
Technology Education for Women

by D. I. Y. Technology in Closing Gender Gap

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Abstract

Today more than ever, the importance of technology is increasing rapidly and related job opportunities are growing in electrical engineering, computer science and other related fields. Despite this trend, female employment in these fields is still low and it is hard to find renowned female scientists and programmers. In addition, most attendees at technology exhibitions and readers of technology magazines are male. Why aren't women interested in computer science and electrical engineering? I believe that creating an interest in technology and science for women from a young age could help increase the number of females in technology-based fields. When a mother and daughter make electronic crafts together, the mother becomes a good role model for technology use, and can help stimulate her child's interests in science and technology.

Keywords

women, children, D. I. Y. technology, electronic crafts, technology education, parents teaching

ACM Classification Keywords

J4. Social and Behavioral Science, Sociology, J5. Arts and Humanities, Arts, Fine and performing

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Introduction

This paper explores the reasons why women are not interested in technology and how this can be overcome. The paper then describes the D. I. Y. (Design It Yourself) technology projects "Tech D. I. Y. for Moms and Kids" as an educational tool for mothers to use with their daughters. Finally, I conclude with a discussion of the results of survey, preliminary user testing and plans for continued work in this area.

Background Research

It's very hard to find females who are interested in studying electronics or in pursuing the field of technology as a career path. Even at home, buying and repairing electronics are typically the male's role. Furthermore, computer science, electrical engineering, and other technology related fields are overwhelmingly populated by males [1]. Even though we live in an age of technology and electronic jobs are gaining popularity, the gap between females and males is not narrowing. The argument of gender and ability continues.

Girls are Socialized to Believe that Math is Hard

From kindergarten, boys tend to be interested in computer games and mechanical toys and girls are more likely to play with dolls or be involved in more social games [2]. Moreover, the mass media and family environment implant preconceived ideas about gender roles. Perhaps, the best example of this is the Barbie doll advertisement Mattel used to introduce a Barbie Doll, "Teen Talk Barbie," which told little girls that "math is hard." Researchers suggest that children internalize belief systems about "appropriate" careers at a young age (as early as pre-kindergarten). They carry these belief systems throughout their educational

career and adult job tenure [3]. These internal and external elements affect children's belief systems, to the point boys tend to pursue more jobs in technology fields.

Women and Men both Have Mathematical Ability

The general misconception about mathematics and technology is that women are afraid of them and they don't want to learn or use them. Conversely females and males have similar mathematical and mechanical ability. Patricia Campbell supports this by insisting that "there is no convincing evidence of innate gender differences in mathematical ability" and "there is almost no difference in the performance of male and female students who have taken equal advantage of similar opportunities to study mathematics." [4] In most cases, females are not encouraged to express these subject interests. If they are given the opportunity to express their interests, they will be able to prove their abilities.

Female Role Models are Hard to Find

Most of the renowned scientists, mathematicians and successful pioneers of technology are male. Gender discrepancies in the field of science, math, and technology can be attributed, in part, to public media images that focus on the successes of boys in these areas. Parents, teachers, and guidance counselors are not encouraging girls to pursue science, math, and technology classes, clubs, and careers. [5] As a consequence, a girl does not have the same opportunity to pursue these fields. The role of mothers in families often limits their daughters' career interests by not exposing them to a wide array of possible careers. Therefore, if mothers are given the means to educate their daughter about the available

opportunities in technology, their daughters' interests in these fields will most likely translate to the increase of females in technology-based careers.

As we have seen, in most cases, gender has nothing to do with the ability to learn about technology or other related field and females have the possibility to learn and enjoy technology just as their male counterparts. But they are not as interested in learning about technology as males because of limited access to these opportunities at a young age.

Approach

To overcome the external elements and expand female interest in technology and science from a young age, I set up an environment where the mother serves as a role model for their child. As mother educates daughter she creates a potential for her daughter to be an active participant in the technology field, stimulating her daughter's interest in technology and gain confidence in herself. However, it is very difficult to change the attitudes of mothers towards technologies and spark an interest. Combining electronics or technologies with female-centric hobbies is one approach.

