

006
7
Int

Interactive Multimedia in Education and Training

Sanjaya Mishra
Indira Gandhi National Open University, India

Ramesh C. Sharma
Indira Gandhi National Open University, India



IDEA GROUP PUBLISHING

Hershey • London • Melbourne • Singapore



Acquisitions Editor: Mehdi Khosrow-Pour
 Senior Managing Editor: Jan Travers
 Managing Editor: Amanda Appicello
 Development Editor: Michele Rossi
 Copy Editor: Lori Eby
 Typesetter: Amanda Appicello
 Cover Design: Lisa Tosheff
 Printed at: Yurchak Printing Inc.

Published in the United States of America by
 Idea Group Publishing (an imprint of Idea Group Inc.)
 701 E. Chocolate Avenue, Suite 200
 Hershey PA 17033
 Tel: 717-533-8845
 Fax: 717-533-8661
 E-mail: cust@idea-group.com
 Web site: http://www.idea-group.com

and in the United Kingdom by
 Idea Group Publishing (an imprint of Idea Group Inc.)
 3 Henrietta Street
 Covent Garden
 London WC2E 8LU
 Tel: 44 20 7240 0856
 Fax: 44 20 7379 3313
 Web site: http://www.eurospan.co.uk

Copyright © 2005 by Idea Group Inc. All rights reserved. No part of this book may be reproduced in any form or by any means, electronic or mechanical, including photocopying, without written permission from the publisher.

Library of Congress Cataloging-in-Publication Data

Interactive multimedia in education and training / Sanjaya Mishra, Ramesh C. Sharma, Editors.
 p. cm.
 ISBN 1-59140-393-6 -- ISBN 1-59140-394-4 -- ISBN 1-59140-395-2
 1. Interactive multimedia. I. Mishra, Sanjaya. II. Sharma, Ramesh C.
 QA76.76.I59I5816 2004
 006.7--dc22
 2004003752

British Cataloguing in Publication Data

A Cataloguing in Publication record for this book is available from the British Library.

All work contributed to this book is new, previously-unpublished material. The views expressed in this book are those of the authors, but not necessarily of the publisher.

Interactive Multimedia in Education and Training

Table of Contents

Preface vi
Sanjaya Mishra, Indira Gandhi National Open University, India
Ramesh C. Sharma, Indira Gandhi National Open University, India

Part I: Planning and Design Considerations

Chapter I
Planning for Multimedia Learning 1
Patrick J. Fahy, Athabasca University, Canada

Chapter II
Toward Effective Use of Multimedia Technologies in Education 25
Geraldine Torrisi-Steele, Griffith University, Australia

Chapter III
Interactive Multimedia for Learning and Performance 47
Ashok Banerji, Monisha Electronic Education Trust, India
Glenda Rose Scales, Virginia Tech, USA

Chapter IV
Teaching, Learning and Multimedia 60
Loreen Marie Butcher-Powell, Bloomsburg University of Pennsylvania, USA

Chapter V
Reaching Students of Many Languages and Cultures: Strategies for Developing Computer-Based Learning Units 73
Rika Yoshii, California State University, San Marcos, USA
Alfred Bork, University of California, USA
Alastair Milne, California State University, San Marcos, USA
Fusa Katada, Waseda University, Japan
Felicia Zhang, University of Canberra, Australia

Chapter VI	Designing for Learning in Narrative Multimedia Environments	101
	<i>Lisa Gjedde, Danish University of Education, Denmark</i>	

Part II: Pedagogical Issues

Chapter VII	Principles of Educational Software Design	113
	<i>Vassilios Dagdilelis, University of Macedonia, Greece</i>	

Chapter VIII	Multiple Representations in Multimedia Materials: An Issue of Literacy	135
	<i>Michael Sankey, University of Southern Queensland, Australia</i>	

Chapter IX	Empirical Validation of a Multimedia Construct for Learning	158
	<i>Paul Kawachi, Kurume Shin-Ai Women's College, Japan</i>	

Chapter X	Multimedia, Cognitive Load and Pedagogy	184
	<i>Peter E. Doolittle, Virginia Polytechnic Institute and State University, USA</i>	
	<i>Andrea L. McNeill, Virginia Polytechnic Institute and State University, USA</i>	
	<i>Krista P. Terry, Radford University, USA</i>	
	<i>Stephanie B. Scheer, University of Virginia, USA</i>	

Chapter XI	Cognitive Skill Capabilities in Web-Based Educational Systems	213
	<i>Elsbeth McKay, RMIT University, Australia</i>	

Chapter XII	Usable and Interoperable E-Learning Resources Repositories	249
	<i>S. Retalis, University of Piraeus, Greece</i>	

Part III: Applications and Case Studies

Chapter XIII	Interactive Multimedia and AIDS Prevention: A Case Study	271
	<i>José L. Rodríguez Illera, University of Barcelona, Spain</i>	

Chapter XIV	Interactive Learning in Engineering Education	289
	<i>Katia Tannous, State University of Campinas – Unicamp, Brazil</i>	

Chapter XV	An Embedded Collaborative Systems Model for Implementing ICT-based Multimedia Cartography Teaching and Learning	306
	<i>Shivanand Balram, Simon Fraser University, Canada</i>	
	<i>Suzana Dragičević, Simon Fraser University, Canada</i>	

