Materiality Constraining and Enabling Collaboration in Secondary School Maker Centered Learning

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Abstract: This study analyzes the active role of materiality within collaboration in maker-centered learning. Collaborative making requires teams to manage the design task and organize their work processes simultaneously. Taking a case study perspective on a co-invention project, we focused on one team, wherein participation was unevenly distributed. While the making task enabled embodied contribution, the tools and materials also limited these opportunities. Neither social nor material aspects alone determined the participation within the team.

Sociomateriality of collaboration

Collaboration within small teams of students has been investigated rigorously, especially from the perspectives of collaborative talk and actions (e.g., Buchholz, Shively, Pepper, & Wohlwend, 2014). However, less attention has been directed to the material aspects of collaborative teamwork. The role of tools and materials has been acknowledged in negotiations of participation (Rowell, 2002) and the control of the process (Buchholz et al. 2014), as well as in interaction (Day & Wagner, 2014). Authors of studies taking a sociomaterial perspective (Barad, 2007) consider materials to be more than passive mediators of human actions and argue that social and material are constitutively entangled (e.g. Toohey & Dagenais, 2015). The fixed properties of materials do not determine the meaning of materiality; rather, this meaning is performed through relations (Orlikowski, 2007). In this study, our aim was to track the dynamic, active role of materiality as a constraint and an enabler for the collaboration within a small team.

Research context and methods

During spring 2018, we conducted a co-invention project with a secondary school in Finland. An open-ended design task challenged teams of students aged from 13 to 14 years to "invent a smart product by relying on traditional and digital fabrication technologies." The eight-week project involved three preparatory sessions and ten design sessions. The focus in this study was on one of the student teams, consisting of two girls and one boy: Mary, Lisa, and John, who designed a smart pillow. The data consisted of 12 hours and 42 minutes of video recordings from the team's design sessions.

We analyzed the data across three levels (Ash, 2007). At the macro level, we created a process rug (Figure 1), which revealed unevenly distributed participation, as one of the students (John) mostly engaged in non-task-related activities. The intermediate level allowed for the identification of relevant events, the moments of contact between John and the other team members or the shared object. Furthermore, we identified which materials were involved in these actions. The micro-level focused on the relations among the students and the materials, by focusing on details.

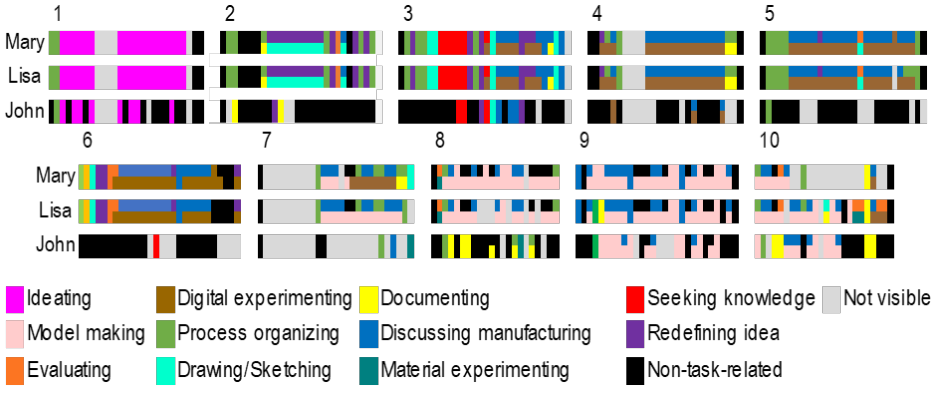

Figure 1. Process rug of the team's design activities. Time flows from left to right: numbers 1 through 10 are the design sessions. Colors illustrate various verbal or embodied actions.

Findings

When the team focused on coding, their preliminary ideas regarding the pillow's functionalities were refined or discarded. The physical microcontroller provided feedback in response to the code, and the team worked intensively around the microcontroller and a single laptop. The illustration below (Figure 2) shows how John tried to approach the coding task, but after a while gave up. The laptop, as a material object, was small and singular and did not invite multiple students to work with it simultaneously. However, the material alone did not determine the nature of participation, which was instead sociomaterially entangled (Orlikowski, 2007). Mary and Lisa found a way to work together on the singular laptop; only John was excluded.

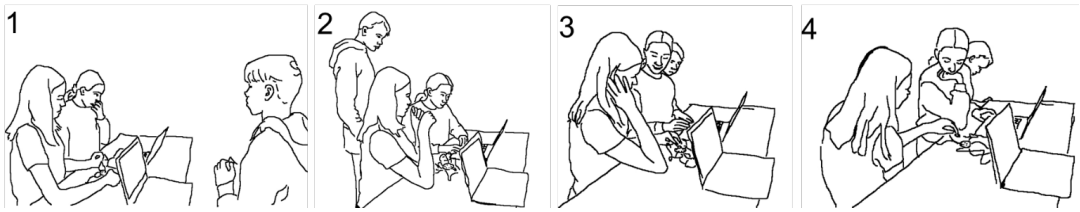

Figure 2. The size and shape of a laptop constrains opportunities for participation.

When John first proposed that he could also sew, Mary and Lisa delegated the task of making the portfolio to him. The physical materials invited him to tinker. Eventually, after John had persistently restated that he would like to sew, all three team members managed to work together around the same pillowcase. The sewing task allowed him to take part in the collaboration through embodied means and transformed his participation from that of an observer to that of a contributor (Rowell, 2002). The material setting provided enough tools for three students and provided various options for multiple simultaneous tasks. Furthermore, the materiality offered a means of participation beyond verbal discussions (Day & Wagner, 2014; Toohey & Dagenais, 2015).

Conclusion

Co-invention projects offer diverse opportunities for participation and collaboration. The multisensory qualities of physical materials can invite students towards the joint task and provide embodied access points for contribution. However, support from the teacher is needed, especially regarding the division of labor. Sufficient material resources as well as scaffolding the social aspects of teamwork are needed to ensure that opportunities to participate are available to all team members. This is a preliminary case study. In the future, we plan to develop the methodology of sociomaterial video analysis and apply it to larger video data set in order to gain further insight into the roles of tools, materials, and space.

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