Interacting with Technology to Interact Physically: Investigating Affordances of Tabletops to Facilitate Collaboration for Conflicting Users

Preben Hansen[1(✉)], Fernando Loizides[2], and Andri Ioannou[3]

[1] Interaction Design and Design for Learning Stockholm University, Stockholm, Sweden
preben@dsv.su.se
[2] Emerging Interactive Technologies Lab, University of Wolverhampton, Wolverhampton, England
fernando.loizides@wlv.ac.uk
[3] Cyprus Interaction Lab, Cyprus University of Technology, Limassol, Cyprus
andri.i.ioannou@cut.ac.cy

Abstract. In this work, we investigated the affordances of tabletops in order to begin testing them within a specialised and sensitive collaborative learning environment; namely, that with users in conflict. We utilised a bespoke prototype application named '*IdeaSpace'* which makes use of multi-touch interactive tabletop technology and is specifically designed to encourage user collaboration. We tested the usability and interaction with a group of users as a pilot test, followed by a second test in a shared space with crowds of users serendipitously using the tabletop in an open, public space. From the tests we identified and isolated findings directly relating to collaboration elements needing attention before introducing *IdeaSpace* to participants in conflict.

Keywords: Collaboration · Tabletop technology · Conflict

1 Introduction and Motivation

Collaborative Information Learning focuses on the notion that information interaction is not always a solitary activity and that people working in collaboration for learning tasks should be supported. One of the strengths of collaborative learning or problem solving is that all the team members are working towards solving a common ultimate goal. This fact is a key element needed to encourage communication between individuals. It is through collaboration and achievement that relationships and negotiations are hypothesized to be strengthened and improved [11]. The need for communication and collaboration to solve common problems is paramount in the setting where conflict exists between two or more parties of individuals. Collaborative learning as a teaching model has gained a wide acceptance and attention in recent years [1]. Collaborative activities may occur synchronously or asynchronously, be co-located or remote [7, 12]. Tabletop interaction mainly belongs to the same time/same place. The potential of multi-touch interactive tables to support collaboration and group work has, to date, been discussed in relatively few studies [8, 13, 14]. A table that handles multiple simultaneous touch

D.K.W. Chiu et al. (Eds.): ICWL 2016, LNCS 10013, pp. 266–270, 2016.
DOI: 10.1007/978-3-319-47440-3_30

inputs is considered to enable collaboration by allowing different patterns of turn taking, negotiation and interaction [3, 4]. It has also been suggested that multi-touch tabletops increases learners' engagement in 'creative conflict' [2]. A key factor in using tabletop technology is its value in encouraging interaction and willingness to participate [6]. In [1], the authors make a distinction between studies on and principles of single-tabletop environments and multi-tabletop environments. Besides general encouragement to participate, using tabletop technology has also equity in physical interaction compared with other devices [5], promote joint attention on the task and improve the (learning) experience and motivation to engage in the task [3]. Our work involves physically bringing together individuals which have conflict, either due to racial or cultural background differences and to encourage dialogue and team building as a means of acceptance between the involved parties. In the specific case of conflict, the facilitator wishes to present a common problem to the involved participants which will not cause debate as to a suitable solution. The solution of the problem should cause a benefit for all parties involved thereby causing a situation where a Nash Equilibrium is applicable [9, 10]. We report on findings from pilot testing the IdeaSpace application of space physicality and user behavior.

2 IdeaSpace Overview

IdeaSpace (See Fig. 1) is a bespoke application which is custom built to work on the Samsung Surface (codenamed SUR40). SUR40 is a digital table top which detects 50 touch points, thus allowing for multiple users to manipulate the interface simultaneously, making it ideal for collaborative work [15].

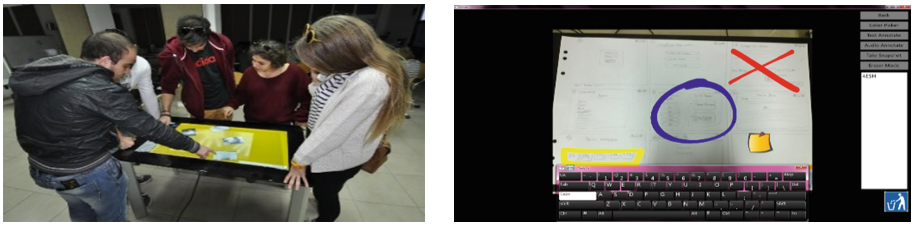

Fig. 1. Students using IdeaSpace (left) and the IdeaSpace Interface with Annotations (Right) running on the Samsung Surface Interactive Tabletop

IdeaSpace aims to allow users to collaboratively prototype interfaces, posters, ideas and generally anything that can be digitally or physically presented. Each project can hold digital designs (images) of brainstorming ideas. These can be added either from an external source such as a camera /USB pen drive or by the application taking advantage of the scanning technology of the SUR40 to allow users to scan designs they made physically. This happens from placing a paper on the surface on the tabletop and pressing the 'scan image' button. Once these designs are loaded from the different sources, the users can then proceed to discuss and annotate the ideas. Annotations can be done using voice recording, 'finger paint annotations' or text (keyboard based) annotations. Several

annotations can be taken for each image by all users. Each annotation including a screenshot can then be uploaded to Facebook in order to share the thoughts with other stakeholders and receive feedback.

