

**“Lecture” with Interaction in an Adult Science Methods Course-Session:
Designing Interactive Whiteboard and Response System Experiences**

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Abstract

The current article addresses adult learning theory synthesized with higher educator use of interactive graphical interface, via the interactive whiteboard (IWB) and interactive response system, to provide an educational design framework for moving the traditional direct instruction “lecture” cognitively and kinesthetically to an interactive inquiry-based experience. To off-set retention of information issues experienced in lecture format/direct instruction presentations and the typical absence of immediate application of skills and content addressed, the authors designed an interactive science methods presentation with IWB software for instruction within a science teaching methods course for undergraduate students. Educational design principles are addressed for creating the interactive presentation and a visual portrayal of the IWB slides are included. Challenges and questions for further consideration are identified.

Introduction

Higher education or Teacher education faculty have wrestled with the problem of facilitating understanding of course content for large groups of students to the degree that they can transfer the content addressed. Despite the fact that most preservice teachers can be defined as digital natives (Prensky, 2001), Kleiner, Thomas, and Lewis discovered that most teacher education programs do not adequately prepare teachers to infuse technology into their classrooms upon graduation. Prior to prompting students to apply content, educators must consider ways to enhance content presentations, or lectures, to include: active learning (Brookfield & Preskill, 2005; Hinde & Kovac, 2001; Ebert-May & Allred, 1977; Williams, 2008); interactive components requiring collaboration (Sutcliffe, Codgell, Hansel & McAteer, 1999); and problem solving opportunities (Browne & Blackburn, 1999). Science methods

courses in teacher education contain the dual challenge of facilitating content-area information that is then applied to inquiry-based teaching strategies for K-12 students. The current paper addresses an educational design framework, “Lecture with Interaction” that contains direct instruction components for the distribution of key course-session science content but weaves collaboration, problem-solving and interactivity into the experience using presentations authored with SmartNotebook software for the Interactive Whiteboard.

A “New” Literacy with a New Technology

While many educators have focused on IWB technology merely for the “bells and whistles” so inherently attractive to so many, we have leveraged a literacy strategy derived from writer’s workshop (Graves, 1983) called “mini-lesson.” Writer’s workshop as Graves defined it provides teachers with a framework for facilitating student writing in a recursive (or cyclical) and discrete manner (specific stages of writing are: brainstorming, drafting, revising, editing and publishing). According to Graves the mini-lesson is used by the teacher to address student needs as they occur in the writing workshop in any stage of writing. For example, a mini-lesson topic might be “how have you developed sub-plots from your major plot”? The mini-lesson is fluid in that the teacher and students can identify problems, define them, discuss and then put new understandings in the next round of writing. In our sensibility, we have taken the notion of the mini-lesson and applied to an undergraduate science methods course session where students are assigned an activity, experience an IWB presentation/discussion structured by the professor in the same manner that a mini-lesson would be fashioned in a writer’s workshop. What misconceptions might students have related to the science activity? What content can we present and interact around to address those misconceptions? The mini-lesson strategy functions to

anchor and focus our use of the motivational and attractive technological features of IWB in a way that points us to dynamic interactivity and discussion of content.

IWB Software and Hardware Description

Similar to PowerPoint, IWB software supports presentation authoring with all of the typical tools available in most software products. For the current article, the authors used SmartNotebook v. 10 presentation software for the IWB but there are a plethora of similar and competing products that would suffice (<http://www.fsdb.k12.fl.us/rmc/tutorials/whiteboards.html#brands>). The main distinction between IWB authoring software and other presentation software is that the IWB software contains tools allowing you to easily program interactivity. Students then can literally get out of their seats, approach the IWB at the front of the room and click and drag items on the board and/or click items that play audio, video or other types of files. This would take the place of raising your hand to speak as now the student raises their hand, speaks, and physically demonstrates a point by placing an item/s in a two-dimensional location. This interactivity can also involve a small-group manipulating the IWB in front of the large group thus empowering the individual or small-group with an audience for demonstrating their thinking.

