Computer Center

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Educational Computing Books: Continuing Growth and Diversity

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A suggested sign of growth and diversity in a field is the growth and diversity of its publications. Judged by this standard, educational computing is very much alive and prospering (another indicator is the large number of titles that include subtitles!). Not only have the number of publications increased, but they have improved in quality, with many now focusing on recently created topics and research results. In addition, several have begun to integrate advances from several fields. The large number of books in educomputing probably also reflects the size of the potential book market constituted by educators in all disciplines.

The publications described below in no way exhaust available titles. Rather, they have been chosen to represent the diversity of books that have recently appeared. For reviews of other books see the *American Biology Teacher* of March 1983 (pages 167-169).

Alessi, S.M. & Trollip, S.R. (1985). *Computer-based instruction: Methods and development.* Englewood Cliffs, NJ: Prentice Hall, Inc. Softbound. 418 pages. $22.95.

This is the most thorough and readable text that I have seen to date on the subjects of design and development of educational software. Readers will not find a review of specific software, but after reading this text they will be able to design their own and evaluate others' effectively. After an overview of computer hardware, software and applications throughout society, the authors focus on methods of computer-based instruction. The authors' research backgrounds in formal education and in instructional computing design are evident from their discussions of the process of instruction itself as well as the major ways in which computers are being used (tu-torials, drills, simulations, instructional games and tests).

Educomputing has progressed far enough that each of these approaches now is characterized by a unique set of properties important to learning efficiency. For example, simulations have seven major components, one of which is its context. In turn the context itself has ten factors, including the object being simulated, precision, and the level of realism. The software designer must decide which option in each factor is best for each situation. In a way this is analogous to a research scientist who must make many decisions in the process of performing an experiment. In both cases the success of the activity depends to a considerable degree on choices among the options available for each factor.

The authors devote the remainder of the book to the actual development of computer-based instructional materials. After reviewing several others' approaches they introduce their own eight step procedure. The book concludes with an index and appendices. One appendix summarizes the instructional factors for each strategy, while another provides a checklist to evaluate the quality of educational software.

Bork, A. (1985). *Personal computers for education.* NY: Harper and Row, Publishers, Inc. Softbound. 179 pages.

The author has attempted to write the first complete book on the use of computers in education. His basic organizing principle for the book is that pedagogical issues take precedence over such technical details as the nature of hardware. The first of the book's three parts is titled, "Modes of Computer Learning." It examines programming, computer literacy, intellectual tools, computer-based learning and management systems. By intellec-tual tools Bork means devices that extend the human intellect and expand the power of our minds. As the author himself explains, the book's second part concerns various topics, ranging from the advantages and disadvantages of educomputing and the basics of computer hardware, to developing curriculum material for computers. Two chapters about the future of computing constitute the third part. Written in a conversational style, the book is a discussion of the world of educational computing as seen through the eyes of a veteran in the field.

Culp, G. & Nickles, H. (1983). *An Apple for the teacher: Fundamentals of instructional computing.* Monterey, CA: Brooks/Cole Publishing Co. Softbound. 239 pages.

This is a practical book designed especially for educators who want to know the basics of BASIC and principles of their use in educomputing. Written in a light and entertaining style the book nevertheless achieves its objectives. It can be read profitably in the individual study mode, but it also can serve as an excellent medium for inservice workshops. Chapters contain both listings and sample outputs of instructive programs. Several relevant and readable appendices include a basic introduction to using the Apple computer and Applesoft BASIC. For an informative and easy introduction to fundamental BASIC and instructional design for educators, this is a good source.

Dennis, J.R. & Kansky, R.J. (1984). *Instructional computing: An action guide for educators.* Glenview, IL: Scott, Foresman and Company. Softbound. 256 pages.

The authors state that their book's

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". . . single goal is to promote educators' thoughtful selection and use of both computerized courseware and the devices needed to deliver it." Each of the 14 chapters evolved from a "paper" by persons of the Instructional Computing Advisory Committee of the East Roachment New York Independent School District. The current authors revised and expanded them. This is a readable and informative book that achieves the authors' goal (in spite of some of the simulated text screen displays on pages 157-160 being upside down!). Since certain memos and other documentation are included, it also might serve as a case study for one method to raise the educomputing consciousness of different types of people in the education process. The book is not written in the usual textbook format. Being unique in its approach, some readers will value it as the best introduction to instructional computing for practicing educators while others will be less than enthusiastic!

Harper, D.O. & Stewart, J.H. (Eds.). (1983). *RUN: Computer education.* Monterey, CA: Brooks/Cole Publishing Co. Softbound. 245 pages. $16.95.