3 Pilot Study

We recruited 4 teams of 4 participants per team. Participants were both undergraduates (12) and post-graduates (4) from multimedia related disciplines. Participants were given a common task to load images of on interface design they wished to create and to use the capabilities of tabletop and ideaSpace to suggest improvements. After each weekly session (a total of 2) with the software the participants were interviewed for qualitative feedback. The participants' behavior and screen contents were monitored by an observer. A second testing phase also involved observing the use of the tabletop application in a public environment when the number of participants is not predetermined and test for serendipitous usage. The public space included a 5 h long exhibition with over 3000 attendees of all ages. Over 100 participants in varying group numbers and ages interacted with the tabletop. The observational findings were analyzed by visual inspection both in real time independently and confirmed and agreed upon post-study through collaborative discussion by three investigators.

Participant Roles: Coordinators, Active Contributors and Passive Contributors. During the interaction participants engaged in giving feedback to their team on elements of the designs that they thought needed improving or changing. Usually, one of the team members took over the interactive part of manipulating the interface, we dub this person as the *Coordinator*. The most dominating and enthusiastic individual would take it upon himself to take charge of the activity and directed the activity and discussion, placing the most verbal and haptic into the activity. In the case of the open table display, an individual who remained by the tabletop when others left and therefore 'had experience' in using the technology would become the coordinator when other participants joined in. Besides the coordinator, the other participants would be either *Active Contributors* - participants that were heavily involved within the discussions and would sometimes even take over the coordinating process temporarily - or *Passive Contributors* - participants that were mostly uninvolved with the discussion and collaboration process and only contributed via material they provided. **Encouraging transfer of information.** Transfer of information, especially between users with conflict is vital to encourage mutual understanding. The participants would collaboratively comment on the usability and suggest different alterations to the interfaces unitedly - giving a shared problem to deal with. What was noticed in the task, as well as from feedback given later by the participants is that the collaborative effort would help participants understand better different views and perspectives, even if they were not all agreed upon. **Physical Space Positioning.** Physical positioning is important when users are in conflict. During the pilot test we observed two limitations to do with the spatial layout of the tabletop and applications. The uses were not instructed on how to position themselves. The application ideaSpace, is suitable for an audience sitting around the table during overview mode of the prototypes, while more specialized tasks, such as annotating an image is better

done by one side of the tabletop. Other software, such as ideasMapping [5], are specifically designed for all the functions to facilitate all four sides of the table with equal opportunity to use the software. ideasMapping saw users sitting on the four sides of the table (See Fig. 2: left). In the ideaSpace example, the users adapted themselves around the table, mostly towards the viewing orientation (See Fig. 2: right).

Fig. 2. (Left) User Position compared to the tabletop. (Right) Users adapting to the tabletop environment. Usually the coordinator is located in the middle of the width of the table.

References

1. Kharrufa, A., Martinez-Maldonado, R., Kay, J., Olivier, P.: Extending tabletop application design to the classroom. In: Proceedings of the 2013 ACM International Conference on Interactive Tabletops and Surfaces (ITS 2013), pp. 115–124. ACM (2013)
2. Basheri, M., Munro, M., Burd, L., Baghaei, N.: Collaborative learning skills in multi-touch tables for UML software design. Int. J. Adv. Comput. Sci. Appl. **4**(3), 60–66 (2013)
3. Buisine, S., Besacier, G., Aoussat, A., Vernier, F.: How do interactive tabletop systems influence collaboration? Comput. Hum. Behav. **28**(1), 49–59 (2012)
4. Gutwin, C., Greenberg, S.: A Descriptive Framework of Workspace Awareness for Real-Time Groupware. Kluwer Academic Press, CSCW (2001)
5. Ioannou, A., Zaphiris, P., Loizides, F., Vasiliou, C.: Let'S talk about technology for peace: a systematic assessment of problem-based group collaboration around an interactive tabletop. Interacting with Computers, iwt061.I.S (2013)
6. Piper, A.M., Hollan, J.D.: Tabletop displays for small Group study: affordances of paper and digital materials. In: Proceedings of CHI 2009, 1227–1236. ACM (2009)
7. Rodden, T., Blair, G.: CSCW and distributed systems: the problem of control. In: Proceedings of ECSCW, pp. 49–64, Amsterdam, The Netherlands (1991)
8. Rogers, Y., Lindley, S.: Collaborating around vertical and horizontal large interactive displays: which way is best? Interact. Comput. **16**(6), 1133–1152 (2004)
9. Cournot, A.: Researches on the Mathematical Principles of the Theory of Wealth (1838)
10. Nash, J.F.: Equilibrium Points in N-person Games. Proc. Natl. Acad. Sci. **36**(36), 48–49 (1950)
11. Mintzberg, H., et al.: Some surprising things about collaboration—Knowing how people connect makes it work better. Organ. Dyn. **25**(1), 60–71 (1996)
12. Johansen, R.: Computer support for Business Teams. The Free Press, New York (1988)
13. Morris, M.R., Cassanegro, A., Paepcke, A., Winograd, T., Piper, A.M., Huang, A.: Mediating group dynamics through tabletop interface design. IEEE Comput. Graph. Appl. **26**(5), 65–73 (2006)

14. Harris, A., Rick, J., Bonnett, V., Yuill, N., Fleck, R., Marshall, P., et al.: Around the table: are multipletouch surfaces better than single-touch for children's collaborative interactions? In: Proceedings of CSCL, ICLS, 335–344 (2009)
15. Ioannou, A., Loizides, F., Vasiliou, C., Zaphiris, P., Parmaxi, A.: Tabletop support for collaborative design: an initial evaluation of IdeaSpace. Educational Media Intern. 1–12 (2015)