Contemporary Technologies in Education

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Editors

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Maximizing Student Engagement, Motivation, and Learning

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Foreword: Maximizing the Effectiveness of Learning with Media

Learning with Media

The field of education is confronted by a revolution in potentially useful computer-based technologies, ranging from digital games to wikis to online courses. The educational potential of these kinds of computer-based technologies is explored in the ten content chapters of *Contemporary Technologies in Education: Maximizing Student Engagement, Motivation, and Learning* edited by Olusola O. Adesope and A. G. Rud. In short, the guiding question addressed in this book is, "How can we best use technology to help students learn?" To answer this question, rigorous experimental research is needed to identify instructional features in technology-rich environments that maximize learning outcomes and promote appropriate learning processes.

Historical Context of Educational Technology

This certainly is not a new question, as is reflected in the history of research on educational technology (Cuban 1986; Saettler 1990/2004). However, a worthwhile lesson to be drawn from this history is that the educational technologies of the twentieth century were sometimes oversold, which should temper our enthusiasm for claims about the educational value of today's technologies. For example, Cuban (1986) documents the rise and fall of educational technologies throughout the twentieth century such as motion pictures in the 1920s, radio in the 1930s, television in the 1950s, and programmed instruction in the 1960s. In the present book focusing

on the twenty-first-century technologies, Glazewski (2019) adds *Second Life* to the list of highly touted technologies that have failed to live up to expectations. In short, an important message reflected in this book is that the use of educational technology should be based on research evidence and grounded in scientific theory rather than follow from grand promises and rosy predictions by visionaries.

What is new about the question of how to use technology is the array of technologies being made available in the twenty-first century, such as wikis (Reich 2019), digital games (Annetta et al. 2019; Virk and Clark 2019), MOOCs (Waks 2019), virtual reality (Kessler, this volume), cognitive tools (Nesbit et al. 2019), and learning analytics (Winne 2019; Wise 2019). Yet, ways must be devised to adapt these technologies to the human mind, including how we learn, and research evidence is needed to determine which instructional features are most effective.

Overall, this book reflects three themes for research in educational technology: (i) shifting from media comparison studies to value-added studies, (ii) broadening research in educational technology to include dependent measures of learning and motivation, and (iii) deepening research on educational technology to connect instructional design principles with theories of learning and motivation.

Theme 1: Shifting from Media Comparison Studies to Value-Added Studies

First, this book reflects a shift in research paradigm in the field of educational technology from media comparison studies to value-added studies (Mayer 2014a). In media comparison studies, researchers compare the learning outcomes of students who learn with one medium versus the learning outcomes of students who learn with another medium. For example, we can ask whether students learn better about electromagnetic devices when they play an interactive, desktop game called *Cache 17* or when they receive the material in the form of a slideshow presentation (Adams et al. 2012). This research paradigm is relevant to the classic debate of the effects of instructional media versus instructional method in education (Clark 2001; Clark and Feldon 2014; Kozma 1991, 1994). Furthermore, the media comparison paradigm is problematic to the extent that learning is caused by instructional method rather than instructional media (Clark 2001; Clark and Feldon 2014) or even to the extent that

learning is caused by the instructional method afforded by instructional media (Kozma 1991, 1994). Finally, it is challenging to conduct media comparison research because of difficulties in ensuring that the two groups are equivalent in instructional content and instructional method, and differ only in instructional medium.

In value-added studies, researchers compare the learning outcomes of students who learn with a base version of a learning situation involving technology with the learning outcomes of students who learn with the same version with one feature added. For example, we can ask whether students learn better about environmental science when they play a version of an interactive, desktop computer game called *Design-a-Plant* in which an on-screen agent, Herman-the-Bug, communicates by using text printed on the screen versus when he presents the same words in the form of narration or what can be called spoken text (Moreno et al. 2001; Moreno and Mayer 2002). This approach explores the instructional impact of using the affordances of a computer-based technology, which in this case involves using spoken text. Value-added studies can be useful in pinpointing instructional design principles for maximizing the effectiveness of computer-based learning situations. Consistent with the growing consensus favoring value-added studies, the chapters of this book include value-added studies and this appears to be a reasonable strategy for future research.

Theme 2: Including Dependent Measures of Learning and Motivation

The editors of this book call for expanding the measurement of outcomes to include not only changes in learning outcomes, such as knowledge and skills, but also changes in learning processes involving motivation and engagement during learning. Several chapters examine how learning analytics—analysis of detailed computer-recorded data on what students do during learning—can be useful in understanding the underlying learning process for each learner and ultimately in adapting instruction accordingly (Winne 2019; Wise 2019). For example, metrics based on persistence on a task before asking to see the correct answer or time spent looking at feedback can be used to assess motivational processes during learning with an online tutor.

