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Communications in INFORMATION LITERACY

ACTIVE LEARNING WITH INTERACTIVE WHITEBOARDS

A literature review and a case study for college freshmen

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ABSTRACT
A well-designed classroom that includes appropriate technology can inspire and support successful instructional design. Interactive whiteboards (IWBs), an example of this technology, have been adopted in Great Britain, primarily in primary and secondary schools. While the literature anecdotally suggests that there are benefits associated with using IWBs in classroom instruction, little has been written about their application and efficacy in higher education. The author describes an exercise designed for college freshman, and discusses the benefits of the group work and active assignments engendered by the IWB.

INTRODUCTION

Numerous factors converged to create a perfect storm of change in educational practices during the later part of the postmodern 20th century. The constructivist learning theories based on the ideas of Jean Piaget and Lev Vygotsky supported new collaborative and team-based teaching methods. New computer and communication technologies allowed students more opportunity to interact with each other, with their teachers, and with information itself. In the library, the huge increase in the amount of data, coupled with the above factors, spurred radical changes in instructional design of library research sessions.

This paper will showcase one new technology:the interactive whiteboard (IWB). Much has been written on how instructors have learned to use this new technology, primarily by Derek Glover and David Miller of the University of Keele (Glover & Miller, 2001; Glover & Miller, 2002; Glover, Miller, Averis, & Door, 2005; Miller & Glover, 2002). The focus here will be not on the reaction of the instructors to this new technology, but on how the IWBs have positively affected students in the classroom, especially in cases where the IWB has engendered or has been combined with

more active or collaborative learning approaches in instructional design.[1]

Literature Review

The IWB was invented in the early 1990s at Xerox, and the Liveboard (as it was then called) was first used exclusively in business settings (Elrod, 1992). As Greiffenhagen (2000) points out, when IWBs moved into educational situations, they were most often used as a replacement for the blackboard, i.e., "…as a tool for the *teacher* and as a resource for whole-class teaching" (p. 9). This trend continues today, and IWBs are often flashy versions of the old chalkboard. However, there are also indications that with the shift in focus from teaching to student learning, the IWB's full potential in the classroom is being utilized in classrooms for more innovative and active lessons.

IWBs are part of a £15 billion ($27 billion) initiative to update all British primary and secondary schools by 2015 (Hennessy, 2004). The British Education Secretary, Charles Clarke, stated that "Every school of the future will have an interactive whiteboard in every classroom" (Arnott, 2004), and in January of 2004 £25 million ($47 million) was allocated to purchase them (Parkinson, 2004). Because of this huge investment in IWBs and their massive exposure to British students, a number of recent studies have looked at the impact of IWBs on teaching and learning in primary and secondary classrooms.

A study of 72 10- to 12-year-olds done by the School of Education at Newcastle University looked at the effective use of IWB technology, teachers' perceptions of IWBs, and the impact of IWBs on classroom interaction and on pupils' attainment (Hall, 2005). It found that students valued IWBs for their versatility, their multimedia capabilities, and the "fun and games" aspect of learning with them (Hall, 2005, p.106–107). Another study of 80 English schoolchildren looked at how 10- to 13-year-old students thought IWBs impacted their learning (Wall, 2005). It found that:

> *The indications are that IWBs can be effective tools for initiating and facilitating the learning process, especially where pupil participation and use of the board is utilized. An important finding is that there is a relationship between IWBs and pupils' views of learning, with visual and verbal-social learning being particularly prominent. The way in which information is presented, through colour and movement in particular, is seen by the pupils to be motivating and reinforces concentration and attention.* (p. 866)

A third study of six classrooms from 2003 to 2004 showed that IWBs had positive impacts on students' motivation, engagement and self esteem (Knight, P., 2005, p. 11).

There have been three articles by British authors that critically review the literature on IWBs. "Using Interactive Whiteboards in Teaching and Learning of Mathematics: a Research Bibliography" lists eight websites and seven articles and reports from 2000 to 2004 that are relevant to primary and secondary teaching of mathematics with IWBs (Jones, 2004). Some of the lessons Jones gleans from these studies are that IWBs should be used as more than just presentation devices, and that while with IWBs "…teaching can change to include more interaction…" there is a "…need to design teaching scenarios that make full use of the interactivity available with an IWB." He also cautions that ultimately, where they are used in every lesson, "…the novelty effect can diminish and that much depends on the overall quality of teaching" (Jones, 2004).