Traditionally, crafts usually involving clothing, fabrics, and other materials have been popular hobbies shared by mothers and their daughters. Recently, D. I. Y. (Design It Yourself) culture is gaining popularity though the Internet primarily because of the ease of sharing and obtaining D. I. Y. instructions. In addition, there are very interesting phenomenon about learning technology and building D. I. Y. project by users on the Internet site such as makezine.com and instructables.com. It's getting more popular in open source system with Web 2.0 because people can easily

publish their own content and distribute it to others. However, most of the readers of Make magazine and authors of D. I. Y. technology instructions on Instructables.com site are still heavily dominated by males. That's why the Craft magazine was published one year later for female readers to fulfill a perceived need to publish a separate electronics hobby magazine for women. By comparing technology-oriented D. I. Y. sites and general women's D. I. Y. site, women appear to be willing to learn technology through their own D. I. Y. project. A few artists and creators have become aware of these problems and have started to develop and distribute D. I. Y. technology projects through Internet to expand women's interests and contribute more to technology. For this reason, the project choose the D. I. Y. craft methodology to not only obtain the instruction and information about the technology easily on the web but also easy to learn electronic with fun craft projects.

Tech D. I. Y. for Moms and Kids

The D. I. Y. (Do It Yourself) technology project for women, "Tech D. I. Y. for Moms and Kids", involves a holistic process of mothers and daughters learning electronics and technology together and sharing this with others. The project enables mothers and daughters in families to begin participating in technology hobbies together. They can start to have common interests in making electronic craft projects together and can gain knowledge. The goal of the project is to increase women participation in technology through D. I. Y. instructions and expose future generations of women to technology-based career path.

Education Project

The Tech D. I. Y. project is used as an education tool. Instructions of the project help the mother explain the fundamentals about what she and her child are making and they will learn while having quality time together.



The first lesson about a basic electronic circuit: Moonlit Flower



The second lesson about series vs. parallel circuit: Secret Tree



The third lesson about insulator vs. conductor: Super iPod

Easy Make Project

The project is easy to start and make. Most D. I. Y. technology project instructions often don't provide basic knowledge to make, and some words are hard to understand for novice. Moreover, making an order through a store with a lack of information about electronic parts can be difficult. For this reason, the project includes detailed instructions with basic electronic knowledge from beginner level to advanced level. The D. I. Y. kits provide all of the materials to make the project along with paper instruction, so the users don't need to spend time and money to find or prepare them.

Electronic D. I. Y. Project for Female

Although there are already lots of kits for making robotics such as *Lego's Mind Storm*, it's still not familiar with female children. There are more focus on the external form with decoration to stimulate female's interests, so that they can see that technology crafts can be attractive without exposing wire and circuits. The materials of Tech D. I. Y. project are selected from feminine oriented interests and popular crafts materials for women such as fabrics and papers, which are easy for them to handle. The themes of the projects are also interesting for women and include aesthetic elements such as flowers and other decorations.

Safe Electronic Craft Project

The Tech D. I. Y. projects are safe. In many cases, electronic projects require soldering skill. Soldering includes lead and can be very harmful for children and fertile women. Although soldering skill is still required to make electronic projects. For this reason, the projects don't require any soldering skill, but rather use alternative ways to connect electronic parts such as banding wires by hand.

Core Features

The Tech D. I. Y. for Moms and Kids project have developed three lessons, from the beginning level to the intermediate level. The first project is "Moonlit Flower", and the lesson is to learn a basic circuit. The flower is using a basic electronic circuit. The kit includes: one battery, one light, and one switch. For the switch we use a snap. When the snaps are closed, the LEDs on the flower light up. The second lesson is "Secret Tree" for connecting many LEDs using a parallel circuit. For the second lesson project, recycling materials such as shopping bags and gift tissue paper were used. For cutting the tree shape, the instruction includes a template. When the Velcro closed on backside of the tree, the LEDs light up. The third lesson is making "Super iPod". This is an intermediate level and is a challenge to make without learning the first and second lessons prior. Furthermore, the project requires more time to make. With this project the users learn what a conductor and an insulator are. There are soft fabric switches on the pillow cover and the switches connect to an already hacked mp3 player. So, when they push the switch, they can listen and control music.