As an example of the potential of learning analytics, in a recent study, Rawson, Stahovich and Mayer (2017) used smart pen technology to record every pen stroke of engineering students as they solved assigned homework problems. Course grade was predicted by metrics based on these pen strokes, such as the total number of pen strokes, and proportion of pen strokes produced more than 24 hours before the deadline. Future work is needed to determine whether this technology can be used as an early warning system to alert students when they are engaging in strategies that are likely to lead to or hinder success in a class they are taking.

Theme 3: Connecting Instructional Design Principles to Theories of Learning and Motivation

This book also highlights the need to ground design principles in research-based theories of learning and motivation, which I refer to as applying the science of learning to education (Mayer 2011). For example, the cognitive theory of multimedia learning is based on the idea that people have separate channels for processing verbal and visual material, only a limited amount of processing can occur in each channel at any one time, and deep learning occurs when the learner mentally selects relevant information, organizes it into a coherent structure, and relates it to relevant prior knowledge (Mayer 2009, 2014b). Instructional methods used with educational technology should be understood in terms of the underlying cognitive processes they are intended to foster.

Similarly, a potential benefit of various educational technologies is their positive effect on student motivation and engagement, so they should be interpreted in terms of current theories of academic motivation (Wentzel and Miele 2016). Relevant motivational theories include interest theory (Alexander and Grossnickle 2016) which holds that people try harder to learn when they are interested; expectancy-value theory (Wigfield et al. 2016) which holds that people try harder to learn when they value what they are learning; self-efficacy theory (Schunk and DiBenedetto 2016) which holds that people try harder to learn when they feel confident about their competence to learn the material; and self-determination theory (Rigby and Ryan 2011; Ryan and Deci 2016) which holds that people try harder to learn in situations where they feel competent, autonomous, and related to others.

Conclusion

What is new in the field of educational technology is the availability of a new suite of computer-based technologies, some of which are explored in this book. What is not new is the human learning and motivation systems that are responsible for promoting valued outcomes. What also is not new in the field of educational technology is the instructional goal of improving learning and motivation through appropriate use of effective instructional methods. The challenge of applying computer-based technology in education is to identify evidence-based and theory-grounded principles for how best to adapt the affordances of technology to help people learn rather than to expect people to adapt to every new learning technology that comes along. This effort will benefit from value-added studies using measures of learning outcomes and learning processes, as exemplified in this book.

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References

Adams, D. M., Mayer, R. E., MacNamara, A., Koening, A., & Wainess, R. (2012). Narrative games for learning: Testing the discovery and narrative hypothesis. *Journal of Educational Psychology, 104,* 235–249.

Alexander, P. A., & Grossnickle, E. M. (2016). Positioning interest and curiosity within a model of academic development. In K. R. Wentzel, & D. B. Miele (Eds.), *Handbook of motivation at school* (2nd ed., pp. 169–187). New York: Routledge.

Annetta, L. A., Shapiro, M., Luh, A., & Berkeley, S. (2019). Practical implications of serious educational games: Thinking like a designer and understanding like a learner. In O. O. Adesope & A. G. Rud (Eds.), *Contemporary technologies in education: Maximizing student engagement, motivation, and learning.* New York: Palgrave Macmillan.

Clark, R. E. (2001). *Learning from media.* Greenwich: Information Age Publishing.

Clark, R. E., & Feldon, D. F. (2014). Ten common but questionable principles of multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (2nd ed., pp. 151–173). New York: Cambridge University Press.

Cuban, L. (1986). *Teachers and machines: The classroom use of technology since 1920*. New York: Teachers College Press.

Glazewski, K. (2019). The innovation is in the pedagogy: Emphasizing new and different questions we might ask learners. In O. O. Adesope & A. G. Rud (Eds.), *Contemporary technologies in education: Maximizing student engagement, motivation, and learning*. New York: Palgrave Macmillan.

Kozma, R. (1991). Learning with media. *Review of Educational Research, 61*, 179–212.

Kozma, R. (1994). Will media influence learning: Reframing the debate. *Educational Technology Research and Development, 42*, 7–19.

Mayer, R. E. (2009). *Multimedia learning* (2nd ed). New York: Cambridge University Press.

