the whiteboard, showing how many students voted for each possible response and which response was the actual correct one.

During the year we received support and guidance from our school's Teacher Research Team (TRT) as we went through the process of collecting and analyzing data for our research project. Our first guiding question was, "How does the use of the ACTIVboard promote interactive teaching and learning?" We felt this question was particularly important because, as teachers, we wanted to discover and develop ways of using the ACTIVboard that will change our traditional relationship with our students from transmitters of knowledge to enablers of learning. We also wanted to discover how the use of whiteboard technology can be used to tap into the various multiple intelligences and learning styles of our students and to learn what happens when it is used to promote interactive learning and the development of literacy, problem solving, creativity, and collaboration skills with our students. So, our second guiding question was, "How does the use of the ACTIVboard support instructional strategies that lead to the development of literacy, problem-solving, creativity, and collaboration skills of students?"

Literature Review

We began our project by reviewing the literature on the importance of using technology to improve pedagogical skills and promote active student learning. Marzano (1998) conducted a meta-analysis of 100 research reports on instruction and identified and reviewed categories of instructional strategies that enhance student achievement. Then Marzano, Pickering, and Pollock (2001) identified nine categories of instructional strategies that are most likely to lead to enhanced student achievement when they wrote their book, *Classroom Instruction That Works: Research-Based Strategies for Increasing Student Achievement*. Brabeck, Fisher, and Pitler (2004) took the nine strategies and showed specific examples of how technology could support those instructional strategies. We believe that the nine instructional technology strategies mentioned in this article can be directly applied to effective uses of the

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whiteboard:

1. Classroom practices associated with identifying similarities and differences, including comparison and classifying tasks.
2. Summarizing activities (deleting or substituting information that is not critical to the overall meaning of text) and note-taking (determining what is most important and stating that information succinctly).
3. Reinforcing student effort and providing recognition for solving problems, deducing a correct answer, or achieving specific goals.
4. Mastering skills through practice.
5. Learning new knowledge through both linguistic and non-linguistic ways (drawings, images, diagrams, video clips, and kinesthetic movements).
6. Cooperative learning (working with others to complete a task).
7. Setting objectives and providing feedback (including an explanation of why an item is correct or incorrect, letting students know where they stand relative to a specific target of knowledge or skill).
8. Generating and testing hypotheses (planning and conducting simple investigations, formulating and testing questions, making observations, and developing logical conclusions).
9. Using cues, questions and advance organizers to give students a preview of what they are about to learn or experience and to activate their prior knowledge.

(Brabeck, Fisher, & Pitler, 2004)

Methodology

Next, we looked at the features of the ACTIVboard in terms of instructional delivery. Each of us kept detailed journal observations and interview data from 48 second grade students when they used the ACTIVboard. In addition, three other second grade teachers who also taught ACTIVboard lessons provided us with their input based on their own observations of how and what their students learned as a result of using the ACTIVboard.

We also videotaped and photographed various ACTIVboard and follow-up classroom assignments for analysis. Some of the lessons were taught in different ways (traditional instruction vs. ACTIVboard instruction). Differences in student responses to the lessons (oral responses, test or quiz results, authentic student work performances), as well as what students said about the use of the ACTIVboard vs. non-ACTIVboard presentations were noted in the teacher's journals. This was done so that we could compare what the students demonstrated that they knew and could do as a result of the learning sessions using the technology and not using technology.

Data Collector software, a qualitative data-analysis computer program, was used to record each observation or interview entry made by the teachers when they wrote reactions to the lessons. The second grade teachers sent their journal entries as e-mail attachments to the technology resource teacher who copied and pasted the

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reactions onto the software's data cards. Data collector cards were also created using observation and reaction statements from inclusion special education teachers who observed the lessons. In all, sixty-one data cards were created and then coded according to the following categories:

- Lesson Delivery
- Student and Observer Reactions
- Instructional Strategies (specifically the nine instructional strategies listed by Brabeck, Fisher, & Pitler, 2004)

Using the find and sort feature of the software program, topic cards were created for each category. This process enabled us to explore relationships between concepts and to determine frequency of occurrences.

