120th ASEE Annual Conference & Exposition
FRANKLY, WE DO GIVE A D*MN
June 23-26, 2013

Paper ID #8025

Supporting K-12 Teachers that Want to Build Their Own Do-It-Yourself (DIY) Interactive Digital Whiteboards

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Abstract

While some K-12 teachers in the U.S. have been given access to interactive digital whiteboards in their classrooms, many others have not. In this paper, we examined a case study in which a teacher built a do-it-yourself (DIY) interactive whiteboard so that he could teach middle school mathematics in Ciudad Juarez, Mexico. Using this case study as a model, a group of two teachers were provided with the materials and supports necessary to build their own do-it-yourself (DIY) interactive digital whiteboards, similar to those sold by commercial companies such as SmartBoard and Promethean, but at a small fraction of the price. Unique components of each teachers experience were described, and then the teachers were compared on individual components of the process. The case studies demonstrated that each teacher had unique facets to their experience, but there were also common features. These differences helped illustrate what idiosyncratic frustrations might occur during the DIY interactive digital whiteboard building process. The common features point to a possible roadmap of expectations regarding other similar undertakings by teachers to build a DIY interactive digital whiteboard.

Introduction

While some K-12 teachers in the U.S. have been given access to interactive digital whiteboards in their classrooms, many others have not.[1] This paper describes a proposed line of research inquiry addressing this problem, as well as the results from a pilot study that was conducted in order to determine if the proposed line of research is feasible. In this proposed line of inquiry we intend to examine K-12 teachers building and using do-it-yourself (DIY) interactive digital whiteboards similar to those sold by commercial companies such as SmartBoard and Promethean, but created at a small fraction of the price. Through this line of inquiry we will address the research questions of:

1. What are affordances and constraints of K-12 teachers making DIY interactive digital whiteboards for their classroom?
    a. What aspects of making DIY interactive digital whiteboards were most successful in terms of teacher reports of feasibility and impact on outcomes of interest?
    b. Which aspects of making DIY interactive digital whiteboards were the least successful and instead the most difficult in these areas for teachers?

2. What supports would be optimal for guiding K-12 teachers in the development of their ability make DIY interactive digital whiteboards for their classroom?

a. Were there changes in teacher attitudes toward instructional technology, including perceived value, confidence in using educational technology, and interest as a result of making DIY interactive digital whiteboards? Were there differences in these areas between teachers who participated in these activities compared to teachers who used traditional whiteboards?
b. What instruments are most reliable and feasible in measuring the constructs of interest with the population of interest?

This present paper will describe the completion of a pilot study that was designed and undertaken with the intention of jumpstarting this line of inquiry by gauging feasibility of the intervention. Specifically, this pilot study examined a case study where a middle school teacher working in Juarez, Mexico built a do-it-yourself (DIY) interactive digital whiteboard to support the teaching of mathematics to his students. [Note: This teacher is also a Ph.D. candidate in an educational technology program, and a co-author of this paper.] Although a few of the teachers at his school had commercial brandname SmartBoards, he was not in on of the classrooms where they were installed. This paper then discusses two cases of teachers in Texas who built their own DIY interactive digital whiteboards with the support of the original teacher described in the first case. The first participant who was supported was a male preservice elementary teacher studying to receive a Master's degree in social sciences, and the second participant who was supported was a female inservice elementary teacher studying to receive a Master's degree in educational administration. The participants undertook the intervention at an educational technology research laboratory located within the college of education at a southwestern university in the United States. The activity consisted in learning how to build a DIY interactive digital whiteboard. Both were provided with the materials and supports necessary to build their own DIY interactive digital whiteboards, similar to those sold by commercial companies such as SmartBoard and Promethean, but at a small fraction of the price. Based on the data collected from the current and future elementary teachers who participated in the pilot study building their own DIY interactive digital whiteboards, implications for the design and development of support materials for other teachers desiring to build their own DIY interactive digital whiteboards are presented, as well as an assessment of the feasibility of the larger line of inquiry proposed.