Mayer, R. E. (2011). *Applying the science of learning*. Boston: Pearson.

Mayer, R. E. (2014a). *Computer games for learning: An evidence-based approach*. Cambridge, MA: MIT Press.

Mayer, R. E. (2014b). Cognitive theory of multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (2nd ed., pp. 43–71). New York: Cambridge University Press.

Moreno, R. E. & Mayer, R. E. (2002). Learning science in virtual reality environments: Role of methods and media. *Journal of Educational Psychology, 94*, 598–610.

Moreno, R., Mayer, R. E., Spires, H., & Lester, J. (2001). The case for social agency in computer-based teaching: Do students learn more deeply when they interact with animated pedagogical agents? *Cognition and Instruction, 19*, 177–214.

Nesbit, J., Niu, H., & Liu, Q. (2019). Cognitive tools for scaffolding argumentation. In O. O. Adesope & A. G. Rud (Eds.), *Contemporary technologies in education: Maximizing student engagement, motivation, and learning*. New York: Palgrave Macmillan.

Saettler, P. (1990/2004). *The evolution of American educational technology*. Greenwich: Information Age Press.

Rawson, K., Stahovich, T., & Mayer, R. E. (2017). Homework and achievement: Using smartpen technology to find the connection. *Journal of Educational Psychology, 109*, 208–219.

Reich, J. (2019). Just posting in the same place: Confronting the paucity of collaborative behavior in U.S. K-12 wikis. In O. O. Adesope & A. G. Rud (Eds.), *Contemporary technologies in education: Maximizing student engagement, motivation, and learning*. New York: Palgrave Macmillan.

Rigby, S., & Ryan, R. M. (2011). *Glued to games*. Santa Barbara: Praeger.

Ryan, R. M., & Deci, E. L. (2016). Facilitating and hindering motivation, learning, and well-being in schools: Research and observations from self-determination

theory. In K. R. Wentzel & D. B. Miele (Eds.). *Handbook of motivation at school* (2nd ed., pp. 96–119). New York: Routledge.

Schunk, D. H., & DiBenedetto, M. K. (2016). Self-efficacy theory in education. In K. R. Wentzel, & D. B. Miele (Eds.). *Handbook of motivation at school* (2nd ed., pp. 34–54). New York: Routledge.

Virk, S., & Clark, D. (2019). Disciplinary-integrated games to integrate high school biology as mathematical modeling. In O. O. Adesope & A. G. Rud (Eds.), *Contemporary technologies in education: Maximizing student engagement, motivation, and learning*. New York: Palgrave Macmillan.

Waks, L. J. (2019). Return, revenue, and revolution: Contributions of MOOCs to higher education. In O. O. Adesope & A. G. Rud (Eds.), *Contemporary technologies in education: Maximizing student engagement, motivation, and learning*. New York: Palgrave Macmillan.

Wentzel, K. R., & Miele, D. B. (Eds.). (2016). *Handbook of motivation at school* (2nd ed). New York: Routledge.

Wigfield, A., Tonks, S. M., & Klauda, S. L. (2016). Expectancy-value theory. In K. R. Wentzel, & D. B. Miele (Eds.). *Handbook of motivation at school* (2nd ed., pp. 55–74). New York: Routledge.

Winne, P. (2019). Supporting self-regulated learning and information problem solving with ambient big data. In O. O. Adesope & A. G. Rud (Eds.), *Contemporary technologies in education: Maximizing student engagement, motivation, and learning*. New York: Palgrave Macmillan.

Wise, A. (2019). Learning analytics, educational research, and pedagogical practices: Leveraging big data in powerful ways. In O. O. Adesope & A. G. Rud (Eds.), *Contemporary technologies in education: Maximizing student engagement, motivation, and learning*. New York: Palgrave Macmillan.

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Olusola O. Adesope is a Boeing Distinguished Professor of STEM Education in the College of Education at Washington State University. His research is at the intersection of educational psychology, learning sciences, instructional design, and technology. His recent research focuses on the cognitive and pedagogical underpinnings of learning with computer-based multimedia resources; meta-analysis of empirical research, knowledge representation through interactive concept maps and diagrams, learning analytics, social programming, and investigation of instructional principles and assessments in Science, Technology, Engineering, and Mathematics (STEM) domains. He has served as Principal Investigator or co-PI on more than 12 external grants, mostly from the National Science Foundation. More recently, he is a co-PI on a $3 million grant for mass dissemination and investigation of the effects of desktop learning modules for learning engineering concepts, and another NSF computer science education grant that is exploring the use of social programming environments to foster both technical as well as soft skills development. He is currently a senior associate editor of the *Journal of Engineering Education*, and serves on the editorial boards of several other top-ranking journals such as the *Review of Educational Research*, *Journal of Educational Psychology*, *Educational Technology Research & Development*, etc. He has delivered numerous conference presentations and is the author of more than 100 publications including 3 books.