In order to determine how the use of the whiteboard facilitates and promotes interactive teaching and learning, we triangulated the data from four data sources:

- Our analysis of student work samples completed by students following whiteboard lessons.
- The consolidated information on the Data Collector topic cards.
- The paper and pencil survey responses of the students who indicated what they liked and did not like about using the ACTIVboard.
- What we saw students doing when we reviewed the videotapes and digital images taken during ACTIVboard lessons.

Findings

In addition to looking at how the use of whiteboard technology can be used to improve our pedagogy skills, we wanted to determine how this form of technology taps into the various multiple intelligences and learning styles of our students. Specifically, we wanted to learn what happens when the ACTIVboard is used to promote interactive learning and how it can be used in the development of literacy, problem-solving, creativity, and collaboration skills with our students. Our findings are reported in three areas: lesson delivery, student and observer reactions, and the nine instructional strategies.

Lesson Delivery

We found that delivery of instruction provided us with an opportunity to actively engage our students in a variety of ways from planning stories to reinforcing skills and learning new concepts. Students were able to move images, click on links, and activate sounds and movies with a simple tap and drag of a pen and, in doing so, be easily seen and heard by the rest of the class. Students engaged in collaborative problem-solving skills as they worked in partner and larger team groups. Using ACTIVote devices, each class member's response to questions was counted and the votes were visually shown in bar graphs, tying wonderfully into mathematics. Most of all, using the

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ACTIVboard helped us make significant changes in how we teach. We were no longer front-and-center purveyors of information.

By far, the most common responses students and teachers made about the use of the ACTIVboard for lesson delivery were related to viewing the lesson. Respondents used the words "brighter," "bigger," "wider," and "clearer" when comparing what they were able to "see" on the ACTIVboard screen to what they view from a computer on a classroom TV monitor. However, hearing sounds was another matter. The laptop's built-in speakers were not very loud. Once we attached external speakers to the laptop, then a whole class could hear sounds such as those embedded in interactive web sites.

When reviewing the data for evidence of student motivation and attentiveness, the words "student-centered" and "involved" were noted most often by the teachers when describing how engaged the students were during ACTIVboard lessons. The teachers were pleased that, when using the ACTIVboard, students could take turns choosing and dragging graphics from various software programs to complete compare-contrast charts, create scenes, and plan a story by filling in story organizers. One teacher wrote in her journal,

> Today we were able to open a story plan in Kidspiration and together, as a class, we planned the characters, setting, actions, problem, and solution for a story. All the kids were involved, including the reluctant writers. As they lined up to go back to class, they were talking about their ideas for their stories.

She continued to describe how "eager" and "excited" her students were to complete a follow-up lesson once they returned to their classroom.

> When we got back to the classroom, they were very eager and excited to start their stories. They sat and wrote for about 30 minutes, which is quite a long time for sustained writing at this time of year in second grade. Most of them actually finished drafting their stories, which is unusual for one sitting. Most of the children had a beginning, middle, and end. Most followed the plan pretty closely, adding some new ideas.

Student and Observer Reactions.

The words "fun" or "liked" were the most frequently used words when students were verbally asked to describe their reactions to the ACTIVboard lessons (sixty-eight times as noted in the sixty-three data collection cards.) They gave a variety of reasons as to why they liked using the interactive technology, but the most common reasons were:

- They liked moving graphic objects around the screen with the pen.
- They liked using the ACTIVotes to indicate their choices for answers when the teachers asked quiz questions.
- They liked playing an instructional game or engaging in an interactive web site activity with other team mates on the board with the whole class being able to watch and cheer them on.