Chapter XVI	Cave Automated Virtual Environment: A Supercomputer-based Multimedia System for Learning Science in a Science Center	327
	<i>Leo Tan Wee Hin, Nanyang Technological University, Singapore</i>	
	<i>R. Subramaniam, Nanyang Technological University, Singapore</i>	
	<i>Sharlene Anthony, Singapore Science Centre, Singapore</i>	

Chapter XVII	Multimedia Learning Designs: Using Authentic Learning Interactions in Medicine, Dentistry and Health Sciences	350
	<i>Mike Keppell, Hong Kong Institute of Education, Hong Kong</i>	
	<i>Jane Gunn, The University of Melbourne, Australia</i>	
	<i>Kelsey Hegarty, The University of Melbourne, Australia</i>	
	<i>Vivienne O'Connor, The University of Queensland, Australia</i>	
	<i>Ngairé Kerse, University of Auckland, New Zealand</i>	
	<i>Karen Kan, The University of Melbourne, Australia</i>	
	<i>Louise Brearley Messer, The University of Melbourne, Australia</i>	
	<i>Heather Bione, The University of Melbourne, Australia</i>	

Chapter XVIII	Using an Interactive Feedback Tool to Enhance Pronunciation in Language Learning	377
	<i>Felicia Zhang, University of Canberra, Australia</i>	

About the Authors	400
--------------------------------	------------

Index	411
--------------------	------------

Preface

There have been many experiments and innovations in the field of education and training regarding knowledge delivery. From face-to-face to virtual education, different technologies have played great roles at different times. In the last two decades, due to the advent of computer technologies, information delivery has got new meaning. Development, access, and transfer of text, sound, and video data have given a unique face to classrooms, libraries, and training and resource centers, in the form of interactive multimedia programs.

Interactive multimedia as a subject/topic is still in its stage of infancy, which excites and attracts educational technologists. However, design and development of an interactive multimedia program is a complex task involving a team of experts, including content provider(s), multimedia developer(s), graphic designer(s), and, of course, the instructional designer(s), who most of the time plays the role of a project manager as well. This book is not about multimedia development, but the subject matter delves into the complex issue of planning, guiding, and designing multimedia from the instructional perspective. As such, we address pedagogical issues, applications, and effectiveness.

What is Interactive Multimedia?

Multimedia has been defined in a number of ways. It is not our intention here to go into the details of these definitions. But, in order to clarify the use of the term in the context of the book, we would prefer to quote a few of them:

Definition 1: "Multimedia is the combination of a variety of communication channels into a co-ordinated communicative experience for which an integrated cross-channel language of interpretation does not exist" (Elsom-Cook, 2001).

This definition gives way for two approaches—one that is termed the "multiple-media" utilization, and the other in which a combination of different channels acquires unification as a medium. The latter approach leads us to the next definition:

Definition 2: "... multimedia can be defined as an integration of multiple media elements (audio, video, graphics, text, animation, etc.) into one synergetic and symbiotic whole that results in more benefits for the end user than any one of the media elements can provide individually" (Reddi, 2003).

Definition 2 essentially tries to emphasize the second approach of Definition 1 with more clarity and spells out the components of multimedia. Taking a systems theory perspective, it also tells us that the overall effectiveness of multimedia is better than any one component of it. But, neither of the definitions explicitly includes the "interactive" power of multimedia, as in Definition 3:

Definition 3: "The term 'interactive multimedia' is a catch-all phrase to describe the new wave of computer software that primarily deals with the provision of information. The 'multimedia' component is characterized by the presence of text, pictures, sound, animation and video; some or all of which are organized into some coherent program. The 'interactive' component refers to the process of empowering the user to control the environment usually by a computer" (Phillips, 1997).

Though the authors of various chapters use different words and phrases throughout the book, the intentions are invariably in tune with Definition 3 referred to above.

Multimedia has been a favorite area for organizations as a means of training employees. McCrea and others (2000) and Urdan and Weggen (2000) found online training being given preference by organizations, considering that with this method, employees can be trained in less time, with less cost, and more effectively than with other methods. It has been found that integrating multimedia into course delivery certainly adds to the advantages (Najjar, 1996).

Authors of the various chapters in this book critically examine interactive multimedia as a tool for education and training in various settings. Much has already been said in the literature about how-to aspects of multimedia development (Boyle, 1997; Phillips, 1997; Villamil & Molina, 1998; Lachs, 2000; Elsom-Cook, 2001; Low et al, 2003; Reddi & Mishra, 2003). Here, the authors make

an attempt to build a theoretical understanding based on experience and research. The pictures projected in all these chapters are successful implementation stories of multimedia, and how it is useful as an educational tool. Nevertheless, there is a huge amount of literature on “no significant difference.” Kahn (n.d.), in a short review, questions the effectiveness of multimedia in online training but recommends that it has a place “where visual/ or auditory depiction could enhance the learning experience.” Contributors of different chapters share their innovative uses of the potentials of multimedia, and this is expected to further motivate and guide other teachers and readers to use multimedia in their teaching. The chapters in the book are organized in three parts—planning and design considerations, pedagogical issues, and application and case studies.