Background and Significance

Technology is part of our daily lives and it advances quickly, consistently introducing new products into the marketplace. Students, teachers, and parents are all consumers of these technology products, and schools are often actively encouraged to incorporate technological tools into their classrooms. Researchers in the field of educational technology sometimes investigate how budgets for technology are being spent by schools, and if their choices for what to purchase an effective utilization of limited funds. Dessoff (2011)[2] recognized that "under pressure to keep spending down but also keep pace with rapid technology changes, many districts are future-proofing their schools—trying to get the most out of tech spending by providing solutions they can use now and in the future without major, expensive infrastructure overhauls" (p. 46). Implementation of budgetary decisions for purchasing educational technology oftentimes reveals the

answers to concerns about the advantages and disadvantages of particular technologies in classrooms, and the news is not always positive. Some educational technologies have demonstrated value as teaching tools, while other educational technologies appear to have affordances pertaining mostly to classroom management but not necessarily pedagogical aims.[3] For these reasons and others, access to technology does not always translate to improved student performance.[4]

Interactive digital whiteboards, such as the brandname SmartBoard and Promethean, are one of the educational technologies that seem to show promise for providing both pedagogical and classroom management affordances to a classroom.[5] In one recent study, more than half of current U.S. math and science teachers surveyed reported that they had used interactive digital whiteboards.[6] However, one obstacle to widespread adoption of interactive digital whiteboards is the expense of the equipment, which can run into thousands of dollars. Further, without commitment from a teacher interested in using the interactive digital whiteboard properly, many remain either unused or are being used as very costly dry-erase boards.[7] Fortunately, recent technological innovations have made it possible to build a do-it-yourself (DIY) interactive whiteboard for a fraction of the price of the professional brandname models. The process requires that you already have a computer with a projector, with the only additional hardware equipment required specific to the interactive whiteboard being a Nintendo WiiMote (or a knockoff such as that made by GigaWare) and an infrared LED flashlight. Software is provided free and open-source from designer Johnny Lee, and is available for both PC and Mac. DIY interactive whiteboards have advantages such as their low-cost (approximately $40 for the WiiMote and IR LED flashlight), reduced maintenance and service costs sometimes associated with other brandname interactive whiteboards, quick installation, and easy mobility from one classroom to another.

Schools across the United States are trying to provide their students with learning environments where educational technology is an active component of the classroom. Interactive digital whiteboards show strong potential to be a useful and affordable addition to these learning environments, adding a new level of interactivity to digital multimedia tools including computers and projectors. DIY interactive digital whiteboards give a new set of instructional strategies and techniques to teachers who might otherwise not have access to this educational technology, which might have impacts on students' classroom participation, motivation and collaboration. Effective building and use of DIY interactive digital whiteboards by teachers in classrooms can be supported through the design, implementation, vetting, and assessment of appropriate supports for those teachers interested in participating in this endeavor – and this research proposal describes a line of inquiry designed to specifically address this undertaking.

Research Design

This pilot study performed an assessment of the feasibility of a line of inquiry investigating teachers' experiences building and using DIY interactive whiteboards and potentially other related teaching tools (such as DIY interactive clickers and DIY document-cameras). This line of inquiry will be aimed to assess how such DIY teaching

tools might stimulate teachers' interests and motivation to develop novel ways to teach using innovative educational technologies. The participants in the pilot study assessing feasibility of the intervention were provided with the materials and supports necessary to build their own do-it-yourself (DIY) interactive digital whiteboards, similar to those sold by commercial companies such as SmartBoard and Promethean, but at a small fraction of the price. The broader research agenda will be iterative in nature with results from the first phase informing design and implementation of the subsequent phase. This larger agenda will include two phases, and each of the two phases will be the subject of at least one study, and might contain two studies with one journal article having a qualitative focus and one journal article having a quantitative focus. An outline of our working plan for the two phases of this research agenda is presented below, followed by a description of the activities in each particular phase, as well as a depiction of the corresponding research studies.