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Observers (two special education inclusion teachers and a visiting technology specialist from another school) noted the value of using this technology for tapping into multi-sensory avenues of learning. For example, when the technology resource teacher taught a lesson to fifth grade students who were learning to plot points on a grid to win a race car game, a special education teacher wrote in her observation/reflection about the lesson:

> I liked it because you know there are always students who are not going across and up/down to plot points during the classroom lesson, and in a big group with everyone working at a desk, it's not always easy to see who is doing it wrong. With the ACTIVboard, we were able to watch each student plot their path and correct them as needed. Also, the students loved watching the activity so they had the reinforcement of watching others plot their points. Since they were trying to "win" the race, they were very motivated and paying strict attention. It is hands on, which uses a kinesthetic sense, so hopefully more students will remember the lesson.

The technology specialist who visited us from another school noted in her observation/reflection report to us that when ACTIVotes were used, "the students' votes were compiled and shown as bar graphs with class discussions focusing on how people used factual thinking. Students were able to make choices and shared their preferences for making responses to questions [posed by the teacher]." She also noted that the use of the ACTIVotes was especially good for reviewing previously learned lessons for tests.

Nine Instructional Strategies

How does the use of the ACTIVboard relate to improving pedagogical skills and promoting active student learning? We looked for evidence in our data that addressed the nine instructional technology strategies that Brabec, Fisher, and Pitler (2004) said are effective in promoting student achievement. We found evidence that the lessons the teachers taught using the ACTIVboard fell into each of the nine categories:

Similarities and Differences. Most of the ACTIVboard activities involving comparing, contrasting and classifying concepts were math, social studies and science lessons:

1. Students matched money words to images and values of coins.
2. Students used highlighting pens to show patterns on a 100's chart.
3. Students used clipart to show similarities and differences between the United States and Mexico (people, places, and traditions).
4. Using images, students completed compare-contrast charts to indicate the characteristics of insects.
5. Students chose images to show "opportunity cost" in an economics lesson by showing two objects on a screen (such as a hamburger and a teddy bear) and asking the students which one they would want to have. Once an

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object was chosen, the other was dragged from the screen showing the remaining object. The object eliminated was known as the opportunity cost because it was the object that was sacrificed.

Summarizing and Note-taking. Graphic organizers and list charts were most commonly used for writing and reading lessons:

1. Completing story planners to write fairy tales or story retellings.
2. Completing data retrieval charts with images of animals so students could have visual reminders of ideas to use when writing about the animals.
3. After reading a "big book" on the ACTIVboard screen, students completed column lists of short vowel words found in the story.

Reinforce Effort and Recognition. Voting with the ACTIVotes and seeing how votes were cast through bar graphs reinforced correct responses. Students actually cheered when their whole class gave a correct answer. Oral discussions often occurred, giving students opportunities to discuss why they had chosen specific answers.

Homework and Practice. Some of the PowerPoint presentations teachers created and used with the ACTIVboard were posted on the school's Blackboard web site for homework review. Practice activities using the ACTIVboard in school included lessons on:

1. Using counting back strategies while using number charts.
2. How to study spelling words using "look, cover, write, and check" spelling practice exercises.
3. Re-grouping in math using virtual manipulatives (ones and tens blocks).

Linguistic and Non-linguistic learning. Using graphics to illustrate words and concepts was the most common use of the ACTIVboard. However, having students move word boxes to complete CLOZE reading sentences was another way for teachers to assess students understandings. Other specific lessons were:

1. Creating maps to include mountain ranges, rivers, and lakes using a template map of the USA.
2. Demonstrating the concepts of "how many more?" by creating stacks of virtual blocks to compare number values.
3. Using graphic images to convey story elements (Example- a student used an unhappy face, a deer, and a skunk to convey the "problem" in the story that involved a skunk spraying a deer in the forest).

Cooperative Learning. Students worked in pairs, teams of students, or one at a time when responding at the board. When using the ACTIVotes, they worked in pairs or alone when voting. Students had to discuss their choices with one another, giving rea-

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sons for those choices, and at times they had to "negotiate" in order to come to a compromise.

Setting Objectives and Providing Feedback. Using the ACTIVboard to use images or story planners to retell stories or create a story was the most common example of setting objectives. Again, the use of the ACTIVotes was the most common way to provide feedback to responses.