The British Educational Communications and Technology Agency (BECTA) published a short report in 2003 called "What the Research Says about Interactive Whiteboards." It contains summaries of the benefits of IWBs for teachers and students, factors for their effective use, and a 14-item bibliography. The report's authors found some key benefits of IWBs, concluding that their use "encourages more varied, creative and seamless use of teaching materials; engages students to a greater extent than conventional

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whole-class teaching, increasing enjoyment and motivation; (and) facilitates student participation through the ability to interact with materials on the board" (BECTA, 2003, p. 1).

In "Interactive Whiteboards: Boon or Bandwagon? A critical review of the literature," Smith et al. "...looked to identify any impact on classroom interaction, on teachers' perceptions and on pupils' attainment, progress and attitudes" (p. 91). They note that while pupils' and teachers' views of IWBs are overwhelmingly positive, evidence of their impact on students' achievement does not yet exist. They also caution that most of the reports show only mixed, limited, or anecdotal support for the benefits noted (Smith et al., 2005, p. 92).

There are also a few articles reporting on IWB use in the United States. A descriptive study looked into the pros and cons of IWB use in foreign language classes in grades six through 12 (Gérard, 1999). It noted that the students liked to interact with the board and had fun doing so. Another study of 609 community college students looked into students' use and perceived value of seven types of educational technology, including IWBs (Student perceptions, 2002). Two placebo-like findings of particular interest were:

1. The more often students believe a given piece of equipment is used, the more they believe it helps them learn–even if the piece of equipment was not used.

2. Students' perception of the helpfulness of technology tends to be global: the more a student believes one piece of equipment helps in learning, the more he is apt to believe other types of equipment help. (Student perceptions, 2002, p.5)

The only article found related to IWBs in a university setting was "How Smart is a SMART Board for an Academic Library? Using an Electronic Whiteboard for Research Instruction" (Knight, E., 2003). While the article reviews the basics of using an IWB, the only examples of instruction given are the familiar lecture/demonstration mode. No mention of IWBs in relation to interactive or group learning was reported.

It must be recognized that most of the articles mentioned relate the use of IWBs in primary and secondary schools, not in college or university settings. Many of the studies were done in secondary schools; therefore, some of the students would have been almost as old as entering college students, and the findings may also be relevant at least to college freshmen. Most of the studies do not show much increase in student learning in cognitive areas; more often they point to increase in the *affective domain*.

The affective domain has been much less studied than the cognitive one, but it is gaining the attention of researchers and educators. Learning began to be separated into these two realms in 1956 with the publication by Bloom of the *Taxonomy of Educational Objectives: the Classification of Educational Goals, Handbook I: the Cognitive Domain.* In 1964, Krathwohl, Bloom, and Masia published the second volume, *Taxonomy of Educational Objectives: the Classification of Educational Goals, Handbook II: the Affective Domain.* The affective domain focuses on learners' motivations, their attention to and emotional response to learning, and the value they attach to learning. It also focuses on the areas of self-concept, self-esteem, and social interaction in the learning environment. It has been posited that, because the components of the affective domain are far less quantifiable than the cognitive one, research in this area has not been as prolific (Sonnier, 1989, p. 8). However, as Monique Boekaerts states,

> *It has become evident that effective teaching is not a question of putting information across to a group of students. It is more a question of initiating behavioral change in every student… Indeed, it has become clear that students learn in dynamic social learning environments in which the various interactors continuously influence each other, thereby changing the leaning situation itself as well as their own appraisal of the situation. Theories of learning that focus exclusively on*

> *information processing cannot grasp this complexity*. (Boekaerts, 1994, p. 199)

In many of the studies cited above, using an IWB in a classroom was shown to positively impact students' affective learning. Librarians often have affective learning goals for students in library sessions, such as keeping their attention and motivating them to learn about research. Most librarians hope that students will ultimately value the research process and experience it as enjoyable and fun. In the balance of this paper, the author will give an example of integrating the IWB into active, group learning for undergraduate students in order to meet some of these goals.