PHASE I: Spring 2013 (1/15/2013-4/30/2013) --

- Initial testing of the intervention activities with teachers.
- Validation of the instruments for assessment and gathering participant feedback.
- Revising intervention activities and implementing redesigned activities with second sample of teachers.
- Gathering data on outcomes of interest and participant experiences.

PHASE II: Fall 2013 (9/1/2013-12/31/2013) --

- Repeating the intervention activity with final version of instructional design.
- Assessment of teachers' beliefs, attitudes and ability to build DIY interactive digital whiteboard and teachers' interests and motivation to develop novel ways to teach using innovative educational technologies.

Phase 1: In the first phase of the project (Spring 2013) the research team will design, develop, and test a set of prototype activities that support teachers in the effort to build a DIY interactive digital whiteboard. Validated and well established instruments measuring teachers' attitudes toward and interest in educational technology (Survey of Teacher's Attitudes Toward Information Technology and the Survey of Teacher's Attitudes Toward Computers) will be administered at the onset of the intervention and then again at the end of the intervention to measure changes in these constructs of interest. At the mid point and conclusion of the intervention, the participating teachers will be asked to describe their perceptions of the supports and activities and the parts of the lessons they enjoyed the most, the components they found the most. Vetting of the lessons and continued analysis of the instruments will be performed after analysis of video, interview, and survey data, with the goal of selecting lesson components that were received favorably by the teachers, and that are open to further revision and improvement. This phase will produce both quantitative studies that focus on changes in the survey data and a qualitative study that describes the lessons and teacher perceptions of their experiences.

Phase 2: After performing revisions based on the teachers' feedback received in phase 1, our research team will then spend the second phase of our study (Fall 2013) implementing the lessons with a new set of participants. One section of teachers will

experience learning to teach with a commercial-brand interactive digital whiteboard, while another section will experience learning to build and teach with a DIY interactive digital whiteboard. The addition of the control group into the research design at this phase will allow our research team to reach more definitive conclusions about the relative impact. At the beginning and end of the intervention, all participants will complete the same (possibly slightly edited) instruments measuring their attitudes toward, interest and engagement in, educational technology. Research articles written based upon this phase will focus on changes in these constructs of interest within and between the experimental and comparison groups.

This paper will now discuss the conditions under which the pilot study testing the feasibility of the intervention was conducted, including information about the participants, the data collection, the findings, and the limitations and future research.

Participants

Participants for the pilot study were recruited from a college of education, and all participants were either current or future teachers interested in educational technologies. These students generally range in age from 18 to 40, and are predominately female Hispanics. Criteria for inclusion include: currently a K-12 teacher or undergoing certification to become a K-12 teacher, and have an interest in innovative but affordable educational technologies.

Data Collection

The pilot study described in this paper focused upon a description of the application by a preservice elementary teacher and an inservice elementary teacher of the online resources and supports provided to assist them in building a DIY interactive whiteboard. This was performed so as to assess the feasibility of an intervention to be utilized in a larger line of inquiry. The research team video recorded the activities, collected written field notes, and at the end of the activities a short interview took place asking the participants about their reactions to the intervention. The findings from this pilot study are primarily intended for the purpose of determining implications for the design and development of support materials for other teachers desiring to build their own DIY interactive digital whiteboards are presented, should the intervention be determined to be feasible.

As a discussion of data collection methods that will be utilized in the larger line of inquiry, it is planned that data collection for this line of inquiry will include task based interviews, questionnaires, surveys, focus groups, and observations. *Task based interviews:* Task-based interviews will take place at the beginning and end of the intervention. A sampling of teachers will participate in task-based clinical interviews. Teachers will be presented with tasks then asked to think aloud as they work through the tasks. All task-based interviews will take approximately 20-25 minutes. *Questionnaire / surveys:* Attitudinal questionnaires and surveys about technology and creating DIY technology tools will be completed at the beginning and end of the intervention. Teachers will compete the “Survey of Teachers’ Attitudes Toward Computers” and the “Survey of Teachers’ Attitudes Toward Information Technology” as well demographic surveys

questions. *Focus groups:* A sampling of teachers will participate in focus groups. The focus group will occur during instructional time. A semi-structured protocol will be used for the focus group. Focus groups will take approixmately 45-60 minutes. *Interviews:* The purpose of the teacher teachers interviews is to gain insight into their perceptions about the DIY activities and their attitudes about technology as a result of learning how to use the SmartBoards. The teacher interview will follow a designed protocol and occur during instructional time. If deemed appropriate, follow-up interviews will be used to clarify responses. The teacher interviews will be audio-recorded and the teachers will be asked to verify a summary of their responses to the questions. *Observations:* Some instructional observations will be performed during the project to gauge how teachers are implementing the whiteboards and interacting with them.

