When Two Hands Are Better Than One: Enhancing Collaboration Using Single Display Groupware

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ABSTRACT

In this paper, we describe Single Display Groupware, a software model that enables multiple users to work simultaneously at a single computer display. We discuss the collaborative benefits observed during a pilot study of the SDG application, KidPad.

Keywords

CSCW, Children, Single Display Groupware, educational application, input devices, Pad++, KidPad.

INTRODUCTION

Most current computer applications are designed to support the tasks of a single user manipulating a single input device. It is not uncommon, however, for users to work together at a computer during a collaborative task. For example, limited resources in U.S. elementary school classrooms often provide students the opportunity to work in groups and share access to computer technology.

An important role of education is encouraging group work—building teams and developing communication skills. Regrettably, kids may be growing up believing technology has no place in encouraging group work, and that instead, technology is about one kid controlling the application while all others sit and wait.

Researchers have shown significant learning advantages can be obtained by turn taking with two mice in collaborative environments and that there are tasks which kids preferred to perform with a friend rather than alone [2]. These benefits suggest the exploration of an alternative software model, Single Display Groupware (SDG), which enables groups of users to perform actions simultaneously by allowing the application to communicate with multiple input-devices [3].

Previous work in SDG includes the MMM system by Bier and Freeman [4] and the work on Collaboratively Controlled Objects (CCO) by Bricker [5]. Although MMM was an important proof-of-principle architecture, the authors never demonstrated any collaborative benefits of SDG. Bricker's CCO work investigated only very limited kinds of user interaction.

This study investigates the collaborative benefits of a SDG version of the KidPad hypermedia story-creation application [1].

METHOD

The pilot study involved 72 local elementary school children between the ages of 8 and 12. We observed them during 40 sessions over a period of three months. The authors participated alongside the users, asking questions, suggesting tasks, and answering questions. Qualitative data were collected through observations and from reviewing and scoring video recordings of 28 of the sessions. Our findings were compiled from the topics most frequently discussed by the users or those behaviors most often observed during the sessions.

The first phase of the project was to assess a baseline of collaborative behavior when collaborating with a single input-device program. We chose to use KidPix, a familiar children's drawing program that does not include any special support for collaboration and is often used by educators in collaborative settings. The children participating in this phase were asked to draw a story together, requiring them to share control of the single input-device.

The second phase of the project involved developing a similar application within an SDG architecture. Using the results of our baseline study as a guideline, a version of our KidPad drawing environment [1] was developed that supported communication with multiple input-devices.

Finally, to test the hypothesis that collaborative behavior would be enhanced by enabling multiple concurrent input-devices, the collaborative behavior of a second group of children was observed using KidPad. Pairs of children were observed in two different settings, with a single or with multiple input-devices. The single input-device condition allowed us to better compare users' behavior across the baseline application and the SDG environment. It also made it simpler to parcel out any significant differences in the multiple input-device condition that were the result of enhanced collaboration.

ACM SIGCHI '98 (Late-Breaking Result)

BASELINE STUDY

The baseline study using KidPix showed us the problems using existing software tools in a collaborative setting. There was a great discrepancy between behavior observed for the active, mouse controlling, partner and the passive, non-controlling, partner. The following behaviors were typical:

- The passive user often pointed at the screen in an attempt to physically manipulate screen objects and interact more directly with the application. There was an average of 8 pointing events every 10 minutes.
- Users fought for control of the input device. There was an average of 5 attempts every 10 minutes. These ranged in severity from both partners always keeping their hands near the mouse to having one partner physically restrain the other.
- The quality of communication was less collaborative. Most talk was from the passive partner issuing orders to the active partner. Only 6 of the 28 groups scored showed behavior where the active partner actively solicited opinions from the passive partner.
- Lack of attention: the passive user tired of watching and looked away from the task an average of 3 times every 10 minutes.
- Frustration: the passive user expressed irritation over not being an equal participant in the collaborative effort an average of once every 10 minutes.

These differences centered on a single theme: the passive partner desires to maintain some level of control or involvement.

To test the potential collaborative benefits of SDG, we chose to develop an application that enabled users to create dynamic, hypermedia stories—a real-world task deemed important by other educators [1]. We worked together with groups of students where the kids were our partners in design. The application developed thus far is of low to moderate complexity, with the ability to draw and move graphical shapes; to configure tool color and pen width; and to erase and unerase graphical objects.

COLLABORATIVE BENEFITS OF SDG

The most straightforward benefit we witnessed in the SDG setting was enhanced collaborative communication. This included: soliciting help from partners, offering to 'show' partners how to perform a task (as opposed to doing it for them), and fewer verbal commands. Partners often helped each other by gesturing with their own input device, or, if needed, by giving up control of their input device. Since helpers could demonstrate a task while the user continued working along side, the frequency of student-student peer interaction and student-teacher interaction are increased, and the character of the collaboration was radically altered.

Additional observations of how two input devices enhanced collaboration included:

- The kids had more fun, smiled more, and looked at each other more often. Even the two kids who said they liked KidPix better never let their attention wander away from the activity.
- Curiosity and exploring the interface was enhanced: users swapped input devices, learned to use tools together, erased each other's work, tried to use multiple devices on one tablet, and even tried four-handed manipulation of a single input device.
- Kids were aided in their ability to find things, because they could do it *together*—so if a task is problem solving or creative in nature, SDG supports collaboration, which in turn supports the task.

CONCLUSION

We have demonstrated collaborative benefits for an SDG application of low to moderate complexity. The baseline study revealed significant hindrances that centered on the passive user's need to maintain some level of control over the program and involvement in the task. By introducing a second input device, not only did these difficulties disappear, but also new collaborative possibilities emerged, such as the increased potential for peer teaching/learning.

Our research focus now becomes 'when are two hands *not* better than one', or 'how complex can SDG applications become without introducing frustration and sacrificing functionality'.

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