An IWB is an interactive display roughly 3 x 5 feet that connects to a computer and LCD projector. Similar to a regular LCD project the IWB projector beams the computer's desktop onto the board's surface and supports user control of the computer using a pen, finger or other device by touching the IWB and not the computer. The board is typically mounted to a wall or on a floor stand in the same general location that a chalkboard or chart paper stand would be (see Figure 1. Interactive whiteboard).

Figure 1. Interactive whiteboard.



Note: Projector location can vary from wall to ceiling mounts.

Smith, Higgins, Wall and Miller (2005), in their meta-analysis of IWB use in educational settings, signaled the need for establishing a consensus on effective teaching and learning prior to a focus on leveraging the bells and whistles of the technology. Given this sentiment, the authors created a presentation incorporating collaborative, active and problem-solving components to teach the science content of the water cycle in a teacher science education course. The interactive presentation, in juxtaposition to the traditional lecture, thus included supporting a large group of students in their interaction within the presentation as if it were a more intimate and collaborative setting.

An additional component supported by IWB is the Interactive Response System (IRS) that consists of remote control units for all students. Guthrie and Carlin (2004) found that use of

IRS can increase motivation during those moments when passivity can set in during direct instruction by the professor. The IWB author can build in response prompts, essentially seeking whole-group reactions, that ask the respondent to vote in response to a question placed on the board. Instantaneously the IRS tabulates student responses and visually portrays the summary of responses on the IWB. IRS use can incorporate collaboration provided that questions to the whole-group are preceded with prompts such as “prior to answering this question, discuss with your small group what your current thinking is.” IRS can also be used by the professor to conduct quick assessment checks either as an initial exercise to better inform the rest of the course session or as closure to ascertain effectiveness of instruction.

Course Session Student Characteristics: Pre-Service Teachers

The students in this course session consisted of teacher education majors, referred to as “teacher candidates” or “pre-service teachers.” Many preservice teachers are what Prensky (2001) defines as digital natives. That is, they grew up “surrounded by and using computers, videogames, digital music players, video cams, cell phones, and all the other toys and tools of the digital age” (p. 1). These students need to be taught how to integrate the multiple literacies with which they are so familiar into their own teaching to better address the students whom they will teach. Research (Eakle & Alvermann, 2006 as cited in Alverman & McLean, 2009; Hague & Mason, 1986; Hull & Zacher, 2004; Prensky, 2001; Tierney, Bond, & Bresler, 2006) documents that when students are involved in using out-of-school literacies that use digital media, they are more engaged in the learning process. Too often in-school literacy tasks do not mirror the ways that students use literacy in their everyday lives (Dunston & Gambrell, 2009). When allowed to use these multiliteracies, a term coined by the New London Group (as cited in Sylvester &

Greenidge, 2009), in school and university settings, students can find new “respect for classmates and their opinions, understanding work team dynamics, and using them for high-quality outcomes, taking turns, recognizing the different learning that can occur in the collaborative and cooperative context” (Afflerbach, 2007, p. 170). In addition, the Partnership for 21st Century Skills (2003) identified learning skills relevant for students who will job-search with individuals in a highly competitive global society, or flattened world as described by Freidman (2005). The Partnership described three discrete categories of skills: information and communication skills, thinking and problem-solving skills, and interpersonal and self-directional skills. For future teachers and students to be successful, Pensky (2001) offers powerful advice in his statement—“we need to invent Digital Native methodologies for *all* subjects, at *all* levels, using our students to guide us” (p. 6). The IWB Interactive Lecture model provides teacher preparation educators with methodology for developing content knowledge and pedagogical knowledge, as well as provides pre-service teachers with content knowledge and pedagogy.

