Talk and Tech: The Impact of Technology Type and Setting on the Communication Patterns of a Child With Autism

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Abstract: This paper presents the potential effect of a computer programming curriculum on the verbal communication skills of an elementary school student with autism. The student participated in a block-based computer science curriculum for 2 years. We observed his work in three distinct contexts: (1) the general education classroom, working without computers, (2) the same classroom, working on laptop computers, and (3) the computer lab, working on a desktop computer. Careful video analysis revealed that the student communicated more (as measured by speaking time and number of interactions initiated with others) when working on a computer than without one, regardless of the type of computing devices used (laptop vs. desktop) and classroom context (classroom vs. computer lab).

Introduction and background

More schools are seeking to implement Computer Science (CS) in the traditional school day. One indicator of this is the release of the K-12 Computer Science Framework (2016) which outlines CS concepts and practices that are appropriate across schooling. Moreover, the framework argues that all students should have the opportunity to engage in CS learning at school regardless of their gender, race/ethnicity, socioeconomic status, disability status, or zip code. When discussing underrepresentation in computing, students with learning disabilities are often left out of the conversation. While work (e.g., Snodgrass et al., 2016) has focused on understanding pedagogical strategies to support computing for students with learning disabilities, and limited work has focused on technology and communication for students with learning disabilities (e.g., Archmadi et al), more work is needed. This study investigated the behavior and discourse of an elementary school student, "Alex" who participated in a CS curriculum in 4th and 5th grade. Alex was diagnosed with Autism Spectrum Disorder (ASD), a neurodevelopmental and characterized by differences in "social reciprocity and communication" (Lord et al., 2000).

Alex was one participant in a larger design-based research study (Barab & Squire, 2004). From 2013 to 2015, we followed over 1,500 students in 10 California elementary schools through a series of computer programming lessons, which used a modified block-based programming environment. Alex was in 4th grade (age 10) when the study began and he was diagnosed with ASD. By 5th grade, Alex had learned metacognitive, coping strategies to better control his emotions and received most of his instruction within the general education classroom. Alex participated in the CS curriculum in both grades. During 4th grade, he completed a 10-hour module on digital storytelling as part of this project. In 5th grade, he completed an additional 10-hour module on digital game design. Alex did not have a self-reported interest in CS before beginning the curriculum. In our previous study (Gribble, Hansen, Harlow & Franklin 2017), we found that Alex spent more time talking with peers in the computer lab compared to the typical classroom. In this study, we added data from a third context (working in a typical classroom on laptops) to investigate whether the setting (typical classroom or computer lab) or type of technology (laptop or desktop) impacted Alex's communication patterns with peers and his teacher.

Data collection and analysis

We video recorded six 45-minute classroom lessons (two 45 minute videos from each of the three contexts). Context 1 was a typical classroom. No computers were used. Students were told they should brainstorm ideas for their programming projects with peers nearby. Context 2 was a typical classroom with laptops. Students completed programming exercises using laptops in a typical classroom. They were instructed to incorporate sprites – programmable objects or characters – and start a script/code. The teacher challenged the students to use 3 sprites and 15 coding blocks for this exercise. Context 3 was a computer lab using desktop computers. Students completed guided programming exercises to learn about variables. For all six videos, we coded the number of seconds Alex spoke with his teacher and peers and the number of conversations he initiated with his teacher and peers to observe the change in his communication behaviors based on the change in context.

Results

The results of this study are depicted in Table 1. In the first context, Alex had few conversation initiations with others (4 with teachers, 2 with peers). When peers attempted to initiate a conversation with him, he became non-responsive and disengaged by leaning back in his chair. In the second context, the number of conversations initiations with the teacher doubled from 4 to 8 times, and the conversations initiated with peers increased from 2 to 31. In the final context, Alex initiated the most interactions with the teacher (10) and maintained a large number of interactions (24) with peers. Specifically, Alex discussed new ways children could use the code blocks in new innovative ways, which did not go unnoticed by his teachers who asked Alex to lead a coding demonstration at the end of the sessions.

Table 1: Alex's communication performance in each setting

Context	1. Typical classroom (no technology)	2. Typical classroom with laptops	3: Computer lab with desktop computers
Speaking time	300 seconds	1565 seconds	955 seconds
% of speaking time during class	11%	58%	35%
# of conversation initiations with teacher	4	8	10
# of conversation initiations with peers	2	31	24

Conclusion

We saw an increase in Alex's communication behavior when he used a computer as a mediating object to think with and act through. Regardless of context (classroom or computer lab), Alex communicated more when he used a computer. In our previous study (Gribble et al., 2017), Alex spent more time talking with peers in the computer lab compared to the typical classroom. In this study, we added a third context (working in a typical classroom on laptops) to determine if the setting (typical classroom or computer lab) or type of technology (laptop or desktop) impacted Alex's communication patterns. Alex spoke for longer periods of time and initiated more conversations when working on a computing device, regardless of technology type and setting.

There are limitations to this study. This study only focused attention on one student with ASD. These findings are not generalizable to all students with ASD or students with other learning disabilities. We encourage future studies to focus on the social-emotional benefits that computer programming can provide, particularly connected to verbal and expressive language development. More research is needed to realize the K-12 Computer Science Framework's vision of educational equity within the fields of computing.

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