Planning and Design Considerations

Planning for multimedia is a much broader consideration than the design and development issues. It is important because the implementation of multimedia-enabled teaching and learning has to be integrated into an already existing system and practice. Moreover, issues such as media mix, choice, and teaching—learning functions should match the requirements of the subject. It is in this context that Patrick Fahy, in Chapter 1, discusses the characteristics of multimedia in relation to basic pedagogic tasks and organizational realities. He emphasizes that successful implementation of multimedia-enabled teaching and learning includes organizational change, changes in attitudes, and issues related to cost, acquisition of appropriate technologies, and human resources. In Chapter 2, Geraldine Torrisi-Steele provides conceptual guidelines and a planning framework for effective use of multimedia in education. Banerji and Scales in Chapter 3 review current developments in performance support systems and recommend use of interactive multimedia based on performance-centered design for teaching and learning. In Chapter 4, Loreen Butcher-Powell provides a theoretical framework for enhancing teaching through the use of Web-based multimedia. In Chapter 5, Yoshii and others discuss the Irvine-Geneva development strategy for computer-based learning materials that can be adaptable to many languages and cultures. Based on the experiences gained in the development of a group of software systems, the authors describe software characteristics and tools that can be successfully implemented in global education. In the last chapter of this part (i.e., in Chapter 6), Lisa Gjedde describes a narrative (storytelling) framework for designing multimedia learning environments.

Pedagogical Issues

Learning is primarily the process through which we become the human beings we are, and it takes place through a variety of media, strategies, and processes, of which interactive multimedia is just one. Using these media and technologies, we internalize information and knowledge available in the external world to construct our own experiences. Research into human learning is primarily categorized into three distinctive groups: behaviorism, cognitivism, and constructivism. There are others who also believe in experiential learning and andragogy. All of these have significance for the design and development of interactive multimedia. In this part dealing with theoretical issues, there are six chapters. In Chapter 7, Vassilios Dagdilelis discusses the principles of designing educational software and emphasizes that “construction of educational software should be based on some method; otherwise it is in danger of failing of costing too much or of being greatly delayed.” Michael Sankey, in Chapter 8, continues the discussion of multiple representations in multimedia materials raised in the previous chapter. Sankey reviews the issue of multimedia literacy of learners and investigates the learning styles, visual representations, and cognitive constraints experienced by the learners when information is presented in multiple ways. Based on these analyses, Sankey suggests a set of 12 design principles. In Chapter 9, Paul Kawachi discusses a four-stage model for learning critical thinking skills using multimedia. The four stages of Design for Multimedia Learning (DML) model are brainstorming cooperative group learning using synchronous media, lateral-thinking collaborative learning using asynchronous media, hypothesis testing in a collaborative synchronous manner, and experiential learning in cooperative synchronous media. Though this model is more about multiple-media use in teaching and learning, it has a new innovative framework to offer in the context of use of interactive multimedia on the Web. Peter Doolittle and others in Chapter 10 focus on multimedia and the effect of cognitive load on teaching, training, and learning. Based on a review of research, they present seven principles of multimedia design:

Individuals learn, retain, and transfer information better

1. when the instructional environment involves words and pictures rather than words or pictures alone (multimedia principle)
2. when the instructional environment involves auditory narration and animation rather than on-screen text and animation (modality principle)
3. when the instructional environment involves narration and animation rather than on-screen text, narration, and animation (redundancy principle)
4. when the instructional environment is free of extraneous words, pictures, and sounds (coherence principle)
5. when the instructional environment involves cues, or signals, that guide an

- individual's attention and processing during a multimedia presentation (signaling principle)
6. where words or narration and pictures or narration are presented simultaneously in time and space (contiguity principle)
 7. where individuals experience concurrent narration and animation in short, user-controlled segments, rather than as a longer continuous presentation (segmentation principle)

In Chapter 11, Elspeth McKay examines contextual issues involved in interactivity of multimedia instructional materials and the cognitive style construct as a meta-knowledge acquisition process. From a human-computer interaction (HCI) perspective, she describes a framework applicable in Web-based educational systems. In the next chapter (Chapter 12), Retalis looks into the issue of interoperability of multimedia learning objects. This chapter describes a brokerage system for the exchange of learning resources.

Applications and Case Studies

Interactive multimedia has applications in a variety of situations in education and training, in corporate presentation, in advertising, and in many other areas. In this part, there are six chapters presented as illustrative case studies of the application of multimedia. In Chapter 13, José Rodríguez Illera describes the use of interactive multimedia in AIDS prevention. The design of the multimedia package adopts some of the lessons outlined in Parts I and II of this book, especially the use of role play as narrative and the social construction of meaning that make it a successful program. Katia Tannous in Chapter 14 describes some examples of multimedia use in engineering education that extensively uses the power of simulation. In Chapter 15, Balram and Dragicevic report a new embedded collaborative system for structuring and managing multimedia in cartography teaching and learning. In Chapter 16, Leo Tan Wee Hin and others describe a multimedia system for learning science in an informal setting of a science center in Singapore. The authors present a case of high-quality visualizations, interactivity, immersive experiences, and stereoscopic imagery in the multimedia virtual environment that contributes toward experiential learning and has the significant influence of the constructivist approach. In Chapter 17, Mike Keppell and others describe the use of multimedia in dental and health science courses. Using a case-based learning design and learner-centered approach, the illustrative multimedia examples demonstrate the importance of instructional design. In the last chapter of the book (i.e., Chapter 18), Felicia

Zhang reports on the use of interactive feedback tools to enhance language learning, in this case, Chinese Mandarin.