Generate and Test Hypotheses. Making observations and developing conclusions were most evident when the teachers developed PowerPoint presentations to teach students about science and social studies concepts. For example, when showing a presentation on the Hopi Indians, students were shown pictures of pueblos built under cliffs. When asked why they thought the houses were built there, students had to discuss (collaborate with one another) to generate viable reasons and then used ACTIVotes to give their best responses.

Using cues, questions, and advance organizers. Comparing, contrasting, and categorizing activities gave children opportunities to see a preview about what they would be learning, activate prior knowledge, or review concepts previously taught:

1. Using story planners, students used images and words to show beginning, middle and end of stories.
2. Using VENN diagrams, students used cultural, political, and economic images relating to Mexico and the U.S. to show their understandings of same and different.
3. Students found images of creatures to show which creatures are insects and which are not insects.

What were the carry-over effects of the ACTIVboard lessons? Many of the lessons began in the ACTIVboard room and involved follow-up work in the classroom. One second grade teacher gave this example of how she saw the use of the ACTIVboard tying into two areas of effective technology uses:

> We did a math lesson today in the boardroom about adding two-digit numbers. We used ten sticks on the ACTIVprimary software to add two-digit numbers in the tens counting pattern. The children recorded the answers in their math book. They took turns using the ten sticks on the board to help solve the problems. After doing three or four problems together with the tens sticks, the kids seemed to understand the pattern. Most were able to quickly solve the problems without using manipulatives. When we returned to the classroom children independently completed a practice paper with these kinds of problems; they all did very well. This lesson incorporated two strategies: homework and practice and nonlinguistic representations.

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There were also a number of unexpected examples of extended student thinking. During an observation that the technology resource teacher made during the Hopi Indian lesson, she noted:

> I noticed one boy making a math problem out of each ACTIVote response. For example, in one response six students voted one way, and nine students another way to the question, "Which Hopi game would you like to play? The dart game or field hockey?" After looking at the bar graph showing six and nine votes, he said, "That's six plus nine, making 15 of us!"

During the same lesson, she observed:

> A girl student offered a suggestion to her teacher after the class had just used the ACTIVotes to make a response to a question, "You should add a question to that. You should ask the children which vegetable (based on what the Hopi eat) would you like to eat? Corn? Beans? or Squash?"

In this case, the young girl was thinking like a “test creator” and thinking her teacher should be asking children to express preferences for their responses.

Conclusions and Implications

For the most part, students did not have trouble using the ACTIVboard pen to click and select objects on the screen. However, clicking to drag objects was a problem for some children since they had to remember to keep the pen straight and not hold it at an angle. Also, students and teachers had to remember to stand slightly off to the side of the screen because standing in line with the light from the projector tended to cast a shadow on the screen.

The height of the board should also be considered when setting it up for primary students. Quite often we noticed very short students having difficulty dragging images or clicking on spaces that were at the top of the board. Our board sits on a stand and the legs would need to be adjusted so the board sits lower to the floor if it remains designated for primary use.

Another consideration to make when setting up the ACTIVboard is finding a room that is big enough for a whole class. The room dedicated to the ACTIVboard at our school did not allow adequate space for students. Students seemed crammed in a small room and it was often hot during the winter months. Children had to sit on the floor since there was no room for desks, tables, or chairs. Getting to the board to take a turn was difficult and students did not have the opportunities to respond using manipulative objects or writing/drawing materials as they would have if the board had been in a classroom with the students sitting at their own desks. Students wanted to get started on their responses to the ACTIVboard lessons right away, and the time it took to travel to and from the board room was time consuming and this seemed to destroy the momentum of a lesson.

What will be the future use of interactive whiteboards at our school? The second grade teachers would like to see one in each of their classrooms. It is evident from what they have learned and the lessons they have used and developed that it would be used on a daily basis in all subject areas. Who knows, when we share this

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report and demonstrate the lessons to the rest of the faculty, there may be a stampede of teachers on their way to the board room to sign up for its use.

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