The project provides two kinds instruction: text and video instruction inside the D. I. Y. kit and on TechDIY.org site. With instruction, the users are able to learn about fundamental knowledge of electronics and circuits, and to complete the crafts projects. In addition, the projects provide video instructions to watch the whole process of making the project.

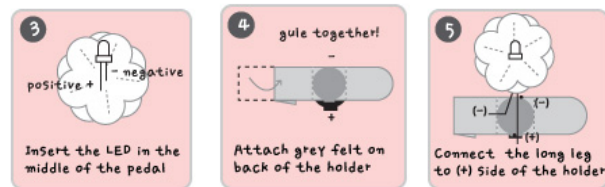


Figure1: Instruction diagram for Moonlit Flower

In addition, the D. I. Y. kit includes paper instruction with general information on electronics and all materials such as fabrics, electronic parts, and thread in the bag. It helps people save time finding materials. Also, if users want to prepare materials, they are able to find detailed material information on the web site. On the TechDIY.org site, the mothers not only obtain instruction of the craft projects but also are able to buy the kits at TechDIY.org site. In addition, they can share or suggest ideas to develop other D. I. Y. projects.



Figure2: Users can buy a kit(left) or prepare materials by themselves with information at TechDIY.org(right).

Survey and User Testing

The objective of this research was not only to gather data about how women learn technology using the Tech D. I. Y. project and how mothers' learning effects their children's motivation about learning technology, but also encourage many mothers to participate in the project with their children. With the goal of developing the concept and determining the target users' needs, the survey was conducted at Maker Faire 2007 Austin, TX for thirty-six mothers who have children in kindergarten or elementary school. The Survey included eighteen questions regarding technology habits, craft activities, and the Tech D. I. Y. project. The results of the survey showed that they make more than two craft projects and spend more than twelve hours per month. Those surveyed answered with positive feedback about the Tech D. I. Y. project. However, when asked if they would rather use the crafts kit or prepare materials by themselves, they answered that they didn't know. One possible reason is a lack of familiarity with making crafts using electronic parts.

The survey results affected a change in the direction of the project. Prior to the survey, the main focus was developing and distributing the kits in order to introduce the project to more users. Afterwards, the project was distributed via on-line instructions on the TechDIY.org site and through pdf instruction by email. Reading the instructions allowed mothers to more fully understand the project and provided with the confidence to work with electronic parts, and decide to start the project. This result showed that granting women confidence about working with the technology to is a primary task. If they feel difficulties about the technology in their initial experiences, they often give up easily and impose limitation on their ability. So, the

Tech D. I. Y. project is necessary to minimize error according to women's abilities and easy of understanding instructions, and avoiding negative experiences.



User Testing with six mothers and seven children in the lab

For investigating a user's ability to make the kit and discovering problems with the instructions, eleven mothers were invited for user testing. Six were invited to make the kit with their children under direct observation in the lab and five mothers participated independently giving feedback by email after making the crafts at home with their children. The research found that cooperation between mothers and daughters was important in giving the confidence to learn. Also, it took mothers two or three times longer to make the project with their daughters than to make it alone. The mother and daughter enjoyed the time to discuss the division of tasks in order to make the project and find solutions whenever they faced a problem. When they completed the project, participants said, "It was very challenging, but I know I'm very good at it, now." Even though the beginner's level craft project was simple to learn, users still felt challenged. However, they were very satisfied and proud of what they had archived and wanted to conduct future lessons.

Future Work

With the Tech D. I. Y. project in the research, mothers have a good time with their children and find confidence to learn new knowledge. It also offers alternative views of how mothers and their children relate to technology. As a result, children will see that women can understand and be creative with

technology. For further development of this project, I would like to create more variety of lessons within each level to allow users to learn on a step-by-step basis. Also, developing the lesson with solar panels or rechargeable batteries will be included in further instruction to learn sustainable practice. I would also like to begin long-term studies investigating whether such activities could impart women's participation in electrical engineering and related technology fields to hold workshop with more mothers and daughters. I hope that when our daughters grow up they will feel more comfortable about technology and use it to improve the quality of their life and remember what they learned with their mothers about technology and how we can enjoyed these activities together.

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