Conclusions

In education and training settings, interactive multimedia packages have been found to be used as library-based multimedia resources for teachers and students; as supplementary curricular material for a specific course; as a tool for teaching and reinforcing analytic and reading skills and for building an entire course around the use and creation of multimedia materials (Bass, n.d.). In the modern society, where computer and Net technologies are becoming indispensable, the learning technologies are found to be deployed in all sectors: schools, colleges, universities, and industries. The emergence of the knowledge and educational content industry, the emergence of virtual campuses of learning, the availability of new learning and training tools, and the deployment of such tools to meet the diverse needs of learners have greatly influenced education and training systems. The needs for lifelong learning, just-in-time training, and retraining led to the development of widely accessible and reusable digital multimedia content and learning repositories. As the contributors of this book point out, the advantages are multifarious: increased interoperability, reusability, and individualization of digital learning materials. The learners are benefited in terms of increased quality, relevance, and contextualization of their learning.

The primary objective of *Interactive Multimedia in Education and Training* is to document and disseminate relevant theoretical frameworks and the latest empirical research findings and showcase illustrative examples of multimedia applications in various disciplines. The 18 chapters included in this book have attempted to achieve this objective and shall be useful to teachers, researchers, educational administrators, and policy makers as a one-step reference point on innovative use of multimedia, based on sound pedagogical principles. Nevertheless, there are still gray areas, such as the assessment of multimedia packages, their costs, and return on investment (ROI). In spite of this gap, it is expected that this book will encourage teachers/trainers and administrators to plan, design, develop, and implement interactive multimedia in educational settings: in basic, secondary, higher, and further education, and in business and industrial training.

References

- Bass, R. (n.d.). A brief guide to interactive multimedia and the study of the United States. Retrieved November 24, 2003 from the World Wide Web: <http://www.georgetown.edu/faculty/bassr/multimedia.html>
- Boyle, T. (1997). *Design for multimedia learning*, London: Prentice Hall.
- Elsom-Cook, M. (2001). *Principles of interactive multimedia* (p. 7). London: McGraw Hill.
- Kahn, D. (n.d.). How effective is multimedia in online training? *E-learning Guru.com White Papers*. Retrieved November 26, 2003 from the World Wide Web: <http://www.e-learningguru.com/wpapers/multimedia.pdf>
- Lachs, V. (2001). *Making multimedia in the classroom*. London: Routledge Falmer.
- Low, A. L. Y., Low, K. L. T., & Koo, V. C. (2003). Multimedia learning systems: A future interactive educational tool. *Internet in Higher Education*, 6, 25-40.
- McCrea, F., Gay, R. K., & Bacon, R. (2000). *Riding the big waves: A white paper on B2B e-learning industry*. San Francisco: Thomas Weisel Partners LLC.
- Najjar, L. J. (1996). *The effects of multimedia and elaborative encoding on learning*. Atlanta, GA: Georgia Institute of Technology.
- Phillips, R. (1997). *The developers handbook to interactive multimedia: A practical guide for educational developers* (p. 8). London: Kogan Page.
- Reddi, U. V. (2003). Multimedia as an educational tool. In U. V. Reddi, & S. Mishra (Eds.), *Educational multimedia: A handbook for teacher-developers* (pp. 3-7). New Delhi: CEMCA.
- Reddi, U. V., & Mishra, S. (Eds.). (2003). *Educational multimedia: A handbook for teacher-developers*. New Delhi: CEMCA.
- Urdu, T. A., & Weggen, C. C. (2000). *Corporate e-learning: Exploring a new frontier*. WR+Hambrecht & CO.
- Villamil, J., & Molina, L. (1998). *Multimedia: An introduction*, New Delhi: Prentice-Hall of India.

Acknowledgments

The editors would like to express their sincere gratitude and thanks to all those who directly or indirectly helped in the collation and review process of the book, without whose support, the project could not have been satisfactorily completed. Most of the authors of chapters included in this book also served as referees of articles written by other authors. In addition, many others provided constructive and comprehensive reviews on chapters. Some of those who provided the most comprehensive, critical, and illuminative comments include Dr. Som Naidu, University of Melbourne; Dr. Kinshuk, Massey University; Dr. Punya Mishra, Michigan State University; and Dr. Allison Littlejohn, University of Strathclyde—our sincere thanks to all of them.

A special note of thanks goes to all the staff at Idea Group Inc., whose contributions throughout the whole process from inception of the initial idea to final publication have been invaluable. Especially we are indebted to Mehdi Khosrow-Pour, Senior Academics Editor; Jan Travers, Senior Managing Editor; Michele Rossi, Development Editor; Amanda Appicello, Managing Editor; and Jennifer Sundstrom, Assistant Marketing Manager for providing support from time to time and dealing with our queries at a lightening speed. Their special interest in the publication, and professional guidance made it easier for us to complete the editing work on time.

We would like to thank our employer, the Indira Gandhi National Open University, and its staff members for their constant encouragement to do quality work. Dr. Sharma, especially would like to thank his wife, Madhu, and children, Anku and Appu, for their constant support and understanding.

Last but not the least, all the contributing authors of the book deserve special thanks for their excellent contributions, and we are grateful to all of them for having faith on us during the long development process of the book and for meeting the deadlines.