Findings

Interactive whiteboards (IWB) are regarded as one of the most revolutionary instructional technologies for various educational levels.[8] In this paper, we examined a case study in which a teacher built a do-it-yourself (DIY) interactive digital whiteboard so that he could teach middle school mathematics in Ciudad Juarez, Mexico. The teacher wanted this educational technology because he was convinced that this instructional tool would allow him to engage students in his activities. He also wanted to explore this new technological tool in the authentic context of a live classroom and see how it could help him to engage the students in more interactive mathematics education activities. This particular middle school mathematics teacher had an undergraduate degree in electrical engineering, and felt comfortable based on the information he received from several websites that he would be able to build his own DIY interactive digital whiteboard. He bought the hardware components with his money, and assembly and software installation took him less than two hours. This teacher later began a Ph.D. program in educational technology and was recruited to develop the workshops and online support materials that will be used to help other preservice and inservice teachers to also have success in building their own DIY interactive digital whiteboards.

The first teacher that was recruited to be a participant in this pilot study on the feasibility of the intervention was a female inservice teacher. Before the workshop she reported that felt technology was fairly difficult and something that few non-techie people can access, and that it also seems to require a lot of money. After the workshop, the participant explained that she felt it was fairly easy to find and download the software for the DIY interactive digital whiteboard, and was surprised that the software was free. However, the calibration process was difficult for her because of the requirement to provide a line-of-sight between the infrared camera and the infrared LED. She described the interactive whiteboard as an interesting tool that would be accessible to many teachers. In her case, she already had access to a WiiMote, the only missing hardware was the infrared pen. She stated that she would like to incorporate the DIY interactive digital whiteboard into her classes because the students could be engaged by the interactive activities. At the end of the workshop, she declared that she wanted to share what she had learned in the workshop with other teachers.

The second teacher that was recruited to be a participant in this pilot was a male preservice teacher. Before the workshop he stated that he felt fairly confident using technology, but thought it was often inaccessible to teachers because of the financial cost. After the workshop, the participant expressed that it was fairly easy to perform the setup including the software download and installation, and the calibration of the infrared cameras with the infrared LED, but that interacting with and controlling the DIY interactive digital whiteboard was fairly difficult. He stated that he was excited about the tool and the ability to build one, and described the DIY interactive whiteboard as a potentially powerful teaching tool in classrooms.

In both cases the most difficult part of the activities for the participants was with some of the technological procedures such as the connecting the WiiMote to the PC via Bluetooth, installing the software program, and setting up the equipment. The participants both stated that the instructions were not as detailed as needed for teachers without a background in engineering. Both participants suggested that the instructions should have visual aids and a list of responses to frequently asked questions (FAQ). Both participants voiced the opinion that the technical support provided during the intervention was critical to their successful setup of the DIY interactive digital whiteboard, and stated that without the live support of the workshop team then they would have become discouraged during the process and possibly not completed the setup.

Limitations and Future Research

This study aimed to contribute to the body of research focused upon supporting teachers in developing and building their own affordable DIY educational technologies for the classroom. In general, the two participants in this pilot study assessing the feasibility of the intervention were satisfied with the DIY interactive digital whiteboard, and they stated their beliefs that these tools could be useful in the classroom. This pilot study showed there is value in performing additional research examining teachers using innovative educational technologies to build affordable DIY digital teaching tools for the classroom. Results from this study suggest it is possible that with the proper supports preservice teachers might build DIY interactive digital whiteboards, and this may positively influence their interest and engagement in teaching.

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