Designing Interactivity for Content “Presentations” (or Interactions)

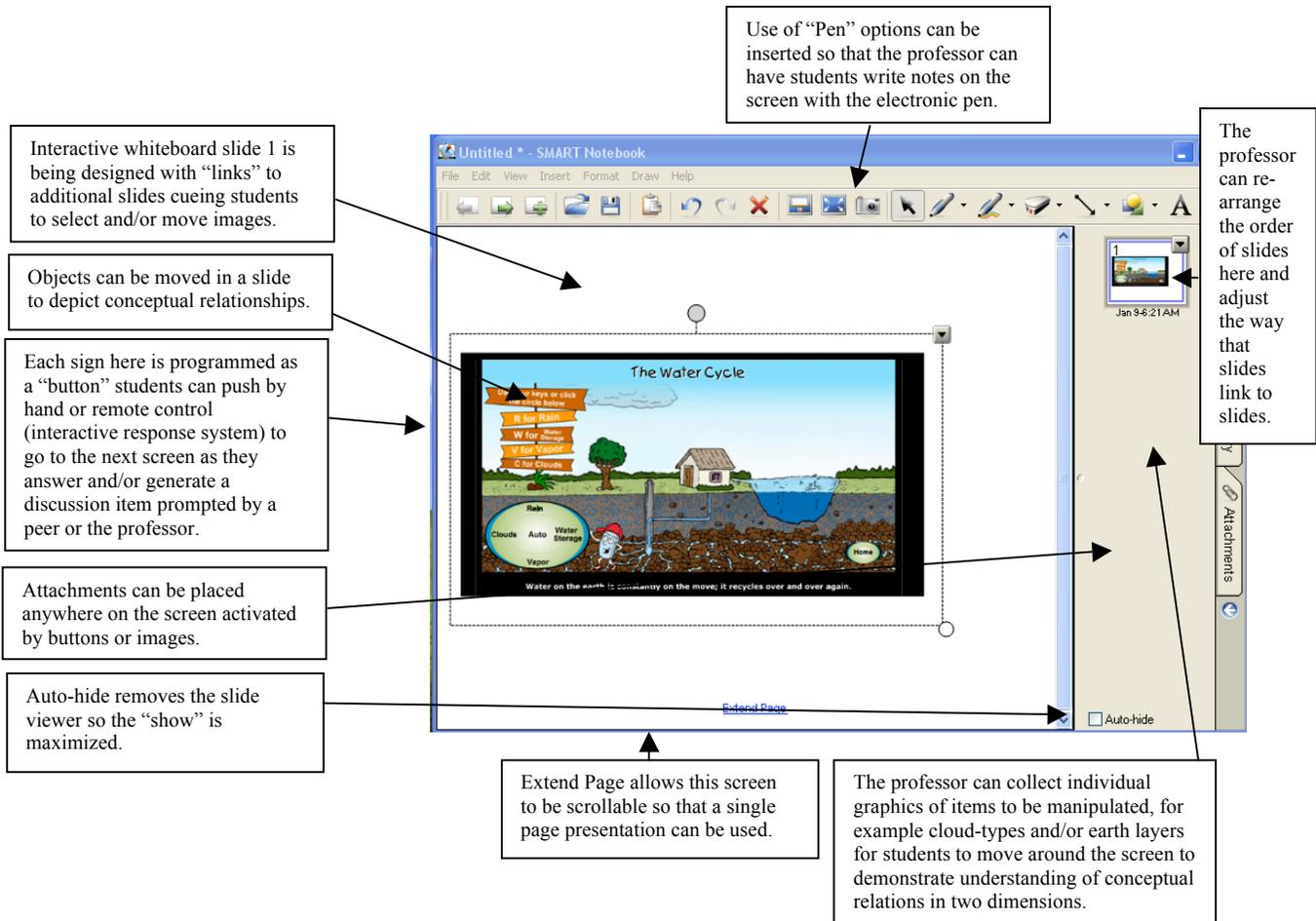
The authors designed a “presentation” with interactivity (see Hake, 1998) addressing water cycle science content prior to having students conduct an inquiry-based scientific experiment to facilitate their content-area knowledge within an inquiry-based learning paradigm (See Figure 1.2. IWB Sample Screen with Explanations). To “practice what we preach” we transformed the lecture-presentation into an intimate discussion involving individual, small-group and whole group exchanges of information, movement (student manipulation of concept facts on the IWB) and discussion. To align our need for increasing our students’ science content knowledge in a “presentation” we thus mirrored inquiry-based science tenets summarized by Thier (2000):

- Introduce content with open-ended questions and/or demonstration as opposed to listing definitions and explanations;
- solicit responses and subsequent questions from students.