To satisfy the needs for preservice and inservice instruction in computer literacy, the authors have assembled about 50 articles relevant to microcomputers in precollege education. With many of them written by recognized leaders in the field, they fall under categories that include learning theory, computer literacy, software and hardware evaluation, ethical and social issues and exceptional students. Valuable inclusions at the end of each section are a set of (mental!) exercises and a series of statements under the heading, "What's Your Opinion?" The latter are excellent springboards for meaningful discussions in small groups, as written assignments, or even as the nucleus of teaching via the Delphi methods (the Delphi method in a computer setting allows students and the teacher to enter their comments on a topic into a computer file accessible to all; in a way it is an electronic bulletin board focused on topics being taught).

Heines, J.M. (1984). *Screen design strategies for computer-assisted instruction.* Bedford, MA: Digital Press. 159 pages.

The title correctly describes its contents: factors to consider when designing video screen layout and strategies to attain optimal design. Aspects covered include the following: functional areas (subdivisions of the screen that are used consistently for a given purpose throughout the entire program); design and placement of visual symbols; menus; aspects of text display; and a screen design tools (e.g., text and graphics editors). A final chapter explores certain aspects of CAI style (i.e., guidelines for program personalities effective in CAI). This is a somewhat dry book about prosaic but important aspects of one component of CAI programming.

Judd, D.H. & Judd, R.C. (1984). *Mastering the micro: Using the computer in the elementary classroom.* Glenview, IL: Scott, Foresman and Company. Softbound. 152 pages.

This readable, terse book is an excellent introduction to using computers in the elementary classroom. It also can be read profitably by administrators and high school educators who wish an understanding of what is or could be done with computers in the primary grades. The following are among the topics covered: software selection; use of LOGO, PILOT and BASIC as programming resources; program creation; word processing to aid in reading and writing skills; and computer managed instruction. The book's objectives are met through such approaches as inclusion of case studies of computer use in the elementary classroom, programming examples and descriptions of short classroom activities. For word processing, several commercial programs are described, including Grammatik, a prose editor. Among other abilities, it automatically checks punctuation, improper capitalization and words and phrases that are commonly misused.

Kearsley, G. (1983). *Computer-based training: A guide to selection and implementation.* Reading, MA: Addison-Wesley Publishing Co. 204 pages.

This book can serve as a guide for administrators involved with computer-based training (the term for education in industry and government). It covers such major steps and topics as the feasibilty study; types of computer-based training systems; design and development of courseware for such systems; and their implementation, management, evaluation, limits and potential. This would be a useful book for educators because it helps us realize that formal education also extends beyond college. Just as important, the book addresses several aspects of the process that most others do not, including management and revision of educomputing projects, and the involvement of additional factors such as other media and student guides.

Liao, T.T. & Miller, D.C. (1977). *Systems approach to instructional design.* Farmingdale, NY: Baywood Publshing Co. Softbound. 153 pages.

This is a collection of articles grouped into three categories: design and implementation of instructional systems: a systems approach; use of technology in specific learning environments; and evaluation systems and technology. An attraction of this book is its extension of something we bio-educators already know but rarely think about: the educational process operating in our course is a system with many components. Both by considering its components in detail and by estimating what effect a change in one component will have on all others, we should be able to predict more exactly how such changes affect learning. Another nice feature is inclusion of several articles that go beyond the usual formal education years. For example, it is interesting to compare our individual approaches with the Air Force's method called Instructional System Development.

Sleeman, D. & Brown, J.S. (Eds). (1982). *Intelligent tutoring systems.* New York: Academic Press. 345 pages. $39.50.

Artificial intelligence (AI) received much media attention since it is an essential part of the so-called Fifth Generation of computer technology. Simply stated, AI is an attempt to design machines that exhibit intelligent behavior (do not be upset when you discover that everyone's concept of intelligent behavior is different!). Education is a natural use for AI because intelligent programs can help students learn more. Ideally, it could be like having a group of intelligent assistants giving individualized attention to students. Looked at in another way, such programs can free human educators to concentrate on teaching even higher cognitive concepts. This is the ideal, and AI in education is still far from it, especially for microcomputers.

Development of such systems requires consideration of many factors since in addition to the subject matter, the computer also must possess pedagogic expertise. Sleeman and Brown, two leaders in the field of AI in education, have assembled a series of articles that summarize major projects in this field (seven of the articles appeared in the January 1979 issue of the *International Journal of Man-Machine Studies*). Perhaps of more value for

bioeducators, the articles convey some idea of the thinking, level of pedagogic detail and computer hardware required for truly intelligent tutoring systems. The articles' titles convey some idea of what is involved. They include: misconceptions in students' understanding; towards a process model for high school algebra errors; the genetic graph—a representation for the evolution of procedural knowledge; student modelling; ACE—a system which analyzes complex explanations; and tutoring rules for guiding a case method dialog. It is clear that even simple intelligent tutoring is a complex process! But there is no doubt that educomputing is moving in this direction.