*Sanjaya Mishra
Ramesh C. Sharma
Editors*

About the Authors

Sanjaya Mishra holds a Ph.D. in Library and Information Science in the area of library networks. He has been a teacher of communication technology to distance educators. He has been involved in successful implementation of many multimedia and Internet-based courses, including a multimedia CD on multimedia. With professional training in distance education, television production, and multimedia, he is actively involved in collaboration at the international level. Currently, he is a senior lecturer at the Staff Training and Research Institute of Distance Education (STRIDE) at Indira Gandhi National Open University (IGNOU), New Delhi (India). Previously a programme officer of the Commonwealth Educational Media Centre for Asia (CEMCA) at New Delhi, he was engaged in conducting training programs in the application of multimedia in education in the Asian region. He has served as consultant to UNESCO, UN-ESCAP, and the World Bank. He was book review editor of the *Indian Journal of Open Learning* (1997-2000) and also edited a few special issues of the same journal. He is author/editor of five books and has contributed more than 60 research papers in reputed professional journals. He is on the editorial advisory boards of many reputed journals including *Distance Education*, *Malaysian Journal of Educational Technology*, *International Review of Research in Open and Distance Learning*, *Educational Technology and Society*, and *PUP Journal of Distance Education*. He is founder editor of the *Asian Journal of Distance Education*.

Ramesh C. Sharma holds a Ph.D. in Education in the area of Educational Technology and is currently working as regional director in Indira Gandhi National Open University (IGNOU) (India) (since 1996). Before joining IGNOU, Dr. Sharma was a senior faculty in a Teacher Training College for nearly 10 years and taught Educational Technology, Educational Research and Statistics, Educational Measurement and Evaluation, and Psychodynamics of Mental Health Courses for the B.Ed. and M.Ed. programs. He has conducted many training programs for the in- and pre-service teachers on the use of multimedia in teaching and instruction. He is a member of many committees on implemen-

tation of technology in the Open University. His areas of specialization include ICT applications, computer networking, online learning, student support services in open and distance learning, and teacher education. He is on the editorial board of referred and international journals in distance education. Dr. Sharma is on the editorial board of many reputed journals like *Distance Education*, *International Review of Research in Open and Distance Learning*, and *PUP Journal of Distance Education*. He is an editor of the *Journal of Information Technology Education* (Informing Science Institute, USA). He has co-authored one book on distance education research and contributed articles to referred journals. He is founder editor of the *Asian Journal of Distance Education*.

* * * * *

Sharlene Anthony is a senior scientific officer in the Life Sciences Department of the Singapore Science Centre. A marine biologist by training, she previously worked with marine mammals at Underwaterworld Singapore, with sea turtles at the Universiti Putra Malaysia, and with sea urchins at Dalhousie University, Canada. Currently, she is pursuing a master's degree at the Nanyang Technological University, Singapore, where she is exploring the linkages of the Singapore Science Centre with the formal education system.

Shivanand Balram is a lecturer in the Faculty of Natural Sciences, University of Guyana. At present, he is a researcher in the Department of Geography, Simon Fraser University, Canada. His nearly 12 years of academic, industry, and consulting experience have focused on geographic information systems and science, university teaching and learning, and physics. Shivanand has published in these areas and has developed "the embedded collaborative systems model for cartography education," "the 18i interactions model for blended learning," and "the collaborative spatial Delphi methodology for group learning and decision-making." His other interests include constructivist learning and Web-based instruction.

Ashok Banerji is an electrical engineer, who integrated management science and then multimedia computing to his professional attainments. His interest in e-learning, simulations, and just-in-time skill support led to one of the earliest Ph.D. research on Electronic Performance Support Systems (EPSS) at the University of Teesside, UK. He was director of Performance Consulting with a company based in Virginia (USA). As senior lecturer at the Education and Staff Development Department in Singapore Polytechnic in Singapore, he introduced courses on Educational Technology and Multimedia for Business and had R&D

funding for several projects on EPSS and multimedia-based training for semiconductor, marine industry, and virtual laboratory development. Currently, he is an adjunct professor in multimedia computing in Calcutta, and as a member of a philanthropic organization, he is working toward promotion of education leveraging technology. He was a consultant for International Telecommunication Union for a project on ICT for development.

Heather Bione is a dentist with a MDS (Melb), who became interested in computer-assisted teaching and learning while working in research with the Department of Restorative Dentistry, The University of Melbourne (Australia). In 1999, she developed seven treatment planning cases for restorative dentistry using the Pathfinder program. Since that time, she has been involved as a content expert, in all four modules, for the pediatric multimedia project developed by the Department of Pediatric Dentistry, The University of Melbourne.

Alfred Bork is professor emeritus of Information and Computer Science at the University of California, Irvine (USA). His degrees are from Georgia Tech and Brown University. Dr. Bork has been at the Dublin Institute for Advanced Studies, the University of Alaska, Reed College, and Harvard University. He directs the Educational Technology Center, a research and development group, in highly adaptive technology-based learning. He is vice president of A Bork Endeavors. Recent projects include production systems for highly adaptive learning, learning about the methods of science, improving reasoning capability, voice input to computers, learning Japanese, and education for all. The Scientific Reasoning Series and Understanding Spoken Japanese are commercially available. Bork is interested in the effective use of highly interactive multimedia technology to make order of magnitude improvements in learning at all levels. He has published hundreds of papers and books about these issues. The most recent book, with Sigrun Gunnarsdottir, is *Tutorial Distance Learning* (Kluwer).