In addition to the IWB experience we transitioned to conducting a water cycle experiment to follow-up on our initial discussion and this experience included additional elements recommended by Thier:

- have students conduct experiments following the scientific process involving hypothesizing, data collection and analyses;
- conclude with a re-evaluation of information addressed during the presentation of the water cycle science content;
- and have students present findings as an oral presentation or write-up (in our case we could have them express their result with IWB authoring).

Figure 1.2. IWB Sample Screen with Explanations.



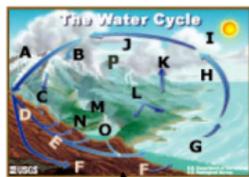
Note: Screenshot of software with Environmental Protection Agency public domain image inserted for Interactive Whiteboard experience.

A Science Education Higher Learning Course Session: Use of IWB

For the current course session the objectives were to facilitate adult students' understanding of the science of the water cycle system and processes and to learn how K-12 students might respond while conducting a hands-on experiment. The first part of the session consisted of a hands-on activity followed by the IWB presentation. An interactive presentation was designed for the IWB consisting of public domain images from the United States Geologic Society. On the IWB we placed an empty chart illustrating water cycle elements and then

included a list that corresponds to certain illustration elements. For example “Precipitation” would need to be touched by a student and dragged the appropriate area of the illustration. Students could hypothesize where a word or term fits on the illustration and then the group discusses the merits of the “idea.” Another student might move the word “Precipitation” to another area of the illustration presenting a new viewpoint. The professor can step in it time to transition to the next set of concepts and either provide the correct answer or allow them to continue with misconceptions until the students have more information from which to generate understandings that replace the misconceptions. (See Figure 1.3. Conceptual Relations-Connecting Water Cycle Elements with Descriptions).

Figure 1.3. Conceptual Relations-Connecting Water Cycle Elements with Descriptions.



Storage in ice and snow
Precipitation
Snowmelt runoff to streams
Infiltration
Ground-water discharge
Ground-water storage
Water storage in oceans
Evaporation

Touch a word/term and drag it to the correct location on the chart.

Conceptual relations: having students touch and drag images to boxes demonstrating their conceptual awareness of the content. Peers can click with their remotes to indicate agreement or disagreement.

