Idea Development in Multi-touch and Paper-Based Collaborative Problem Solving

Emma Mercier, Georgia Vourloumi, Steven Higgins
Durham University School of Education, Leazes Road, Durham, DH1 1TA, UK.
emma.mercier; georgia.vourloumi; s.e.higgins @durham.ac.uk

Abstract: Multi-touch technology has the potential to support collaboration, although there is little evidence about how collaborating using this technology differs from collaboration with traditional materials. In this paper, we examine the interaction behaviors of four groups working with a multi-touch table, and four groups working on a paper-based version of the same task. Results indicate that more ideas are introduced and developed by students in the multi-touch condition.

Introduction

Multi-touch surfaces have the potential to change the way collaborative learning occurs (Higgins et al, 2011). As this technology allows multiple users to interact simultaneously with the content on a shared screen, it may allow more equitable participation of group members. Initial research on this technology indicates that, when compared to a single-touch surface, groups using multi-touch engage in more task-focused and less process-focused discussion (Harris, et al., 2009). Additionally, when compared to paper activities, students using multi-touch have been shown to have higher levels of joint attention and more interactive comments (Higgins et al, 2012). However, there is still much to be understood about how interaction changes when there is equal access to content.

Figure 1. Groups working in the Multi-touch and Paper-Based Conditions.

Method

This study was a within-subjects design, with groups completing activities in both the multi-touch and paper-based condition during a single visit to the research lab. This paper draws on data from one of the mathematics activity that was completed in either a paper-based or multi-touch condition.

Participants

Participants were 32 10-11 year olds who were recruited from two local schools. Groups of eight came to the lab and worked in same gender groups of four. On arriving at the lab students become familiar with the multi-touch tables. Then one group worked on a paper-based history task, while the other group worked on the same task on multi-touch tables. The groups then switched conditions, and worked on math mysteries. Two members of the research team were involved; each taught half of the paper-based and half of the multi-touch activities. Teachers worked with the groups, intervening when groups appeared to be struggling.

Math Mystery

The groups completed a math mystery that focused on number knowledge, asking them to reason through a series of clues about which hotel room a stolen statue had been hidden in (e.g. “The answer does not contain the digit 3”). In the paper-based condition, each clue was presented on a piece of paper, while in the multi-touch condition, the clues were on digital paper, which could be moved and re-sized on the screen.

Coding Scheme

An emergent coding scheme was developed, drawing on prior research on collaborative mathematical problem solving to inform codes that would represent the types of interactions evident in the data. There were three stages to the coding scheme. In the first stage, the unit of analysis was identified. This was defined as an idea, and began when a new idea (or clue) was introduced, and ended when the group moved on to talk about a different idea. Two of the transcripts were double coded in the first stage, with agreement of 83%. In the second stage, the person introducing and engaging with the idea was identified; double coding of one transcript

indicated 100% reliability. In the final stage, student engagement was classified as denoting importance, combining clues or expanding clues (see Table 1). Double coding of one transcript indicated 85% reliability.

Table 1: Phase Three of the Coding Scheme

Code	Definition
Importance	Responses comment on importance of a clue, but do not elaborate.
Combining clues or ideas	Student combines clues or ideas to the introduced idea to build on it.
Expanding	Student expands or elaborates on an idea or clue.

Results

Results indicate that there were more ideas proposed in the multi-touch condition (M = 17.75, SD = 4.65) than in the paper-based condition (M = 14, SD == 1.41). Drawing on the second stage of coding, figure 2 shows who responded to the ideas, indicating that more ideas were introduced by students in the multi-touch condition, for all categories. Teachers introduced more ideas that students responded to in the paper-based condition.

To examine how students responded to the ideas proposed by other students, we categorized the responses into, commenting on the importance of an idea, elaborating on the idea, and combining the idea with other ideas to move the group forward in solving the problem. When the number of types of responses was examined as a proportion of the total number of ideas, results indicated that there is little difference in recognition of importance (12% for paper; 14% for multi-touch). Students in the paper condition combined ideas more often (20%) than students in the multi-touch condition (15%) while students in the multi-touch condition elaborated on ideas more often (21%) compared to students in the paper-based condition (16%).

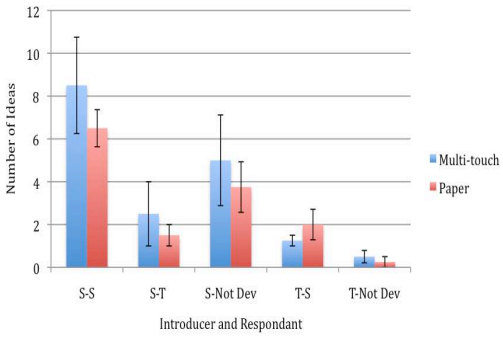

Figure 2. Introducer and Responder to Ideas (S = Student; T = Teacher)

Discussion

We set out to examine idea development in groups working in a paper environment and groups doing the same task on a multi-touch table. Results indicated that there were more ideas introduced in the multi-touch condition than in the paper condition, suggesting that there may were different types of interactions.

Responses to ideas were coded in terms of who responded, and when examined as a proportion of total ideas, there was little difference between the two conditions, indicating that interaction levels were similar in the two conditions. However, when types of interaction were examined as a proportion of total ideas, the results showed that students in the paper-based condition combined ideas more often than students in the multi-touch condition, while students in the multi-touch condition elaborated on ideas more often. These differences suggest that there were different types of collaborative engagement occurring across conditions, with students in the paper-based activity being slightly more focused on putting together the ideas to reach a conclusion. Students in the multi-touch condition focused on making sure that the ideas were re-interpreted, perhaps to ensure all group members agreed on the meaning of the ideas before they moved on. This difference in types of interaction indicates possible ways in which the task medium may have influenced collaboration, and suggests that groups in the multi-touch condition may be more concerned with building a joint problem space than those who used paper. This study adds to our understanding of how using multi-touch technology may influence collaborative interactions, which is essential to our understanding of how to design learning activities that use this technology.

References

Higgins, S., Mercier, E., Burd, L. & Joyce-Gibbons A. (2012). Multi-touch tables and classroom collaboration *BJET,* 43 (6), 1041–1054. DOI: 10.1111/j.1467-8535.2011.01259.x

Harris, A., Rick, J., Bonnett, V., Yuill, N., Fleck, R., Marshall, P., & Rogers, Y. (2009). Around the table: are multiple-touch surfaces better than single-touch for children's collaborative interactions? *Proceedings of the 9th international conference on Computer supported collaborative learning-Vol 1* (335–344).

Higgins, S. E., Mercier, E., Burd, E., & Hatch, A. (2011). Multi-touch tables and the relationship with collaborative classroom pedagogies: A synthetic review. *ijCSCL*. doi:10.1007/s11412-011-9131-y