Give and Take: Children Collaborating on One Computer

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Abstract

When two children work together on one computer, it is necessary for them to share the input devices. This study examines the effects of having multiple mice with two different control passing protocols: *Give* and *Take*. The results suggest that having two mice instead of a single mouse affects the performance of a pair of children playing on a shared computer. This result was gender dependent in that girls solved the most puzzles in the *Give* condition while boys solved the most puzzles in the *Take* condition. Moreover, boys in the *Take* condition exhibited a larger number of exchanges of control than all other experimental conditions.

Keywords:
CSCL, CSCW, input devices, interaction styles, computers in education, children.

Introduction

Children naturally gather in groups around computers, especially to play games. Children observed playing electronic games at Science World B.C. during the summer of 1993 seemed to prefer to play in groups and often appeared to be more successful as a result of collaboration [2, 4]. Numerous researchers have investigated cooperative learning for both computer and non-computer tasks and have found significant benefits in achievement and social aspects [3, 5]. Despite these advantages, many classrooms continue to use the computer only as a tool for individual use.

We believe that in some situations, learning is not necessarily best when one student works on a single computer. Rather, the environment of multiple students collaborating around a single computer provides unique interactions that can result in improvements both in achievement and in attitude towards the task. One way this can happen is through students having to verbalize their ideas in order to work together. This elaboration reinforces the learning process.

The focus of the research reported here is to investigate alternative ways for groups of children to interact with a single computer. One interesting characteristic of children playing single-player video games is that occasionally one of the children will sit holding the inactive controller while waiting for a turn. Why is it important to hold on to a device that has no impact on the game? Perhaps there is a heightened sense of control? Video games often have multiple controllers, but computer games seldom have multiple mice. This study investigates whether having multiple input devices for a single-user computer game affects the interactions between the children and their achievement in the game. Different protocols for passing control between the two mice are explored.

METHOD

The study took place at Science World B.C., during August 1994. The subjects were 132 children (66 girls and 66 boys) between the ages of 9 and 13 who volunteered to play the computer game *The Incredible Machine*, a puzzle-solving game produced by Sierra featuring a wide variety of simulated tools used to construct machines to solve particular challenges. A typical challenge includes building a machine to shoot a basketball into a hoop.

The game was modified for this study to accept input from two mice, but there was still only one cursor active on the screen. Control was passed back and forth between the two mice using one of two protocols described later in this section. Children were placed in same-sex pairs and told that they could play the game together on a shared computer for as long as they wanted, up to a maximum of thirty minutes. They were given a brief introduction to the game and were shown how to transfer control back and forth between the two mice. They were then instructed to try to solve at least the first three puzzles. The children were given no instruction on how to play the game but were supplied with the game manual.

Two different protocols were employed for passing control of the cursor: *Give* and *Take*. These protocols were implemented using two-button mice. The left button was used to play the game (as in the single-player version) and the right button passed control between the two mice. In the *Give* condition, when Partner A pressed her/his right mouse button, control of the cursor would be passed over to Partner B's mouse and vice versa. In the *Take* condition, either partner could take control by pressing her/his right mouse button at any time. The times and number of exchanges were logged automatically by the system.

Our new results were compared to results from an earlier study that examined children playing *The Incredible Machine* with a partner on either one or two computers, or alone on a single computer [1]. The results of the earlier study showed that children playing together on one computer solved significantly more puzzles than either children playing side-by-side on two computers or children playing alone on a single computer. We compared our new results for children playing together with two mice on a single computer with the results obtained in the previous study for children playing together with one mouse on a single computer.

RESULTS AND DISCUSSION

The ability for each child to have his/her own mouse significantly affected performance in the game, as did the protocol used for passing control when two mice were used – see Figure.

In the two-mouse condition using the *Give* protocol, girls solved significantly more puzzles than they did in the one-mouse condition ($p < .05$); there was no significant difference between the mean number of puzzles solved in the two-mouse *Take* condition and the one-mouse condition. The mean number of puzzles solved by boys using the two-mouse *Take* protocol was higher than for the one-mouse condition, although this was not statistically significant ($p < .2$). The difference between the two control passing protocols, *Give* and *Take* was statistically significant for the boys ($p < .06$). Compared to the one-mouse condition, the mean number of puzzles solved by boys went up in the *Take* condition and down in the *Give* condition.

The average number of exchanges per session was relatively consistent over all conditions except for boys in the *Take* condition. All conditions averaged around 30 exchanges per session except boys in the *Take* condition, which averaged 46 exchanges ($p < 0.5$).

Behaviors observed in the two-mouse conditions were different from the condition of only one mouse. There appeared to be fewer struggles over control when using two mice. This could be the result of not being able to prevent a partner from taking control. Another difference was observed in the *Give* mode. Occasionally, when a child was not paying attention, the active child would say "Here, you try now" and then press the button to pass over control. This brought the disinterested child back on task.

The children in this study easily adapted to the addition of the second mouse to the game. They appeared to enjoy having this option and, when asked, most of the children stated that they would prefer having two mice.