Loreen Marie Butcher-Powell is an assistant professor of Business Education and Office Information Systems at Bloomsburg University of Pennsylvania, USA. Within the last two years, she has presented or published more than 15 publications on security and pedagogical techniques. She is NASA's International Advanced Spaceport Technology Working Group (ASTWG) Education and Outreach Committee board member, an international board of editors for the *Journal of Information Technology and Education*, a program committee member and international reviewer for the Informing Science and IT Education Conference in Pori, Finland (June 24-27, 2003), and an expert panelist for the AECT Project for the Pennsylvania State University at University Park, Pennsylvania (USA). Loreen has received the 2002 Teaching Academy Grant

from the Pennsylvania State University at Hazleton, Pennsylvania, and was a 2002 committee member for the \$100,000 Common Wealth College Networking Mini-Grant at Pennsylvania State University.

Vassilios Dagdilelis is assistant professor in the Department of Educational and Social Policy, University of Macedonia, Greece. With a Ph.D. in Applied Mathematics, Dr. Dagdolelis's current interest area includes use of computers in education and training, didactics of informatics, and e-learning.

Peter E. Doolittle is an assistant professor and current head of the Educational Psychology Program in the School of Education at Virginia Tech, Blacksburg, VA (USA). He is also co-director of the Metacognition and Multimedia Project (MMP) at Virginia Tech. His research focus includes the investigation of the development of cognitive and metacognitive strategies within multimedia environments.

Suzana Dragičević is an assistant professor in the Department of Geography, Simon Fraser University, Canada. She has 16 years of academic, governmental, and industry experience focusing on geographic information systems and science, geodesy and surveying, and university teaching and learning in multiple language settings. Her research and teaching interests include spatial data analysis and modeling, fuzzy sets, multimedia cartography, and Web-based GIS. She has published widely on technical and teaching aspects in her research areas. In addition, she has organized special issues for reputable journals, bringing together experts in her field of research.

Patrick J. Fahy is associate professor, Centre for Distance Education, Athabasca University (Canada). His career began with teaching in the public schools of rural Western Canada. From there, he moved to the Alberta college system, spending 20 years in teaching, administration, and research positions ranging from adult basic literacy to graduate-level programs. During this period, he served as newsletter editor and president of both the Movement for Canadian Literacy, and the Alberta Association for Adult Literacy. In the 1990s he moved to the private sector, spending over five years in a multinational technology-based training company, where he managed regional activities in maritime and western Canada. He has engaged in private consulting in the areas of program evaluation and project management across North America for over 25 years. Presently, in addition to developing and teaching educational technology courses in Athabasca University's Master of Distance Education program, Pat coordinates the MDE's Advanced Graduate Diploma in Distance Education (Technol-

ogy) program, and the annual MDE Distance Education Technology Symposium. He is a former president of the Alberta Distance Education and Training Association (ADETA).

Lisa Gjedde is an associate professor at the Danish University of Education (Denmark), where she is affiliated with the Research Programme for Media and ICT in a Learning Perspective. Her background includes a Ph.D. in Communications and Narrative Research, from the Department of Communications, Computer Science and Educational Research, University of Roskilde, Denmark. She has been a visiting research fellow at the University of Sussex, UK. She has done extensive research and development work in the areas of narrative learning processes, creative learning, and digital storytelling.

Jane Gunn is associate professor and research director in the Department of General Practice, The University of Melbourne (Australia). Jane is involved in women's and mental health research and teaching in addition to working as a general practitioner one day a week.

Kelsey Hegarty is a general practitioner and part-time senior lecturer responsible for postgraduate activities in the general practice department of The University of Melbourne, Melbourne. Her research and teaching interests are in women's health and, in particular, women's emotional well-being (partner abuse, depression, counseling). Her research experience includes a doctoral thesis on measurement and prevalence of partner abuse in general practice. She has had extensive teaching experience at undergraduate and postgraduate levels in the areas of communication skills, procedural skills, and management of common clinical problems. She has practiced as a general practitioner for over 15 years.

Leo Tan Wee Hin has a Ph.D. in Marine Biology. He holds the concurrent appointments of director of the National Institute of Education, professor of Biological Sciences in Nanyang Technological University (Singapore), and president of the Singapore National Academy of Science. Prior to this, he was director of the Singapore Science Centre. His research interests are in the fields of marine biology, science education, museum science, telecommunications, and transportation. He has published numerous research papers in international refereed journals.

Karen Kan is a specialist paediatric dentist in private practice in Melbourne, Australia. She completed her Bachelor of Dental Science (1992) and her Master of Dental Science (1996) at The University of Melbourne and gained her

Fellowship to the Royal Australasian College of Dental Surgeons in 1997. Karen has been a clinical research fellow in the Department of Dentistry, at the Royal Children's Hospital in Melbourne (1996), and an assistant professor in the Division of Pediatric Dentistry, School of Dentistry, University of Minnesota, USA (1997). Her current university involvement includes teaching and developing multimedia-assisted learning in pediatric dentistry.

Fusa Katada (Ph.D., Linguistics, University of Southern California) is professor of Linguistics and English at Waseda University, School of Science and Engineering, Tokyo, Japan. Dr. Katada has Teaching Credentials for Mathematics (Tokyo Metropolis Educational Committee) and Certificate in Teaching English as a Second Language (California State University, Long Beach). Dr. Katada was a linguistic programmer at SYSTRAN Inc. in the early 1980s for its English-Japanese machine translation system and was acknowledged as a Scientific Linguist by the U.S. Department of Labor. She had worked for Applied Computer Technology in Education: Upgrade directed by Robert Hertz at the California State University, Long Beach, and Understanding Spoken Japanese directed by Alfred Bork at the Educational Technology Center of the University of California, Irvine. Dr. Katada received her Ph.D. for her work on anaphoric relations in Logical Form. She specializes in formal linguistics: phonology, morphology, and syntax, with allied interests in biological foundations for language, atypical language, and dynamics of linguistic diversity.