The Setting

The Portland State University (PSU) Library has two classrooms equipped with SMART Boards (a type of IWB). The arrangements of seating and instructional technology in these rooms work synergistically to support the creation of fun, energetic, and active peer learning exercises.

The author's primary liaison is with the General Education area at PSU (called University Studies), and the students therein are primarily undergraduates enrolled in Freshman Inquiry classes. These year-long classes cover writing, English, and humanities in an integrated and interdisciplinary fashion. Freshman Inquiry is also taught for college credit in many area high schools, so the students in these classes are often young and always new to college. There are typically between two and four library instruction sessions given to the students over the course of their first year.

For many students, library instruction classes are the first classes that require college-level research. Besides the library research content component, the goals for students in these sessions are affective ones related to relieving library anxiety and promoting the library and librarians as welcoming and helpful allies in their scholarly endeavors.

Description of Classroom and Technology

The library classroom contains five round tables. Each comfortably seats up to seven students. Each student has a networked laptop computer at his or her seat. A SMART Board with a Bluetooth-enabled keyboard and mouse is at the front of the room. The separate round tables encourage group work and the SMART Board's high-tech features engage many students instantly.

A SMART Board essentially combines the features of a large touch-screen computer monitor with those of a whiteboard. It looks like a five-by-six–foot high-definition television screen sitting on a cabinet that is three feet tall. In the cabinet is a computer that displays an image on the screen above. The image is projected from the back, so there are no problems with shadows being cast on the screen. The image on the screen (a Web page, a text document, etc.) is manipulated by touching the screen. For example, if a Web browser is open and a library Web page is on the screen, the catalog link can be touched with a finger and the catalog will open. The scroll bars on the right side of the browser can also be activated by touch in order to explore the document at hand. Touching the "back" button returns to the homepage. The computer is also connected to a keyboard and mouse on a podium next to the SMART Board. The keyboard allows typing into any program on the screen, and navigation can also be performed with the mouse.

Electronic pens in a variety of colors sit on a tray at the bottom of the SMART Board screen. With the electric pen, words can be written on the board with "electronic ink" (although the pen doesn't actually write on the screen, writing displays in the color of the pen), and important text or images can be circled or highlighted. Screen shots of important edits or notes can also be saved for later use and distribution. (For more features of the Rear Projection 3000i SMART Board described above, see http://www2.smarttech.com/st/en-US/Products/SMART+Boards/Rear+Projection/3000i/

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default.htm.)

The other technological component of the classroom is Bluetooth. Bluetooth uses weak radio signals to communicate between electronic devices. Bluetooth enables a keyboard and mouse to be connected to the SMART Board computer without any wires. The keyboard and mouse can be taken anywhere in the room and still be connected to the computer and control the actions on the SMART Board.

Case Study: The Interactive Class

When a class arrives for library instruction, the instructor explains that the session will be very active, and that students will be working in groups. A handout is distributed that contains a number of scenarios, each of which is tailored to a specific learning outcome. (For an example of a Freshman Inquiry class handout, see the appendix.) Each scenario sets up a situation and asks a variety of questions. Students learn the research concepts and skills by answering the scenario's questions in their groups, or by hearing the reports of the other students.

Each group is assigned one scenario and told to work together, share information, and report to the class on what they have found in a 10-minute time frame. The instructor uses the SMART Board to show students where to begin (the library Web page, the catalog, a certain database, etc.). Simply touching the screen catches students' attention. The instructor uses an electric pen to circle important links or areas of displayed pages. Often, before they have begun working on their designated scenarios, students from each group volunteer to report their findings to the class.

As students work in groups to answer the questions posed by their group's scenario, the instructor circulates to answer questions and help groups that appear to be having difficulty. When students are ready to give their group reports, the instructor provides a one-minute lesson on how to operate the SMART Board. This involves showing students how to use the touch screen and how to write with an electronic pen.

