

Effects of Learning From Interaction With Physical or Mediated Devices

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Probably the most important finding from the ecological psychology perspective is that learning occurs when physical organisms interact with their physical environment (Reed, 1996). Mediated environments by definition interfere with this learning mechanism. Yet, increasingly, educational experiences are being mediated through the use of educational television, educational videos, educational software, and on-line courses. Any educational experience that is mediated by a video screen interrupts the coherent learning experience in at least two ways, regardless of the content of the experience: the mediated learning experience interrupts the coherent physical environment of which the learner is an integral part, and the mediated learning experience interrupts the coherent, contingent environment in which the learner's actions are directly related to the consequences of those actions. This study examined the effect of this interruption on children's learning of a novel device. Specifically, we hypothesized that children would learn to use the chinese abacus better when learning on a physical, wooden, abacus, than on a simulation of a chinese abacus.

Method

We worked with 60 third grade children (mean age = 8.95 years, $SD = .56$) of whom 32 were girls and 28 were boys. The children were randomly assigned to learn either from a physical, wooden Chinese abacus or from a virtual, simulated, Chinese abacus. Following brief direct instructions on how to use the abacus to represent small numbers, the children were given practice, using either the wooden or the simulated abacus. Afterwards the children were tested three ways: they did a

recognition test, they did a performance test, and they were given a learning challenge. The full details of the methods used can be found in Flanagan (1996).

The recognition test consisted of 12 small pictures of an abacus, each representing a different number between 1 and 30. The children were asked to "read" each picture and to write down the number that was represented by the abacus. The number of correct answers and the length of time spent on this task were recorded.

The performance test tested their ability to use the abacus to represent numbers they had practiced, as well as numbers larger than they had practiced. There were seventeen practiced numbers and seventeen new numbers included in the performance test. The number of correct answers and the length of time spent on this task were recorded.

Finally, the children were challenged to learn something not covered in the instructions: They were asked to try to use the abacus to add two numbers together, such as "7 + 4". Students were categorized as "spontaneous adders" if they were able to show, without any instruction, that they could use the abacus to start with seven and then add four more to it. They were categorized as "prompted adders" if they were able to use the abacus to add following the prompt "If you start with seven, could you add four more to that?" Students were categorized as "non-adders" if this additional prompt drew nothing but a blank look.

Results

These data supported the hypothesis that children learn better when they are interacting directly with physical materials than when their educational experience is mediated by a video screen, depending on how you define "better". There was no difference between the wooden and simulated abacus users on the recognition test. That is, both groups had roughly the same proportion correct on the recognition test (.91 or .89) and spent roughly the same amount of time (177 s or 166 s).

There was a significant difference, however, between the wooden and simulated abacus users on the performance test. Children who learned and practiced on the wooden abacus were able to produce significantly more ($p < .001$) correct representations (.97) on the abacus than the children who learned and practiced on the simulated abacus (.74) for the practiced numbers and significantly more ($p < .001$) correct

representations (.90) on the abacus than the children who learned and practiced on the simulated abacus (.58) for the new, or non-practiced, numbers. Children who had learned on the wooden abacus also spent significantly less ($p < .05$) time performing this task (120 s) than children who had learned on the simulated abacus (198 s).

Finally, there was a significant asymmetry in the distribution of spontaneous adders, prompted adders, and non-adders over the medium used for learning, such that there were significantly more prompted adders and fewer non-adders among those who used the wooden abacus rather than the simulated abacus ($\chi^2(2) = 9.19, p < .01$).

Discussion

The data supported the hypothesis that children who learn by interacting directly with a physical device will learn better than children who learn by interacting with a mediated version of the device, depending on how "better" is defined. Clearly, if learning is defined, and assessed, by using paper and pencil recognition tests then it doesn't matter whether children interact directly with the physical device or experience a mediated version of the device, according to these data. However, if learning is defined, and assessed, not as what the child is able to recognize, but as what the child is able to do, then the hypothesis is clearly supported by these data. In the performance tests, involving the production of both practiced and new numbers, children who had interacted with the physical device were able to produce more correct numbers than the children who had the mediated version of the device, and they were able to do it faster. Furthermore, when challenged to go beyond the material the children who had interacted with the physical device were significantly more successful than those who had had the mediated experience.

References

- Flanagan, R. C. (1996). *Learning through direct vs. indirect experience: The role of interactivity and physicality in media effects*. Ann Arbor, MI: UMI Dissertation services.
- Reed, E. S. (1996). *The necessity of experience*. New Haven, CT: Yale University Press.