Teacher Education Students' Apply Content Knowledge in Hands-on Experiment

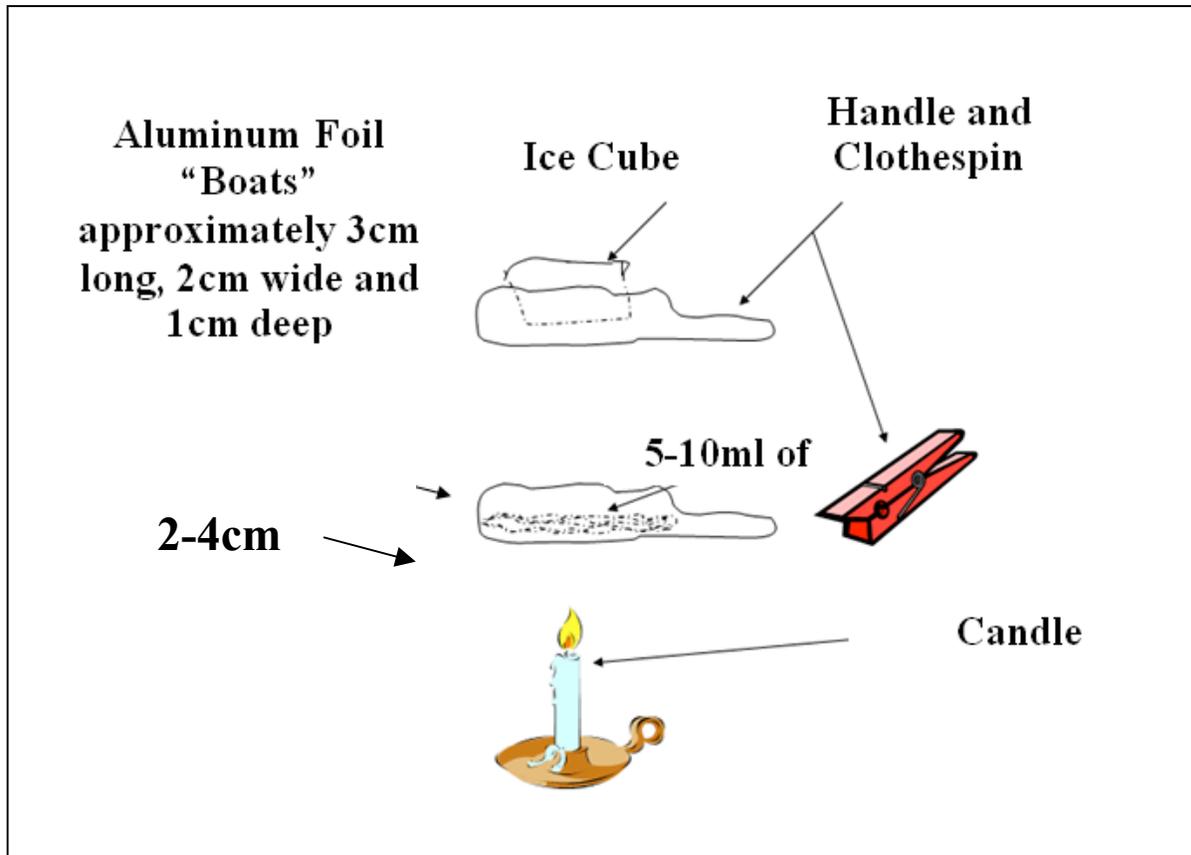
Science education methods coursework usually include extensive opportunities to conduct experiments across many branches of science and for this session students experienced a hands-on experiment suitable for their future K-12 students. See Figure 1.4 (Water Cycle Activity Teacher Education Students Learn to Teach) and Figure 2 (Condensation IWB Post Activity).

After conducting the experiment an extension to this course session might include the requirement that the teacher education students author an IWB presentation for K-12 students using similar design principals discussed above. The high prevalence of IWB systems in K-12 schools dictates that future teachers learn educationally sound ways to use the technology in their teaching and to think of how student-generated work might take advantage of the technology.

Figure 1.4. Water Cycle Activity Teacher Education Students Learn to Teach

<p><u>Materials</u></p> <ol style="list-style-type: none">1) Two pieces 5 by 10 cm pieces aluminum foil2) One clothes pin3) Cube of ice4) Small amount of water5) One candle6) One match <p><u>Procedures</u></p> <ol style="list-style-type: none">1) Place cube of ice in one of the aluminum boats2) Place 10 ml of water in one of the aluminum boats3) Light candle and support on table upright4) Hold aluminum boat that has water with a clothes pin just above candle flame5) Hold aluminum boat with ice cube directly above aluminum boat with water approximately 2 centimeters.6) Observe bottom of boat with ice cube and inside of aluminum boat with water7) Record observations on back of page <p><u>Question</u></p> <ol style="list-style-type: none">1) What water cycle concepts are you observing?2) As a group develop a possible explanation for your observations3) What does this activity parallel to in nature?4) Where is the water on the bottom of the foil coming from? <p><u>Reflection Type Individual Questions</u></p> <ol style="list-style-type: none">1) How was math used in this activity?2) What NSE standard and grade level would this activity match?3) Is this a practical activity for the grade level you teach if not why?
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Figure 2. Condensation IWB Post Activity.



Note: The IWB post activity depicted here represents an opportunity for the instructor to have students move the above pictures to their corresponding images (not shown) such as the candle would be moved next to the sun in the illustration of the water cycle. This follows inquiry-based learning (IBL) espoused by science educators. The expectation is that students first experiment to experience the phenomena with the materials and then conceptualize with their newfound knowledge gleaned from the experiment.

