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**Artificial Intelligence and Education, Volume One: Learning Environments and Tutoring Systems.** Edited by R.W. Lawler and M. Yazdani. Published by Ablex Publishing, 355 Chestnut Street, Norwood, New Jersey 07648; 1987, 439 pp., paperback, \$19.95.

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Microcomputers are becoming as powerful as mainframes were a decade ago. As a result, sophisticated educational applications based on ideas from artificial intelligence (AI) and cognitive science will soon be available to schools and families. Over the next decade, this shift to devices that understand what and how and to whom they are communicating will trigger a transformation in teaching and learning. The more we understand intelligent educational applications, the better we can structure their implementation to maximize benefits and minimize problems.

*Artificial Intelligence and Education* summarizes illustrative research from an international conference held in 1985. Too often, books which present conference papers are like

Frankenstein's monster: a disjoint accumulation of ill-fitting pieces. Fortunately, editors Lawler and Yazdani do an excellent job of interlinking the different chapters and providing an overall perspective for the reader. The book's introduction sets forward its goals and structure, and each section has a prefatory chapter by the editors explaining the interrelationships of its papers.

#### Two Approaches

The book juxtaposes two alternative approaches to educational AI: Intelligent Tutoring Systems (ITS) and Computer-based Learning Environments. ITS extends traditional computer-assisted instruction (CAI) to incorporate knowledge representation approaches, dynamic student models, and pedagogical styles tailored to individual needs. In contrast, Computer-based Learning Environments focus on providing a rich experiential context that students can explore without formal guidance. These contrasting research directions correspond roughly to the distinction between teacher-centered and student-centered educational philosophies.

The Computer-based Learning Environments section is centered on the concept of "microworlds": simplified realities rich in symbolic objects which allow learners to explore the rules governing natural phenomena.

For example, in a physics microworld a pupil could alter the law of gravity and observe how that change affected planetary orbits. Such a learning environment facilitates the transition from solving standard textbook problems to applying formal theories in complex real-world settings.

The chapters in this section describe applications of microworlds in algebra, reading, geometry, programming, and design. Interspersed with these illustrations are several papers which analyze, from a cognitive science perspective, how microworlds complement the mind's learning processes. As a whole, the material on Computer-based Learning Environments builds a persuasive case why information technology, properly used, can enhance rather than impoverish students' experience of reality.

The ITS section contains chapters illustrating tutoring applications for teaching physics, mathematics, programming, medicine, and industrial system control. As in the previous section, these papers on specific systems are interleaved with chapters discussing the design and utility of intelligent instructional devices. Overall, the ITS descriptions indicate why these systems are an evolutionary step beyond CAI and depict leading edge challenges and opportunities in the field.

For readers unfamiliar with AI and cognitive science, *Artificial Intelligence and Education* is intermediate in its technical difficulty. The book is not intended as an introduction for novices, but the typical subscriber to *Educational Technology* will readily understand most of the material. Lay readers who wish to understand the subtler nuances in some chapters may profit from prior reading of books on general work in AI and cognitive science. Possible sources include *Artificial Intelligence: How Machines Think* (F.D. Peat; Baen Books, 260 Fifth Avenue, NY, NY 10001; 1985, 370 pp., paperback, \$8.95) and *The Mind's New Science: A History of the Cognitive Revolution* (H. Gardner; Basic Books, New York; 1987, 430 pp., paperback, \$12.95).

#### Conclusion

In summary, *Artificial Intelligence and Education* is well worth reading. This book makes a significant contribution to understanding the next gen-

eration of instructional computing. The conceptual and computational barriers which have limited the utility of intelligent devices are disappearing; and all of us must be prepared for their advent in workplace, school, and home settings. Building bridges between artificial intelligence researchers and educational practitioners will be a vital step in actualizing the promise of instructional AI. ☐

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