Interactive Whiteboards in STEM

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Abstract

With the rising need for those trained in the fields of Science, Technology, Engineering, and Mathematics (STEM), measures are being made to increase student motivation in these areas. Hands-on activities and collaborative exercises through the use of interactive whiteboards can help spark interest and increase student success in the STEM segments. In addition to improving student motivation, interactive whiteboards can help instructors improve lessons by allowing the implementation of various tools, such as videos, sound clips, and internet resources in real time within the classroom.

Introduction

In the technology-oriented society of today, there is a growing need for people trained in segments of STEM (DeJarnette, 2012). One device that can be used to teach the different aspects of STEM education is the interactive whiteboard, also known as an interactive whiteboard or a smart board. Interactive whiteboards are a substitute for traditional chalkboards or dry erase boards; they have the added benefit of allowing users to incorporate and control multimedia resources (Liang, Huang & Tsai, 2012). Two different options that are available consist of stationary interactive whiteboards, which can be controlled by touching the screen on the classroom wall, and mobile interactive whiteboards, then can be controlled with a tablet (Robertson & Green, 2012). Both options allow students and instructors to interact with each other as well as the content being presented on the interactive whiteboard. The flexibility that interactive whiteboards provide offers a number of possibilities for STEM education, such as the integration of technology, the addition of various multimedia resources, and the incorporation of hands-on activities. This manuscript provides information about, and strategies in regards to, using interactive whiteboards.

How Interactive Whiteboards can be Utilized

Interactive whiteboards can bridge the gap between students' experiences both inside and outside of the classroom by providing a similar transfer of information in the form of digital technologies (Murcia, 2010). Instructors have the ability to use and manipulate in real time a wide range of resources, such as audio files, video clips, photos, and other materials (Betcher & Lee, 2009). These real time examples are especially important for students in STEM courses because equations and calculations are inherent in these fields. The presentation can be manipulated right in front of the students' eyes. An example of where this would be important for STEM would be formulas and calculations. These calculations can be implemented and manipulated in ways previously not possible. In addition, students can interact with these materials, whether it is for participation in lectures or during their own presentations. Interactive whiteboards allow for students to relocate material, complete tasks, and take notes on the existing presentation as well as save files to a database (Hwang, Su, Huang, & Dong, 2009; Liang et al., 2012). There is also interactive whiteboard software that can assist instructors in incorporating all of the various aspects of the technology, specifically student interaction, into the pedagogy (Digregorio & Sobel-Lojeski, 2010). Interactive whiteboards provide a level of flexibility and interactivity that would otherwise be unavailable during lessons. This flexibility is important for any class, but it is seemingly indispensable for STEM courses. The instructor is able to observe the classroom and determine if students are confused by any of the concepts presented to them, and he/she can return to any that were not met with student comprehension.

The Importance of Interactive Activities in STEM Education

Problem-based activities enhance the interest of students and promote critical thinking (DeJarnette, 2012). The use of interactive activities with interactive whiteboards can be very beneficial to STEM education. Specifically, allowing some manipulations of three dimensional objects that, until now, would have been done within two dimensions. This increases the hands-on nature in STEM education (McQuillan, Northcote, & Beamish, 2012). Previous "two dimensional" examples would have required substantial erasing, where the interactive whiteboard can have the shapes and equations preloaded, so they can be recalled at any time (Hwang et al., 2009). This allows the concepts of geometry to be presented less with formulas explaining shapes and more with the observation of shapes and equations to match them. This is a more "naturalistic" learning style to how learning occurs in the real world. The new visibility in geometry and early geometric understanding can provide the basis for higher level concepts in STEM (Hwang et al., 2009). When Hwang et al., (2009) conducted their analysis of math faculty and the use of interactive whiteboards; they found that 90% felt the use had a positive impact on learning. The use and integration of interactive whiteboards in STEM courses should help to increase the amount of time available for teaching, instructor no longer is required to draw diagrams, molecules, shapes, or formulas (Liang et al., 2012; Turel & Johnson, 2012). This then allows the instructor increased time to teach facing the class. A difficulty however, is that it may not be used to let the students participate with the interactive whiteboard technology (Turel & Johnson, 2012).

The implementation of real-world examples and hand-on activities helps motivate students to excel in their chosen field (Murcia, 2010). Classes with hands-on activities, such as laboratory exercises, help students better visualize information presented in lectures and can help bridge the gap between theory and practicality of more complex experiments within STEM (Mackechnie & Buchanan, 2012). Laboratory education is a necessary tool to improve learning outcomes, but large class sizes and high costs can be daunting (Mackechnie & Buchanan, 2012). One solution is to utilize computer technology, such as interactive whiteboards (Mackechnie & Buchanan, 2012). This could help reduce the amount of money spent on a long-term scale in addition to avoiding the issue with the rise of strict health and safety rules (Mackechnie & Buchanan, 2012).

