Girls, Games, and Intrepid Exploration on the Computer

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INTRODUCTION

One way to increase women's participation in technology is to create more female independent problem solvers on the computer, or what Sherry Turkle (cited in Margolis & Fisher, 2002) calls "intrepid explorers." Studies of students who persist in computer science have shown the importance of being "intrepid"—having the desire to explore without fear of breaking the computer, and the confidence to solve problems and deal with setbacks (Margolis & Fisher, 2002). An intrepid explorer is creative and fearless about trying new things on the computer. However, how do people become intrepid explorers? How can learning environments support them? This article addresses these questions by describing ways to support girls to explore intrepidly on computers. These strategies are grounded in previous research as well as our own research on an after school program for middle school girls.

BACKGROUND

Females are still under represented in the world of technology. The percentage of women studying engineering, computer science, and related fields in U.S. universities has dropped from 36% to 20% in the last two decades (National Science Foundation, 1999). Even when they are interested in information technology (IT), girls are less likely to pursue and persist in a high tech career because they tend to believe it is solitary work, entails competition rather than collaboration, and has little social value (AAUW, 2000; Lightbody, Siann, Tait, & Walsh, 1997; Margolis & Fisher, 2002). Recent research suggests that the gender gap in confidence and use of computers is narrowing, although there are still some gender differences in how computers are used (Colley, 2003; Miller, Schweingruber, & Brandenburg, 2001).

Programs to increase the number of girls who pursue and persist in technology must build on research. Women's *persistence* in computer science in college has been linked to peer support, experiences of success in some aspect of computing, seeing computers as useful for expression and for helping society, and rejecting "computer geek" stereotypes (Crombie & Armstrong, 1999; Margolis & Fisher, 2002). Women are more likely to persist when they collaborate while working on the computer (McDowell, Werner, Bullock, & Fernald, 2003).

The National Science Foundation recently released a book called *New Formulas for America's Workforce: Girls in Science and Engineering*, which describes many innovative programs designed to increase girls' interest in technology. Most build on research, but few target middle school students, a critical time for choosing career identities, and none focuses on creating intrepid explorers. There is a great need for theories and models of learning to guide both the integration of research findings into middle school educational settings, and the measurement of the effects of these efforts.

In this article, we first describe a model of intrepid exploration that can provide a framework for efforts to increase girls' participation in IT. We then describe several program strategies that parents and educators can use to support girls to become intrepid explorers on the computer. Finally, we present research on a program offered after school and during the summer to middle school girls.

STRATEGIES TO INCREASE GIRLS' PARTICIPATION IN IT

Intrepid explorers are able to problem-solve and explore without fear of making a mistake or getting lost, and have the confidence to deal with setbacks and errors (Margolis & Fisher, 2002). In our model, an intrepid explorer on the computer demonstrates five capabilities: computer fluency, self-efficacy, problem solving skills, curiosity, and creativity. Table 1 provides examples of each of the five characteristics, which are derived from research on the *Girls Creating Games* (GCG) program. The program is described in more detail in Denner, Werner, Bean, & Campe (2005). The research data include one-on-one interviews, electronic notebooks, and an online survey that measures skills, interests, and attitudes toward computers. The 126 program participants live in a small urban area in California, and are between 10-14 years old (M=11.73, SD=1.0). The girls' ethnicity is mostly white (60%) and Hispanic/Latina (31%), and 36% report that they speak a language other than English at home at least some of the time. Below we describe several program strategies created for and tested within GCG, as well as some of our research findings on whether the strategies were successful in promoting intrepid exploration.

Strategy 1. Increase Computer Fluency

In order to build fluency, programs must build computer skills, capabilities such as managing problems and working with others, and concepts such as understanding modeling and abstraction (Committee on Information Technology, 1999). To this end, the GCG program focuses on creating games and providing instruction in the use of Flash multimedia and animation software (http://www.macromedia.com/). The games are interactive stories, where the player must choose the next step at key points in the story. The girls write their stories and become personally invested in their games, which provide motivation and a context for learning and practicing their computer skills. They add graphics and music, and use Flash's programming language to create animation, and interactive buttons and text elements. Cassell (1998) suggests that storytelling can be used to change the relationship between gender and technology. In fact, our survey data show that participants improved on a range of transferable computer skills, such as how to use keyboard shortcuts, how to work with graphics, and how to work with two software programs at once.

A collaborative learning structure called "pair programming," where two users sit together at one computer (Williams & Kessler, 2000) is also used in

Table 1. Characteristics of intrepid exploration on the computer

Computer fluency	• Demonstrates skills, concepts, and problem solving capabilities across software • Demonstrates a conceptual understanding of IT by asking questions about new ways to use software or how the software is set up • Does not ascribe "magical properties" to the computer • Has a language to describe what they learned
Self-efficacy	• Has confidence; sees oneself as good at some aspect of computing • Has a sense of control; attributes success to ability rather than luck • Does not define oneself as "not good at computers" if they make a mistake • Rejects negative stereotypes about girls and computers
Problem solving skills	• Likes to be challenged • Uses unexpected computer behaviors as information • Able to keep working and/or identify solutions when frustrated • Not afraid to make a mistake; resilient in the event of mistakes • Generates solutions for solving a problem
Curiosity	• Actively seeks out new things to learn on the computer • Tests the ranges and limits of different software or programming languages • Enjoys learning and discovering new ways to do things • Seeks new sources of information about the topics she is curious about
Creativity	• Goes beyond the minimum project requirements • Uses the computer to communicate or express ideas • Attempts to use software or programming languages in new ways • Uses humor