Paul Kawachi has been teaching at universities for more than 20 years and is currently at the Department of Informatics, Kurume Shin-Ai Women's College, Japan. He has recently been awarded Doctorate of Education by the University of Hawaii. An award-winning author, Dr. Kawachi is founder editor of the *Asian Journal of Distance Education*.

Mike Keppell joined the Hong Kong Institute of Education (HKIED) as principal lecturer and head of the Centre for Integrating Technology in Education (CITIE) in January 2003. He was the former head of Biomedical Multimedia Unit, Faculty of Medicine, Dentistry and Health Science, The University of Melbourne (Australia). The CITIE is a design, development, evaluation, and research-based center that has a focus on enriching teaching and learning through educational technology. He is also the Information Technology Academic Development Coordinator for the HKIED and coordinates the implementation of the e-learning platform—Blackboard. The research interests of Dr. Keppell cover four areas: student-centered learning (problem-based learning, case-based learning, project-based learning, and online communities); multimedia design (conceptualizing, concept mapping, design processes); processes

involved in optimizing the instructional designer–subject matter expert interaction; and knowledge management (project management, systems and processes). His current interests at the Institute focus on technology-enhanced authentic learning environments, online communities, problem-based learning, and learner-centered assessment.

Ngair Kerse is a general practitioner at the University of Auckland, New Zealand. Her Ph.D. from the University of Melbourne was an evaluation of a comprehensive education program for doctors, and her continuing research interests aim to improve education for doctors, improve primary care of older people, and inform innovation in primary health care.

Elsbeth McKay is a senior postdoctoral research fellow on Human-Computer Interaction (HCI), at the School of Business Information Technology, RMIT University, Australia. Elspeth has extensive industry-sector experience in computer systems. Her Ph.D. (Computer Science and Information Systems) thesis breaks new ground for effective learning from multimedia with innovative approaches to visual instruction. She also has a Bachelor of Business, with distinction (Business Information Systems), a Graduate Certificate of Applied Science (Instructional Design), and a Graduate Diploma of Education (Computer Studies). Her doctoral research identified that not all individuals cope effectively with graphical learning. Elspeth's research findings clearly identify the complexity of the visual learning environment, and outline prospects for customizing e-learning shells, based on ontological requirements. The prospect of customizing e-learning shells tailored dynamically to the requirements of individual learners has stimulated contemporary research into knowledge mediation, and the associated ontological strategies, of actual learning contexts with Web-enabled asynchronous learning frameworks, design and development of enhanced accessibility through touch screen technologies. Elspeth's continuing commitment to mentoring scholastic achievement is also evident in the number of her international invited Editorships.

Andrea L. McNeill is a doctoral student in the Instructional Technology Program in the School of Education at Virginia Tech, Blacksburg, VA, USA. Her research interest lies in the development of multimedia learning environments designed to enhance learners' cognitive and metacognitive skills.

Louise Brearley Messer holds a Ph.D. in Nutrition from the University of Minnesota, USA, and is currently Elsdon Professor of Child Dental Health, and Director of Graduate Studies at The University of Melbourne, Australia. She is

responsible for the teaching of undergraduate dental students and postgraduate students in all aspects of pediatric dentistry. Much of this teaching today is done using interactive preclinical lab activities and currently developed multimedia modules such as those described in the chapter written by her in this book.

Alastair Milne has a B.Sc. in Computer Science from the University of California, Irvine (USA). He is an adjunct faculty member at California State University, San Marcos. Mr. Milne worked for more than 10 years with the UC Irvine project at the Educational Technology Center, and later with the CUI Geneva group, working on such areas as middleware support for programmers (especially in computer graphics); implementation of scripts; consultation with design teams on scripting procedures and strategy; and later with the incorporation of multimedia into Irvine's middleware support. He has authored and coauthored a number of documents on the system, some for programmers and some for pedagogical audiences. He has led the porting of the entire middleware system into a new operating system and the programming of prototype material using live video on digital videodisc. His current work includes consulting with Rika Yoshii at CSUSM on evolution of the whole strategy to improve scripting automation and to provide development for, and delivery by, the Web.

Vivienne O'Connor is an obstetrician and gynecologist at The University of Queensland, Australia.

S. Retalis is associate professor at the Department of Technology Education & Digital Systems, University of Piraeus, Greece. He holds a diploma of Electrical and Computer Engineer from the Department of Electrical and Computer Engineering studies, National Technical University of Athens, Greece, an MSc degree in Information Technology-Knowledge Based Systems from the Department of Artificial Intelligence, University of Edinburgh, Scotland, and a Ph.D. from the Department of Electrical and Computer Engineering, National Technical University of Athens, Greece. His research interests lie in the development of Web-based learning systems, design of adaptive hypermedia systems, Web engineering, and human-computer interaction. He has participated in various European R & D projects. He serves on the editorial board of international journals such as *Computers in Human Behavior*, *Educational Technology and Society*, *ACM Computing Reviews*, and *Journal of Information Technology Education*. He participates in the ACM Web Engineering special interest group, the IEEE Learning Technologies Standardization Committee, and CEN/ISSS learning technologies workshop.