Positive Effects of Using Interactive Whiteboards

Interactive whiteboards allow instructors who struggle with the limited space of chalkboards and dry erase boards to maintain information from lessons and annotations made by students in a database that they can review later (Robertson & Green, 2012). This also allows instructors to refer to previous lessons so that they can tailor new presentations to suit the needs of students. In addition to storing information provided by students, instructors can display the thoughts and ideas of different individuals on the interactive whiteboard in real time, providing a sense of interactivity and collaboration (Robertson & Green, 2012). By using the tools provided by the interactive whiteboard, it is possible to increase the collaboration of students and assist instructors to retain the attention of larger groups (Hennessy, 2011). To improve collaboration, digital technologies are compiled and presented through one source where everyone can work together to create a better understanding through interactive activities rather than only observing lectures provided by the instructor (Murcia, 2010). Student collaboration and communication is successful, in part, due to the large visual workspace provided by the interactive whiteboard. Also, students are better able to convince peers of their understanding by using the interactive whiteboard to exhibit their ideas through pictures, diagrams, and web pages (Bruce, McPherson, Sabeti, & Flynn, 2011). An interesting aspect reported by Murcia (2010) was that in STEM (science, specifically but applicable none the less) different ideas took multi-modal forms (verbal, experimental, mathematical, figurative, and kinesthetic) and the use of interactive whiteboards enhanced the ability to apply these. McQuillan, Northcote, and Beamish (2012) found that when instructors switch between forms of instruction student engagement levels are higher, and this can be accomplished with interactive whiteboards. In fact, many students felt that they learned more, and the information was easier to understand when there was use of interactive whiteboards (McQuillan et al., 2012). It was also noted that interactive whiteboards help speed up student thinking and allow students to investigate a number of different solutions in a shorter period of time (Bruce et al, 2011).

Interactive whiteboards also simplify the expression of ideas by allowing instructors to add justifications, explanations, and evaluations all in one location, as well as allowing them to directly link information through the internet (Hennessy, 2011). Instructors can display various works by different students to compare and contrast different thought processes used to solve problems (Bruce et al., 2011). Consider further, Liang et al. (2012) found that even novice users of interactive whiteboards integrate abundant multimedia and interactive designs in learning activities. This integration allowed the instructor to be more confident and poignant, which allows more time to guide the learning of the students. Murcia (2010) succinctly stated, "what a teacher does with interactive whiteboard technology is far more important than the technology itself (p. 27)." This is important to keep in mind when implementing the use of interactive whiteboards.

Another interesting effect is that the use of technology in courses can minimize gender differences when compared to the usual teaching methods. An equal development of the memory structures of both genders has been analyzed due to the wider variety of deliverables that the interactive whiteboard provides. In addition, some instructors may favor a certain gender, but the collaboration between mixed groups that interactive whiteboards prompt can help limit such favoritism (Dhindsa & Shahrizal-Emran, 2011).

Some Negative Aspects of Using or Implementing Interactive Whiteboards

Upon examination, there are some aspects of interactive whiteboards that can be problematic. First, instructors may need to change some of the pedagogic strategy that they have been accustomed to, because some strategies that worked previously need to be replaced with strategies that are more beneficial with this emerging technology (Liang et al., 2012; Murcia, 2010; Turel & Johnson, 2012). Implementation without change in lessons is an under-usage of this technology that opens the doors to many meaningful possibilities (Turel & Johnson, 2012). Technology led initiatives in education fundamentally are not based in understanding, but more so on a theoretical positive aspect; pedagogy is often over-sighted (Murcia, 2010). This reformatting could include loading modules, notes, and concepts onto the interactive whiteboard and anything that would bring the teaching style in line with the digital practice; this may take more time than some faculty may foresee (McQuillan et al., 2012; Murcia, 2010). However, the misapplication of interactive whiteboard technology may be just as detrimental. STEM faculty run the risk of "spoon feeding" or "overwhelming" the students (Liang et al., 2012; McQuillan et al., 2012). Instructors may fail to perceive the importance of interactivity; they may fill the lesson with multimedia and lectures. They could lead the lesson without involving the students, eliminating some of the positive effects that the interactive whiteboard could provide (DiGregorio & Sobel-Lojeski, 2010). Contrary to other cited research in this manual, Liang et al., (2012) found that there was a lack of interactive learning with interactive whiteboards. This statement will need to be further addressed because it has been proposed as one of the most beneficial aspects of interactive whiteboards.

An aspect that must first be observed before any implementation of interactive whiteboards is the instructor's acceptance and attitudes about the technology. Turel and Johnson (2012) found that the use of the technology is strongly correlated with attitudes and acceptance by the instructor. More positive attitudes and acceptance of the technology comes with the usage of the technology by the instructors (Turel & Johnson, 2012). Accordingly, the more that the instructors use the technology, the better their attitudes and acceptance will be toward interactive whiteboards. The danger happens when they have positive perceptions and attitudes about the technology, but they are unfamiliar with its implementation or changes that should be made in pedagogy (Turel & Johnson, 2012).

Other problems that have been noted are technology glitches and reproductive instances in which traditional technology could have presented the same information. However, Bruce et al. (2011) observed that only 71 technological issues and 15 reproductive cases emerged from the 296 instances in which interactive whiteboards were used in the study.

Conclusion

Interactive whiteboards connect directly to the internet and can be manipulated either by touching the board or by using an independent tablet. These devices can be utilized in STEM education to assist students excel; therefore, supporting the increasing need for science, technology, engineering, and mathematics professionals. Interactive whiteboards can enhance the success rates of students by assisting instructors, inspiring collaboration, and increasing student engagement. They allow instructors to manipulate information in real time and store information from lessons to better understand and fulfill the needs of students. Interactive whiteboards allow students to interact with the lesson presented on the board, instructor, and other students by manipulating the information. Also, students can participate in lessons and activities through the interactive whiteboard, increasing the levels of interest and engagement. In summation, interactive whiteboards represent a useful tool for a wide array of instruction.

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