Volunteers are solicited from the first group to use the SMART Board and report on their findings. Often there are two or three volunteers who will demonstrate, while the students who remain in their seats are told that they need to help their colleagues at the screen to answer the questions. Volunteers usually wish to explore the screen, which can lead to classroom disorder. The instructor is somewhat forgiving, allowing students presenters to enjoy the screen, but keeping them on task.

As students continue with their reports, the instructor serves as a technology aide, and, when necessary, a keyboard operator. The instructor also suggests different ways of answering questions and has students use the SMART Board to explore and demonstrate those alternatives. Members of a reporting group who are uncomfortable in front of their classmates are offered a Bluetooth-enabled keyboard and mouse, allowing them to report from their table instead.

Disadvantages

There are two major concerns regarding the method of instruction described above: time constraints and classroom control. This manner of active learning, with group work, sharing, and time for technological exploration, is more time-consuming than straight lecture/ demonstration. It should be used judiciously to achieve the benefits listed above, in order to vary the pace and activities within a class, and to reach students with a variety of learning styles. Group work and SMART Board reporting may be beneficial for certain classes and when there are affective learning goals like those noted above.

During SMART Board sessions, the classroom can be noisy and active, and there can be general disorder during the reporting phase. However, it is important for instructors to remember that learning is still taking place. The ability to give up a measure of classroom control is essential for SMART Board

instruction to work. Co-teaching a class with someone familiar with this method, or taking a deep breath and trusting the process, can be beneficial.

BENEFITS

Along with SMART Board technology, the classrooms in PSU Library also include round tables for students, which encourage small group work. Since the benefits of group work are well documented in the literature, the author will discuss only those that also include the use of SMART Board technology. Smith et al. suggest many of these advantages:

> *We would argue that the uniqueness and the 'boon' of IWB technology lies in the possibility for an intersection between technical and pedagogic interactivity; in other words, in the opportunities this technology holds for collective meaning making through both dialogic interaction with one another, and physical interaction with the board.* (Smith et al., 2005, p. 99).

When groups of students are given an assignment and told that they have ten minutes to complete the task and prepare for a class report, it engenders a sense of group responsibility. Students must interact with other group members, and peer pressure keeps them on task. The peer learning that ensues is a way to overcome gaps in individual knowledge and skill. One student with a strong analytical ability can help frame the problem, another with good language skills can come up with appropriate search terms, and another with good technology skills can navigate a database. Because students know they will be reporting back to the class, not only do they have to answer the questions involved in their scenario, they also need to master the skills involved well enough to teach them. The learning is affective; students can see their skills and knowledge valued by peers as they also begin to value those traits in others. Students begin to regard one another as teachers.

Reporting at the SMART Board reinforces affective learning. Because it is fun, exciting, and a bit edgy, students' emotions are heightened during the reporting phase of the session. The learning activity serves as an icebreaker and gives students time to work through library anxiety. The library is seen as a lively, active place that encourages collaboration. Because students are presenting their findings at the front of the class using a high-tech device, their peers recognize them as teachers and see the librarian acting in a supporting role. As team members at a table need to support their representative(s) at the SMART Board, the rapport between group members is strengthened. For many of them it is a first introduction to a college librarian, and librarians are seen, at least partially, as supporting them in their endeavors. This positive role carries forward as students encounter librarians at the reference desk or in individual research consultations.

The instructor also benefits from instruction that includes group work and SMART Board technology. During library instruction sessions, the instructor is no longer the center of teaching, but rather the facilitator of students' learning. Though the instructor spends more time on instructional design, there is more time in class to learn and discover with the students not only what they are learning, but also how they are learning. This also affords the instructor opportunities for pedagogical research.