José L. Rodríguez Illera is the director of the Research Center on Virtual Learning of the University of Barcelona (Spain), where he also teaches courses on Educational Multimedia at the Faculty of Pedagogy. His recent publications include books on *Multimedia Technology for Teaching and Learning in Higher Education* (2003), *Virtual Learning* (2003, in press), as well as articles on "Electronic Reading," "Collaborative environments and task design in the University," and "Multimedia Learning." His work is also focused on research and development. During the last 15 years, he and his group have developed both educational multimedia applications and open tools addressed to teachers, many of them related to language learning. Current interest is on the study of comprehension strategies of digital multimodal texts.

Michael Sankey currently works at the University of Southern Queensland (USQ) in Australia as an instructional designer at the Distance and eLearning Centre and a teacher of Web Design in the Faculty of Education. Michael's current doctoral research is in the areas of the multiple representations of concepts when utilizing multimedia technologies and how the use of these electronic environments can enhance the learning opportunities for students, particularly for those students studying at a distance. With a background in art and design, Michael is passionate about the way in which aesthetically enhanced learning environments can better transmit information and concepts to be communicated to students of all backgrounds. He believes that the use of the Internet and online education hold wonderful possibilities for the future of education, particularly higher education.

Glenda Rose Scales is the assistant dean for Distance Learning and Computing in the College of Engineering at Virginia Tech (USA), where she provides leadership for implementing a world-class distance-learning program. She earned her bachelor's degree in Computer Science from Old Dominion University, her master's degree in Applied Behavioral Science from Johns Hopkins University, and her doctorate in curriculum and instruction from Virginia Tech. Dr. Scales began her career working for the Department of Defense in Fort Meade, Maryland, as a computer analyst. After completing her terminal degree, she accepted a major leadership position at North Carolina A&T State University, where she, along with the distance-learning team, launched the University's virtual campus. She has presented her research in Electronic Performance Support at national conferences and, most recently, a market research study on graduate distance-learning programs for working engineers at the American Society for Engineering Education national conference.

Stephanie B. Scheer is an assistant professor and instructional designer in the School of Continuing and Professional Studies at the University of Virginia, Charlottesville, Virginia (USA). Her research interests include examining the potential of various distance-learning modalities to create rich learning communities for distance learners.

R. Subramaniam has a Ph.D. in Physical Chemistry. He is an assistant professor at the National Institute of Education in Nanyang Technological University and Honorary Secretary of the Singapore National Academy of Science. Prior to this, he was acting head of Physical Sciences at the Singapore Science Centre. His research interests are in the fields of physical chemistry, science education, theoretical cosmophysics, museum science, telecommunications, and transportation. He has published several research papers in international refereed journals.

Katia Tannous is associate professor of Chemical Engineering at State University of Campinas, Brazil. Working closely with undergraduate and graduate students, fellow faculty members, and other research associates, Dr. Tannous has studied a wide range of problems that are fundamental in nature but that have practical applications. Dr. Tannous has interest in educational technology, particularly the application of multimedia and the Internet for teaching and learning.

Krista P. Terry is the director of Instructional Design and Technology and assistant professor in the College of Education at Troy State University in Troy, AL (USA). Her research interests include designing and evaluating multimedia, visual literacy, and designing instruction for distance-learning environments.

Geraldine Torrisi-Steele is currently a lecturer in multimedia technologies at Griffith University (Australia) Gold Coast Campus in the School of Information Technology. Against a practical experience in the design, authoring, and delivery of educational multimedia materials especially for remote communities, she has developed a special interest in the application of multimedia and associated new technologies to learning environments. Until recently, she worked as an educational designer within Griffith University assisting tertiary educators with the design and development of flexible learning online materials.

Rika Yoshii (Ph.D., Computer Science, University of California, Irvine) is associate professor and Department Chair of Computer Science at California

State University, San Marcos (USA). Dr. Yoshii received her Ph.D. for her work on machine translation from Japanese to English. She had worked with Alfred Bork at the Educational Technology Center of the University of California, Irvine, where she was the project manager of the Understanding Spoken Japanese project. She specializes in computer-aided instruction of languages and development of authoring tools for conversational tutoring systems. She has developed computer-based tutoring systems for mathematics, ESL (articles and noncountable nouns), and programming. In recent years, she has been leading the development of authoring tools in Java. She has published many papers on these topics in conference proceedings and journals.

Felicia Zhang has a B.A. (University of Queensland, Australia), Graduate Diploma in Education (University of Melbourne, Australia); Certificate in Teaching English as a Foreign Language (TEFLA) granted by the Royal Society of Arts, United Kingdom; and Master of Arts in Applied Linguistics (Honors) (University of Melbourne, Australia). Ms. Zhang has had more than 10 years of teaching and research experience in the area of language teaching and learning. Since 1994, she has been researching ways of incorporating computer technology into the classroom and teaching curriculum. Ms. Zhang is currently a Lecturer in Chinese and Applied Linguistics at the University of Canberra, Australia. She is currently doing her Ph.D. in the area of pronunciation teaching in Mandarin using a methodology that combines the use of audiovisual materials with a number of computer-enhanced learning software. One of her major concerns in utilizing technology in teaching is the need to cater to a wide range of student needs, i.e., from students with advanced computer skills to students who do not have access at all to technology.