Leonard A. Annetta is Taft Distinguished Professor of Science Education at East Carolina University. Before joining the faculty at ECU, Len was a professor at George Mason University and an associate professor of Science Education at North Carolina State University where his research focused on distance learning and the effect of instructional technology on science learning of teachers and students in rural and underserved populations. Although there is considerable research on distance learning, he has focused on the untapped analyses of learning science through various distance delivery strategies. His research has cascaded from his dissertation on comparing three different distance delivery strategies on science teacher professional development to his current focus on evaluating video games as a teaching and learning tool and as a vehicle for synchronous online instruction. The results of his dissertation research suggested that synchronous interaction proved most effective on learning science in a distance-learning environment. Achieving synchronous interaction in distance learning was possible only through videoconferencing technology until recent years. As technology continues to emerge and the push to be connected through the web becomes more and more critical, it became obvious that there needed to be a strategy to deliver science content, synchronously, over the Internet. Upon accepting a position at North Carolina State University, he vigorously began to parlay the results of his dissertation into a pursuit of how synchronous interaction could come to fruition over the Web. Understanding the popularity of online, multiuser video game play, he began to use his past programming knowledge to build a virtual environment that became the platform for his current research. Through two separate internally funded grants, he designed and created a synchronous, online 3D virtual environment for distance-learning courses offered at North Carolina State.

Douglas B. Clark completed his MA at Stanford University and PhD at the University of California at Berkeley in Math, Science, and Technology Education. Prior to joining the University of Calgary in 2017, he was a professor at Vanderbilt University in the United States. He loves playing digital games and imported board games of all kinds. His research investigates the design of digital-learning environments and the learning processes through which people, particularly middle school and high school students, come to understand core science and computer science concepts in the context of those digital-learning environments. This work focuses primarily on conceptual change, inquiry, modeling, digital games,

explanation, collaboration, and argumentation. His research is now also extending into the exploration of people's own design processes and supporting those design processes. Dr. Clark has served as an associate editor of the *Journal of the Learning Sciences*. He has also served on the editorial boards of several of the most prestigious journals in science education and the learning sciences including *Journal of the Learning Sciences*, *Journal of Research in Science Teaching*, and *Science Education*. He is a Survey Assessment Innovations Lab Network advisor to the National Assessment of Educational Progress (NAEP) in the United States and was one of the original 20 members of the Academic Consortium on Games for Impact that was initially commissioned by the US White House Office of Science and Technology Policy. In addition, he is active with his local schools and runs a weekly role-playing club for middle school and high school students at one of the schools.

Krista Glazewski is a former middle school science teacher and is an Associate Professor of Instructional Systems Technology at Indiana University exploring means of supporting teachers as they adopt new technological and curricular innovations. Her partnership work has spanned multiple regions in the USA to investigate how and under what conditions teachers might adopt and adapt to new practices. She currently serves as editor of the *Interdisciplinary Journal of Problem-Based Learning*, an open-access journal that publishes peer-reviewed articles of research, analysis, or promising practice related to all aspects of problem- or inquiry-based learning.

Greg Kessler is a professor of Computer Assisted Language Learning (CALL) in the Department of Linguistics and Director of the Language Resource Center at Ohio University. He teaches courses in CALL teacher preparation and research methods. His research addresses CALL teacher preparation, student language use in collaborative language learning, the role of students and teachers in innovative pedagogical contexts, student and teacher autonomy, and the relationship between technology and change in the English language. He has overseen the development of numerous technology-enhanced language programs and has spoken, consulted, and published widely in the area of CALL. He has served the teachers of English to speakers of other languages (TESOL) through a number of roles and was president of Ohio TESOL from 2007 to 2008. He co-authored the TESOL Technology Standards Framework as well as the full volume, *TESOL Technology Standards: Description, Implementation,*

Integration. He is currently the interim co-director of the computer assisted language instruction consortium (CALICO). He has taught CALL teacher preparation courses and programs across the United States as well as in Burma, China, Croatia, Czech Republic, Egypt, Greece, Hong Kong, Hungary, Japan, Kazakhstan, Korea, Mexico, Montenegro, Saudi Arabia, Serbia, and Turkey.