CONCLUSION

College freshmen in the author's classes react to the IWB in the same manner reported by studies highlighted in the literature review. Wall's study (2005) and the BECTA report (2003) showed the IWBs were able to catch students' attention and motivate them, while the Hall (2005) and Gerard (1999) studies showed that students' emotions were heightened, and that they enjoyed the playful aspects of the IWB. Some of the studies Jones summarized (2004) also make clear that the IWB affords many more opportunities for interaction and social learning in the classroom. In a report evaluating the use of IWBs in secondary school mathematics

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instruction, Miller and Glover note:

> *One of the greatest gains for IAW [IWB] use is that it can prompt and sustain pupil interaction in a way that exceeds that normally following traditional board use. Teacher comments support this assertion – 'More enthusiasm – you hear positive remarks made by the pupils as they are surprised by what they have just seen'…'Those students who used to be on the sidelines of the whole class teaching experience are brought more into the whole group learning experience – they are watching the screen and following the discussion more.'* (Miller & Glover, 2006, p. 11)

To date there have been no systematic studies of the effect of IWB use in college classrooms, yet there are many potential advantages for student learning suggested by the studies of lower-level students. Some areas for further study suggested by earlier IWB researchers focus on the kinesthetic affordances that IWBs might offer in classrooms. Areas to look at include student activity, making the learning process more vivid and memorable, and ability of theatrical tension (caused by students reporting to their classmates) to add excitement and possibly lead to more memorable learning experiences (Davison & Pratt, 2003, p. 31).

In library instruction sessions taught by the author, evidence suggesting that the IWB has a positive influence on student learning is anecdotal. There are other factors that may have an impact on student motivation and engagement, such as the availability of laptop computers for every student and the implementation of collaborative learning activities. The development of an instrument to measure and assess the impact of instructional methods, including the IWB, would benefit the author and be a useful addition to the literature.

Anecdotal evidence from this case study, accompanied by findings from the studies noted above, do seem to indicate that IWBs and the activity they encourage can positively influence affective learning in the classroom. Some researchers still do not value learning in the affective domain as highly as learning in the cognitive domain, as indicated by the reference to "surface features" in the following quote: "Research to date suggests that teachers and pupils value the surface features of the IWB associated with pace, motivation, engagement, involvement, participation and collaboration" (BECTA 2003). However, it is not clear that attention to such "surface features" of interaction will result in improvements of student learning (Tanner, 2005, p. 726). As colleges and universities continue to use IWBs, more studies will be needed to investigate the cognitive and long-term effects of this technology in the classroom.

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APPENDIX

Freshman Inquiry – Einstein's Universe

Scenario 1

A member of your research team said she found a lot of great citations to articles in a journal called *The English Historical Review*. She's like you to find out the answers to the following questions:

Does our library own this journal?

What years can you find in print in the library?

What years can you find in microfilm in the library?

What years can you access online, and what are the databases called?

Scenario 2

Being somewhat of a scientist yourself, you want to perform an information experiment on the Library Book Catalog . You will search on permutations of "Einstein".

Do a *subject search* for "Einstein".
1. How many related subjects did you find?
2. How many books did you find?

Do an *author search* on "Einstein".
3. How many books did Albert Einstein write?

Do a *keyword search* on "Einstein".
4. How many books did you find?

5. Which is the better search?

Scenario 3

Your classmate recommended a book of love letters that Einstein wrote to a woman named Mileva Maric.

1. Does our library own this book?

2. What is the call number?

3. Is it available for check out at this time?

4. What floor of the library is it located on?

Scenario 4

You want to follow up a bit on the letters between Ms. Maric and Einstein. You go into the *Academic Search Premiere* database to search.

Find an article in *Physics Today* (1994) that deals with this topic. Can you print out the full text of this article?

Find the citation to an article from the New York Times in 1996. Is this article available in this database full text?

If not, see if you can find it in another database (Hint: click on the words "Check the Library Catalog")

Scenario 5

Your instructor said that there might be valuable information on your topic (Einstein) in a database called *America History and Life*. You go to the *America History and Life* database and do a subject search on Einstein.

How many article citations did you find?

Find an article that you can link to directly from this database.

Find an article that isn't full text in the database, but that our library owns (either in print in the library or in another database of articles. (Hint: click on the "Library Links" button).

NOTES

1. There were also many case studies on IWBs at the Smart Technologies website at http://www2.smarttech.com/st/en-US/Case+Studies/Search+case+studies.htm. They were not considered in this literature review as they were not independently reviewed.

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