Development of Girls' Interest and Identities in Computer Sciences Within an CSCL Environment

Yu-Hui Chang, Sarah Barksdale, Lana Peterson, and Cassandra Scharber
chan1173@umn.edu, barks016@umn.edu, pete6118@umn.edu, scharber@umn.edu
University of Minnesota

Abstract: *SciGirls Code* is a two-year project (2016-2018) supporting 16 STEM outreach programs in providing elementary/middle school girls with computational thinking (CT) in an extended learning environment setting. In this proposal, case analyses of six girls are presented to examine their interests in and identities toward computer sciences (CS). Findings reveal increased confidence and interest in CS activities, new appreciation for coding, the importance of teamwork and girls' understanding of gendered identities in CS careers.

Introduction

SciGirls Code is a project with 16 STEM outreach programs to provide 160+ girls and their educators with computational thinking (CT) and coding skills within informal education spaces. As part of the curriculum, programs completed 3 curricular strands (Mobile Apps, Robotics, E-Textiles) between September 2017 - May 2018. With an emphasis in supportive connections with others, we apply the Connected Learning (CL) model (Ito et al., 2013) to understand how girls expanded their interest within production-focused CS activities and how they were empowered in their learning through a gender-equitable, peer-supported environment.

CSCL context

This poster explores how girls' interests were affected by the collaborative participation of creating with technology, and how this learning impacts the development of girls' CS identity from two programs (Team Leo and Team Pictor). Both teams recruited 10 girls, ages 10 to 12. Each strand contained hours of activities that provided exposure to computer sciences such as creating an app using Thunkable, building robots with Hummingbird kits, and designing e-textiles using Lilypad. Following each strand's activities, girls created a group project during a 'makeathon'.

Method, data sources, and analysis

We conducted a qualitative case study (Merriam, 2009) of six girls from Team Leo and Team Pictor to understand girls' development of identities and interest in CS activities. Three girls from each team (Nina, Sophie, Emily, Chloe, Sandy, Karen) were selected for analysis based on the following criteria: participant completed (a) the pre and post open-ended surveys and (b) three semi-structured interviews reflecting on each strand. Data sources were (a) the pre/post surveys, (b) interview responses, and (c) learning artifacts. Content analysis and deductive qualitative analysis (DQA) was conducted using Brennan and Resnick's computational thinking (CT) framework (e.g., computing concepts, practices, perspectives) and the Connected Learning model (Ito et al., 2013) (e.g., interest-powered, peer-supported) as coding schemes to review participants' responses.

Results

Interest and confidence increased yet career aspirations varied

To understand girls' changes over time, we examined Emily and Chloe's development through their reflections after each CS strand.

Emily (Team Leo)

Emily's CS practices were encouraged by a positive hands-on coding experience using Thunkable. In her first interview, she showed interest in learning how to code beyond block languages, but hesitated to consider a career in CS. During her robotic project, in addition to her increased capacity in explaining CT concepts more precisely, she demonstrated the most growth in computing practices such as debugging and remixing the code to make the robot work. Although she expressed that working with robots was "challenging and exciting," she showed low interest in working further with robotics. In her final interview, she showed a strong understanding of CT concepts, practices, and perspectives by problem-solving her design. Additionally, she demonstrated passion during her e-textile creation and articulated an identity as a designer by saying, "I'm designing an app. I'm designing this robot with the mermaid and making her body…I have more impact at being a designer."

 © ISLS

Chloe (Team Pictor)

Chloe began the program with lower confidence in programming compared to her peers. While she never indicated that she was considering a CS career, she gained confidence in her abilities by expressing an interest in doing more CS activities. She had difficulty explaining concepts precisely and used phrases like, "put the sensor thing in (robot)...and then we tested it." She demonstrated an increased confidence in CS when she assisted others to code in another class. Chloe's original motivation was to make an app to take home to work on, but her CS interests shifted to robotics in her final interview. She identified as a coder because of the capacity to "actually make stuff" with a clear direction, such as continuing to collect materials to build a robot.

Teamwork and gendered identities impacted perspectives

Based on participants' responses from surveys and interviews, we identified two sub-groups amongst the six girls. 3 girls (Karen, Emily, Sandy), who we will refer to as group A, consistently demonstrated interest in doing more CS as well as able to see it as a career. In contrast, 3 girls (Nina, Sophie, and Chloe), who we will refer as group B, gained confidence and interest in doing more CS activities but did not develop a career interest in computing.

Group A: Teamwork and gender identities

Two similarities among group A's learning trajectories were: (1) the recognition of the value of teamwork and (2) the awareness of gender identities. All of them mention the importance of "agreement" during teamwork. Karen recalled group decisions and incorporating all voices in the design process as integral to her robotics project. Emily also shared a story of how finding common ground created a productive environment. Sandy connected the value of teamwork in SciGirls to her future career: "When I'm older and I get a job…, there's teamwork in working...you'll work together to do whatever you can." Strong gender identities in CS (e.g., the importance to get women involved in coding) were also revealed during their interview. Overall, group A situated females learning code as empowering and as a route for women to positively impact the world around them.

Group B: Transferring coding experiences into more CS activities

Group B shared a strong desire to apply the skills and knowledge gained from their SciGirls coding experiences into designing robots. Sophie expressed computation as a medium of creation and reusing and remixing as part of the process. Both Sophie and Nina identified themselves as designers and were inclined to do more robot creation at home. Nina reflected that her new skills in coding allowed her to create hands-on designs using the computer. Similarly, Chloe identified herself as a coder, but showed a strong interest in developing more ideas for robotics.

Discussion

Since girls valued coding and its processes as a medium of creation, this appreciation influenced each girl to develop a personal identity as a coder or as a designer. In addition to encouraging girls' interest through experiences with coding, we found that those who developed a CS career interest appreciated teamwork and demonstrated awareness of the role of gender in CS identities. A new perspective on cognition considers not only an individual body, but also recognizes the role and influence of interactions, elements, and aspects within environments (Newen, Bruin & Gallagher, 2018). Future work will examine how the environment and its resulting impact on learners' autonomy, sociality, and personal identity.

References

Brennan, K., & Resnick, M. (2012). Using artifact-based interviews to study the development of computational thinking in interactive media design. Paper presented at the annual American Educational Research Association meeting, Vancouver, BC, Canada.

Ito, M., Gutierrez, K., Livingstone, S., Penuel, B., Rhodes, J., Salen, K., Schor, J., Sefton-Green, J., Watkins, S.C. (2013). Connected learning: An agenda for research and design. Irvine, CA: Digital Media and Learning Research Hub.

Merriam, S. B. (2009). Qualitative research: A guide to design and implementation. San Francisco, CA: Jossey-Bass.

Newen, A., De Bruin, L., & Gallagher, S. (Eds.). (2018). The Oxford handbook of 4E cognition. Oxford, UK: Oxford University Press.

Acknowledgments

This research is based upon work supported by the National Science Foundation under Grant No. 1543209.