

COMPUTERS AS COGNITIVE TOOLS IN DEVELOPMENT AND EDUCATION

Review of *Children and Computers (New Directions in Child Development, No. 28)*,
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At first, most superficial, glance, what is most striking about this book is the absence of mention of the two most researched uses of computers with children: programming and drill-and-practice software. This is all to the good, for, instead, the authors consider interesting and innovative computer applications about which little is currently known. Some examples are animation (Forman), simulation (Chaillé and Forman), and kinetic imagery problems (Klein).

At a deeper level, the unique contribution of this volume is that almost all of the authors are struggling with the question of whether and how the computer as medium privileges or even creates certain kinds of symbol systems. This struggle is most at the forefront in George Forman's discussion of what he terms kinetic print, an "alphabet of movements." For Forman, Chaillé, and Klein, the emphasis is on the ability of the computer to represent movement and transformation in schematic visual imagery, thus opening up possibilities for children to understand process as well as product (Forman and Chaillé) and to develop transformational imagery skills (Klein).

Although Forman and Chaillé concentrate on computer representation as a way to develop notions of the physical world, they also join Klein in considering the potential of computer graphics to produce more general cognitive, and even metacognitive, effects: Spatial thought (Klein), theory-testing (Chaillé), and an ability to distinguish physical fact from display artifact (Forman). Further pursuing this theme, Andrea diSessa, in his chapter, gives an example in which dynamic computer graphics embody and therefore stimulate a new conception of the conventions of spatial and movement representation. Traveling further into metacognition, diSessa focuses on the possibilities for computers to develop in the learner self-reflexive notions of his or her own mental processes: "The conjecture here is that the notion of representation, supported by a computational context, can serve to open up understanding to close inspection and hence to improve intuitive epistemology" (p. 114).

Several authors consider the special forms of interactivity by which children produce their own symbolic representations on a computer screen. Forman observes how preschool children create computer graphics using interactive devices such as joystick, touch pad, light pen, and instant replay. As these children grow older, it will perhaps be second nature to them to take advantage of more specialized graphics programs, using the computer to create artistic, architectural, and dance compositions, a subject discussed in Klein's chapter.

In the chapters by Forman, Chaillé, and Klein, one theme is that the computer makes visible and accessible physical transformations and movements that are, for practical purposes, invisible or inaccessible in the real world. The goal is to make the learner more aware of these transformational processes. In Dennis Wolf's chapter on word-processing, he too exploits the transformational potential of the computer. However, he does so to make the researcher, rather than the learner, aware of transformational processes. Unlike the other authors in another way, Wolf is concerned with the transformation of words, not images. Essentially, he uses the computer to keep a record of movements and changes in written compositions as children do electronic editing. The goal is for the researcher to learn more about the cognitive processes involved in the development of writing and rewriting skills.

The computer as a tool to learn about, rather than influence, cognitive development is also the theme of Roy Pea's chapter. Pea makes the original and intriguing proposal that we should consider computer and child as a single system in the assessment of cognitive development and intelligence. Just as we would not deprive a child of paper and pencil in assessing intellectual skills, Pea asks whether it will, in the future, make sense to do cognitive testing in the absence of the artificial intelligence tools provided by the computer.

True to the title of the series, *New Directions in Child Development*, this book presents ideas and speculations more than hard data. In this respect, it is a stimulating volume. At times, however, interesting speculation becomes unnecessary vagueness when the reader cannot tell whether a proposed computer technique has actually been tried or is still merely an idea in the head of the author. This was a problem with Chaillé's description of her computer pendulum bowling simulation for preschool children and with Forman's discussion of a programmable robot for the same age group.

On the other side of the coin, it was refreshing to read, in chapters by Klein and Forman, of systematic empirical comparison between the effects of symbolic representation on the computer and in other media (although more procedural details would have been helpful in Klein's study). Forman found that, in comparison to playing with three-dimensional characteristics and objects, playing with the same elements on a computer screen made children more aware of movement and action (vs. character identity and motivation with three-dimensional objects). Comparing dynamic computer graphics to realistic video, Klein found that the computer led to better solutions of kinetic and transformational imagery problems for secondary school and college students, but not for elementary school children.

An important strength of this book lies in its attempt to link a wide variety of educational computer applications to theories of cognitive development. This link to developmental theory is especially strong in the chapter of Chaillé, who concentrates on Piaget, and Pea, who concentrates on Vygotsky.

From a pragmatic point of view, *Children and Computers* will be of particular value to those interested in computer applications to preschool education, simply because so little research has so far been done on computer use in this age group. *Children and Computers* will also make an excellent book of readings for a

developmentally oriented communications course that has a primary or secondary focus on computer technologies.

From a conceptual point of view, another great strength of the book lies in its unified and expanded view of computer as cognitive tool, whether tool of the cognitive learner or tool of the cognitive researcher. Happily, the metaphor of tool and tool user has replaced the older conception of stimulus and subject. The ultimate image of computer as tool appears in Pea's vision of joining "the powerful information-processing system of the computer with the frail information-processing system of the human mind" (p. 87). "With the integration of human and computer intelligent systems, we may be able to attenuate human processing limitations" (p. 88). This is a book that will be of interest to all those concerned with the developmental implications of such a vision.