Student Reflections on Pair Programming in Middle School: A Thematic Analysis

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Abstract: This poster reports on a thematic analysis of 64 seventh grade students' reflections on pair programming after engaging in a series of computationally rich science activities over two semesters in the classroom. Thematic analysis of student reflections revealed themes related to (1) Desired Partner Qualities, (2) Experiences with Collaboration, (3) Partner Familiarity, (4) Disposition toward Collaboration, and (5) Pair Programming Logistics. This study contributes toward a deeper understanding of middle school learners' experiences during pair programming.

Introduction

Understanding best practices in collaborative co-construction of knowledge is a central problem in computer-supported collaborative learning (Stahl, 2015). It has been shown that pair programming is an effective collaborative method for improving productivity, increasing satisfaction, and promoting good programming practices (Umapathy & Ritzhaupt, 2017). In pair programming, students share a computer and take turns in two roles: when serving as the *driver*, the student is responsible for writing the code and implementing the solution; when serving as the *navigator*, the student is responsible for catching mistakes and providing feedback to the driver. Implementing pair programming in middle schools is relatively new, yet recent studies suggest pair programming holds great promise for supporting students' learning and engagement in K-12 settings (Campe, Denner, Green, & Torres, 2020). On the other hand, previous work has found challenges in taking turns in conversation, openly listening to ideas, and respecting different ideas (Deitrick, Shapiro, & Gravel, 2016). We need to develop a more nuanced understanding of middle school learners' experiences during collaboration. This poster explores the following broad question: *What are middle school students' perceptions towards working with a partner during pair programming activities in the classroom?* The results shed light on how we can improve middle school learners' experiences in pair programming settings.

Methods

This study was conducted with seventh grade middle school students from a public school in the southeastern United States in the 2018-2019 school year. The research team implemented a series of programming activities via the *Snap!* programming language in this classroom. During the first semester, learners gained experience with programming fundamental constructs of loops, conditionals, and variables. They created games and models to practice these concepts. They were introduced to the pair programming methodology and driver/navigator paradigm. During the second semester, the students learned more advanced object-oriented computer science concepts such as broadcasting and cloning before creating computationally rich models (e.g., a simulation of how creatures evolve traits over time depending on their environment). Students worked with randomly assigned partners across three to four pair programming sessions during two semesters. In addition, they also had the opportunity to work alone on four activities. After all of these activities were completed at the end of second semester, we asked students about their experiences working with a partner using the following prompt: "What did you like and dislike about working with a partner during the in-class coding activities? Please explain with a minimum of four sentences." Out of 75 consenting students, 65 were available during the reflection essay data collection day, and one student's reflections were unrelated to pair programming or partners; therefore, this analysis examines the reflections from 64 middle school students.

Findings

We conducted a deep qualitative analysis of students' reflections using thematic analysis. Using inductive coding, two researchers first independently open-coded the reflection excepts and created a total of 525 independent codes. The researchers iteratively collapsed the codes into new higher-level codes, which ultimately led to five overarching themes and 18 subthemes.

Theme 1: Desired Partner Qualities. Middle school students expect certain traits from a good partner during pair programming activities. One of the sub-themes, Workload Split, was the most common subtheme mentioned by almost half of the students (27/64 students). The other popular subthemes within this theme were Teamwork Attitude, Partner Knowledge Level, and Creating and Exchanging Ideas.

Theme 2: Experiences with Collaboration. Students expressed wanting support for learning (30/64). Other popular subthemes included in this theme were Positive Learning Environment, Preparation for Complex Tasks, and Productivity. The lesser mentioned subthemes were Conflict and Social Growth.

Theme 3: Partner Familiarity. Students expressed that familiarity with their partner affected collaboration. Commonly mentioned subthemes included in this theme were Comfort Level with Partner and Interaction; Productivity in the context of Partner Familiarity was also mentioned by students.

Theme 4: Disposition towards Collaboration. Students hold values and beliefs regarding collaboration, and this theme was encapsulated by the sole subtheme of Attitude toward Collaboration which was mentioned by 25/64 students.

Theme 5: Programming Logistics. Students expressed frustration with the restrictions of pair programming. The most common subtheme was Sharing the Computer, which references the use of one computer leading to less productivity. The other subthemes within this theme were Additional Partners, Switching Roles, and Driver/Navigator Dynamics.

Conclusions

Collaborative learning is increasingly essential for today's complex problem solving. However, the factors leading to the success of collaborative learning need to be further explored. The goal of the study was to understand middle school student perceptions towards pair programming activities. The results show that there are a variety of factors that play into students' perceptions of their collaborations. The Desired Partner Qualities theme was the most frequent theme and students called attention to factors that they look for in an effective partnership. The results also showed that most students believe that working with a partner supports their learning, create a positive and fun learning environment, and prepares them for larger projects. Some students have a strong disposition toward collaboration and prefer working alone, and some report that familiarity with their partner has a strong impact on their comfort during problem solving, interaction quality, and productivity. Investigating the experiences of these middle school students during pair programming is crucial to the research community and practitioners in order to improve both enjoyment and learning outcomes for young learners in pair programming. Future work should continue investigating young learners' experiences during pair programming activities and explore the effectiveness of different combinations of partners and pair programming configurations on learning.

References

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