Creating E-Textile Activities in a Textile Design Course to Engage Female Middle School Students in STEM Learning: An Undergraduate Design Experience

Laurie M. Apple, Kathleen R. Smith, Zola K. Moon, Glenda Revelle,
University of Arkansas, USA

Keywords: STEM, technology, design process, e-textiles

Introduction

Widespread agreement exists that the United States faces a serious challenge in the areas of science, technology, engineering, and mathematics (STEM). There is a particular deficit of females (Watt, 2010) and members of underserved groups like rural populations (Smith, Nelson, Trygstad, & Banilower, 2013) who are interested in STEM topics and qualified to pursue STEM careers. Initiatives are needed to encourage more students, especially females and rural students, to go into STEM fields.

Theoretical framework and rationale

It has been suggested that young girls may be drawn into STEM learning through use of e-textiles (Buchholz, Shively, Peppler, & Wohlwend, 2014) and e-textile construction kits, such as the LilyPad Arduino kit (Buechley, 2006). The LilyPad Arduino kit enables students to create electronic circuits by sewing with conductive thread. These approaches combine activities of traditional interest to females (like sewing and crafting) with electronic circuit design.

Course design

In this project, e-textile activities were designed by a senior level undergraduate textile design class to engage female middle-school students in STEM learning. E-textile activities have the potential to increase enjoyment of and interest in STEM activities, taking STEM courses, consideration of STEM careers, and confidence in STEM ability.

The project team designed and implemented a scope and sequence curriculum of e-textile design activities, using the Lily-Pad Arduino textile circuit kit to engage 10-12 year old females in STEM learning. The scope and sequence curriculum of e-textile activities were designed to engage female middle school students in STEM learning by creating designs to include LED lamps to be sewn to a bookmark, a key-fob, a ball-cap or headband, or a t-shirt, with each design having more detailed components. The senior level textile design class of college undergraduates was instructed to select a design category. Once the students selected the category, they were given specific directions for incorporating LED lamps into the designs. For the bookmark, the textile design students were allowed to use one LED lamp in their design. Designs for the key fob included 2 lamps; the baseball cap or headband included 4 lamps and the t-shirt could include up to 8 lamps. The students were instructed to incorporate the conductive thread as design elements for both the positive and negative charges needed for the lamp to light. The battery was also taken into consideration as the battery needed to be accessible or exposed to turn the lamps on and off. The final designs were to include overall graphics as well as each pattern piece needed to create the design.

The results of this project will enable the research team to select two designs in each category and create kits to be used for e-textile activities. These activities will be used to

engage female middle school students in STEM related activities and to help determine if these types of activities enhance the desire to participate in STEM classes, consider STEM careers and increase confidence in STEM ability.

Learning Outcomes

The goal of this project was for college undergraduates to create textile designs for bookmarks, key fobs, baseball caps or headbands and t-shirts that included specific criteria for LED lamps, conductive thread and battery placement. The designs were developed to engage female middle school students in science, technology, engineering and mathematics (STEM) learning by bringing STEM to traditionally female domains like sewing, crafting, fashion and apparel design. The textile design students learned new design aspects for an atypical market. They were exposed to designing with supplies that were not ordinarily found in textile or apparel products. They also learned the LED circuitry technology in order to be able to successfully incorporate it into their designs.

Research Implications

Research implications from this project include (a) examining comprehension and enjoyment of the design activities, (b) identifying what designs work efficiently and can be easily translated into kits for middle school student activities, (c) investigating how well the activities succeed in supporting middle school students engagement in STEM thinking and STEM activity processes. In addition, the concept of including innovative technology design activities in an undergraduate textile design course could lead to the use of deeper critical thinking skills beyond what is typical in textile and apparel design. Selected e-textile design activities will be revised and improved so that they may be used in a larger research study for both the undergraduate textile design course and the e-textile activities for middle school STEM engagement.

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