Steinberg, E.R. (1984). *Teaching computers to teach*. Hillsdale, NJ: Lawrence Erlbaum Associates. 185 pages. $24.95.

This readable book's purpose is "to present procedures and principles for designing instruction delivered by computer." It is intended both for people who have taught but who have never designed instruction and for those who have designed before but not for computers. Topics covered include lesson design; presentation; responses and feedback; human factors and management; displays and overall lesson structure; evaluation; games, drills and simulations; and efficiency, implementation and learning how to learn. One result of reading a book such as this is the inescapable realization that thorough planning is essential to the design of sound instructional materials. We all know this, but since sound educational computing is a multistage process that requires considerable effort, we are being forced to put it into practice.

Walker, D.F. & Hess, R.D. (Eds). (1984). *Instructional software: Principles and perspectives for design and use*. Belmont, CA: Wadsworth Publishing Co. Softbound. 308 pages.

This is a collection of 21 articles grouped into five categories: issues in the eduational use of computers; principles of software design for education; strategies for developing educational software; evaluating educational software; and prospects for the future of computer-based education (three of the four articles of this last section concern artificial intelligence). The five categories reflect major areas that must be considered in the design and/ or use of computers in education. The articles could be read independently or they could form the basis for group

discussions, be they part of formal courses or workshops, or a journal club!

White, MA. (Ed.). (1983). *The future of electronic learning*. Hillsdale, NJ: Lawrence Erlbaum Associates. 85 pages. $19.95.

The seven papers constituting this book were first presented at a 1982 conference at Columbia University's Teachers College. Revised for a reading audience, they address both the new kinds of learning and the new forms of teaching that will develop from electronic learning. Specific topics include how children learn from electronic sources; a psychology of electronic learning; implications of electronic learning for curriculum and instructions; and the future of electronic learning. The somewhat general nature of the articles and the considerable price for 85 pages will cause potential purchasers to think twice before buying.

Willis, J.W., Johnson, D.J. & Dixon, P.N. (1983). *Computers, teaching and learning: A guide to using computers in schools*. Beaverton, OR: Dilithium Press. Softbound. 257 pages. $9.95.

A well organized and clearly written introduction to several aspects of educational computing. The first chapters set the context of computer assisted education by focusing on such topics as current applications and selection of educational computers. Aspects of BASIC, PILOT and Logo are presented, with emphasis on BASIC. Types of educational uses are described under the headings of CAI, computer managed instruction, and applications in assessment and evaluation. A final chapter contains information sources including periodicals, program suppliers, books publishers, organizations and computer data bases.

A SPECIAL REQUEST: I would appreciate any material or suggestions from readers that would help me improve either or both of two book manuscripts that I am writing: "Artificial Intelligence in Education and Training" and "A Directory and Review of Biology Software." For the latter, your suggestions (and reasons) for the best and worst biology programs would be most appreciated. Please sent your comments and suggestions to Ted Crovello at one of the addresses given in the biography. Thank you!

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Bacteriophage

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Bacteria host an interesting and unique group of viruses known as bacteriophage or phage. Although each phage type has a high degree of host specificity, it is probable that all species of bacteria are parasitized by one to several phages. The importance of this viral group should not be minimized by the beginning biology student, because much of our present understanding of host-parasite relationships and molecular genetics has been elucidated through phage research.

Figures 1 and 2 depict an *Escherichia coli* T2 phage; however, bacteriophages occur in a diversity of shapes and have a variety of reproductive schemes. In this example, the phage particle or virion (Figure 1) consists of a head and a tail. The head is polyhedral and contains a single strand of DNA. The tail is characterized with a collar, a hollow core or tube covered by a contractible sheath and six tail fibers attached to an end plate.

Phage multiplication (Figure 2) is initiated when the phage particle attaches by way of the tail fibers to a specific receptor site on the cell wall of the bacterium, a process known as adsorption (Figure 2). Phages are not only host specific but are usually strain specific and infect only certain strains or varieties of a particular bacteria species. Following adsorption, the phage sheath contracts, the hollow tube in the tail is inserted through the cell wall and the nucleic acid is injected into the host cell's cytoplasm. Essentially, this viral DNA reprograms the bacterium to replicate additional phage nucleic acid, synthesize viral proteins and assemble the new phage particles (up to 200 particles per cell). Phage lysozyme promotes lysis of the bacterium, and the liberated phage particles are now available to infect adjacent susceptible