CONCLUSIONS

The results of this study indicate that the addition of a second mouse to a single player game can affect achievement in the game. This shows potential for increased performance by modifying interactions between the children and the computer. The type of protocols used to transfer control between the two mice in this study had very different results based on gender. This suggests that careful consideration of gender differences is necessary when dealing with interactions accompanying cooperative uses of computers. Further studies are being performed to determine how concurrent interactions with multiple mice affect children's performance and attitudes.

These studies are part of a large-scale project on Electronic Games for Education in Math and Science (E-GEMS), a collaborative effort among scientists, mathematicians, educators, professional electronic game and educational software developers, classroom teachers and children. The goal of E-GEMS is to increase the proportion of children who enjoy learning, mastering and using math and science concepts. Electronic games in this context include both video and computer games. E-GEMS is funded by the Natural Sciences and Engineering Council of Canada, Electronic Arts, Apple Canada, the Province of British Columbia and UBC.

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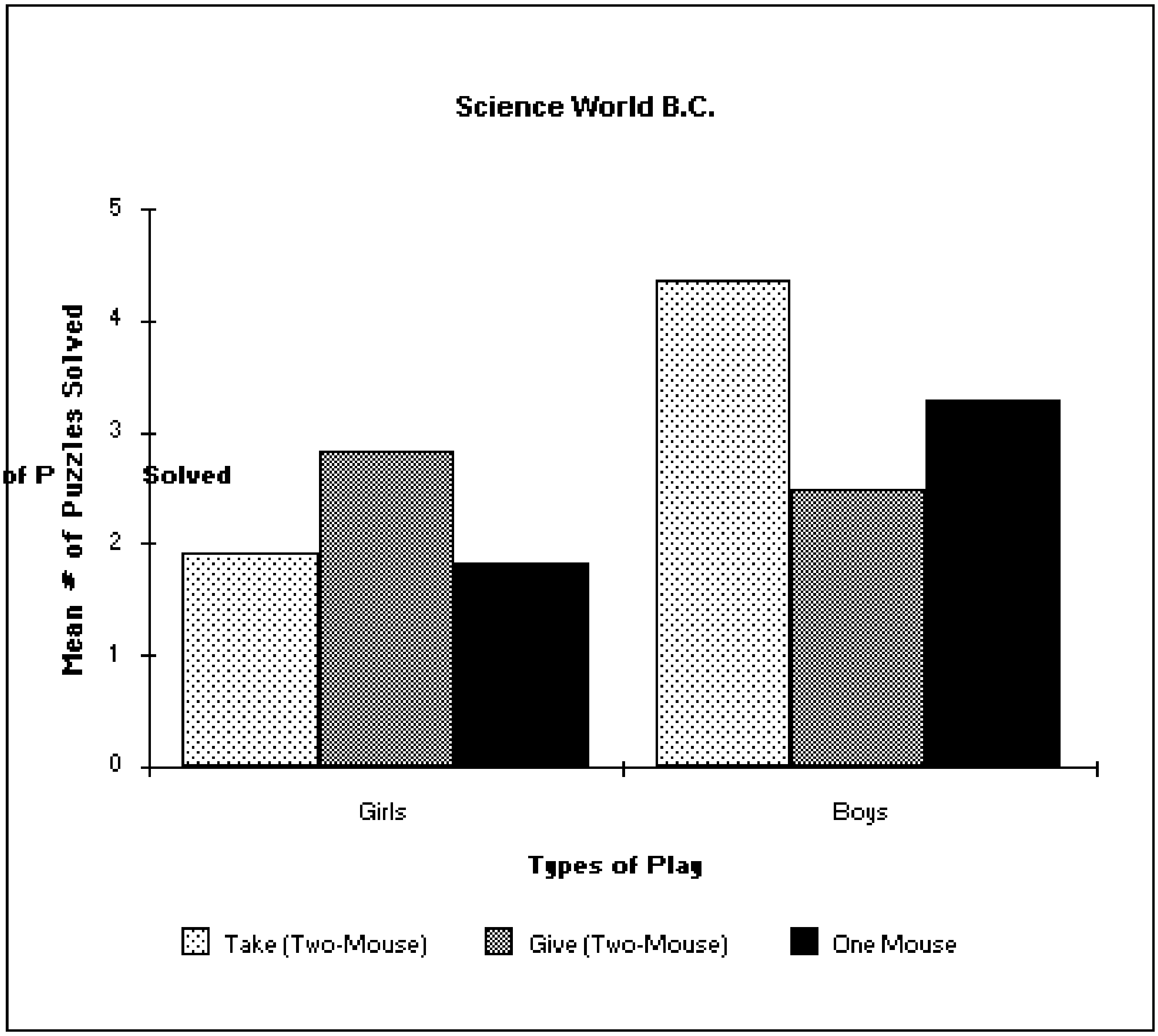
Science World B.C.
Mean # of Puzzles Solved
of P Solved
5
4
3
2
1
0
Girls
Boys
Types of Play
Take (Two-Mouse)
Give (Two-Mouse)
One Mouse