Conclusions

Teacher preparation faculty or higher education faculty who teach adult learners can leverage IWB and IRS technology in many ways to increase student motivation, interest and participation-all functioning to make the traditional direct instruction "lecture" more interactive. In the case of this article, an inquiry-based science methods experience was preceded by the IWB presentation to build students content knowledge without lecture. The mere expectation of having students move up to the front of the group to express their ideas by manipulating images

and words on the IWB move students from passive listeners to active participators.

Incorporating the IRS to assess student understanding instantaneously is also a powerful teaching and assessment tool. Students' misconceptions about the water cycle could be resolved either in the interactive presentation or during the hands-on science experiment follow-up activity.

Clearly, there are numerous ways to use IWB and as educators of teacher education students, who advocate inquiry-based learning, we set out to resolve issues faced by educators during whole-group presentations. We recommend that researchers evaluate various educational design concepts to inform educators of key principles they must follow to take advantage of the tools.

The success of integrating the IWB/lecture in a method's course has the researchers currently involved in developing research strategies that measure achievement increases using IWB over more "traditional" presentational (e.g., Power Point) software uses. Currently, anecdotal data is the only evidence researchers have attained to attest to the effectiveness of incorporating IWB into a science methods course. Both quantitative and qualitative strategies are being considered by the researchers for future implementation and analysis. Specifically, a quasi-experimental study where achievement levels between a control group using traditional presentational software and a IWB treatment group is being considered. Furthermore, a longitudinal based study to determine if IWB skills picked-up in a methods course is transferred and continually used over time in a k-12 classroom is being proposed.

Funding for the development, implementation and field testing of a curricula that focuses on using IWB in multiple content areas is currently being sought. Upon completion of the curricula, researchers want to disseminate IWB uses and success stories through the development of a web site and curricula booklet. Furthermore, additional dissemination at professional

conferences in the content areas where IWB use has been deemed a success is being proposed.

Organizations such as the National Science Teachers Association for curricula dissemination and the National Association for Research in Science Teaching for research findings are subject specific areas for proposed dissemination. The International Society for Technology in Education through conference and/or book development is another logical avenue for dissemination of an IWB based curricula.

Key Design Principles for Educators

The following design principles were applied in this teaching case description and recommended for educators as they not only use IWB but author presentations involving interactivity:

1. Infuse combinations of text and graphics that are programmed to be manipulated in two dimensions (e.g. in Figure 1.3 students had to touch, drag and place water cycle concept facts on the water cycle illustration to demonstrate concept).
2. Organize cooperative groups (3-4) to discuss their ideas prior to prompting them to depict their understanding to the whole group when they manipulate the IWB presentation.
3. Leave questions open and unanswered, to instill an inquiry-guided experience (in the current case, we had the students conduct an experiment with water condensation to further investigate concepts related to understanding the water cycle).
4. Foster the disposition in students of accepting multiple viewpoints as “ideas” are manipulated in two dimensions on the IWB.

5. Lastly, empower learners with assignments involving them to author their own interactive IWB presentations-they too can avoid being the “sage on the stage” during their presentations.

Design notes for inquiry-based learning (IBL) espoused by *science educators*:

1. Student exploration, in the form of conducting experiments, precedes the IWB demonstration to provide them the opportunity to learn phenomena associated with the scientific method.
2. Thus, the introductory presentation would not take place when strictly applying IBL.
3. Student-generated IWB presentations, following experiments, would demonstrate understandings and even guide the instructor in developing extensions or enrichment activities.
4. See the “5E” IBL model for further reading:

<http://faculty.mwsu.edu/west/maryann.coe/coe/inquire/inquiry.htm>

Resources for Educators Learning IWB

Interactive Whiteboard Tutorials (K-12 but applications for higher education as well)-

<http://www.fldb.k12.fl.us/rmc/tutorials/whiteboards.html>

<http://www.waukesha.k12.wi.us/WIT/SmartBoard/specificapps.htm>

IWB Flash Examples-

<http://www.amblesideprimary.com/ambleweb/mentalmaths/protractor.html>

http://teams.lacoe.edu/documentation/classrooms/amy/geometry/6-8/activities/quad_quest/quad_quest.html

Interactive Whiteboard Tools-

<http://www.shambles.net/pages/staff/intwhiteb/>

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