Diane Jass Ketelhut interests center on improving student learning and engagement with science through increasing access, particularly in urban contexts, to scientific inquiry experiences and through raising self-efficacy in science. She looks specifically at the use of virtual environments to deliver scientific inquiry curricula and science assessments to students in the classroom and at professional development to help teachers integrate scientific inquiry into their curricula. Most recently, I am exploring the integration of computational thinking learning into preservice elementary science teacher education. She holds certification in secondary school science and was a science curriculum specialist and teacher (science and math) for grades 5–12 for 15 years. Prior to that, she conducted immunology basic research for 2 years. She received a BS in Bio-Medical Sciences from Brown University, an MEd in Curriculum and Instruction from the University of Virginia, and her doctorate in Learning and Teaching from Harvard University. She was an Assistant Professor of Curriculum, Instruction, and Technology in Education at Temple University for 5 years prior to coming to the University of Maryland in 2011. She is currently an associate professor in the Department of Teaching and Learning, Policy and Leadership at the University of Maryland.

Richard Lamb is an associate professor and director of the Neurocognition Science Laboratory University at Buffalo Graduate School of Education. His research focuses broadly on the use of educational technology, neuropsychology, neuroscience, and psychometric theory to examine some of the factors that may impede or enable learning in science. His tools include computational modeling of student cognitive processes, measurement of affective dispositions, and identification of physiological systems that are associated with learning via neuroimaging technologies. Recently, he has been exploring the use of educational technology, specifically virtual reality in pre-kindergarten through college level educational environments to study learning.

Qing Liu joined the Teaching and Learning Centre as a learning technology specialist. Since 2008, Qing has engaged in various research projects investigating the use of educational technologies as instructional tools to support teaching and learning, such as Intelligent Tutoring Systems (ITS), online peer evaluation systems, and argumentation visualization tools. She has extensive experience in designing and teaching online courses. She holds an MA and is currently a PhD candidate in educational technology and learning design. She is skilled in conducting systematic reviews and meta-analyses of empirical studies. Qing is working on a project that investigates the use of Microsoft Office 365 in school contexts, teaming with researchers from SFU, Microsoft, and the Coquitlam School Board.

Richard E. Mayer is Distinguished Professor of Psychology at the University of California, Santa Barbara. His research interests are in applying the science of learning to education, with current projects on multimedia learning, computer-supported learning, and computer games for learning. His research is at the intersection of cognition, instruction, and technology, with a focus on how to help people learn in ways, so they can transfer what they have learned to new situations. He served as President of Division 15 (Educational Psychology) of the American Psychological Association and Vice President of the American Educational Research Association for Division C (Learning and Instruction). He is the winner of the Thorndike Award for career achievement in educational psychology, the Scribner Award for outstanding research in learning and instruction, and the American Psychological Association's Distinguished Contribution of Applications of Psychology to Education and Training Award. He is ranked #1 as the most productive educational psychologist in the world in *Contemporary Educational Psychology*. He has served as the Principal Investigator or co-PI on more than 30 grants, including recent grants from the Office of Naval Research to investigate how to improve the effectiveness of educational games, from the Institute of Education Sciences to investigate the effectiveness of features of an online tutoring system, and from the National Science Foundation to study students' learning and problem-solving strategies. He is the former editor of the *Educational Psychologist* and former co-editor of *Instructional Science*, and he serves on the editorial boards of 12 journals mainly in educational psychology. He is the author of more than 500 publications including 30 books, such as *Learning as a Generative Activity* (with L. Fiorella), *Computer Games for*

Learning, *Applying the Science of Learning*, *e-Learning and the Science of Instruction: Fourth Edition* (with R. Clark), *Multimedia Learning: Second Edition*, *Learning and Instruction: Second Edition*, *Handbook of Research on Learning and Instruction: Second Edition* (co-editor with P. Alexander), and *the Cambridge Handbook of Multimedia Learning: Second Edition* (editor).

John Nesbit is a Professor of Educational Psychology in the Faculty of Education at Simon Fraser University, Burnaby, Canada. He teaches and conducts research in the areas of educational psychology and the learning sciences; self-regulated learning with multimedia resources and cognitive tools; log analysis as a research method; argumentation, cognition, and learning. He has authored or co-authored about 50 peer-reviewed journal articles and book chapters.

Hui Niu finished her PhD in educational technology at Simon Fraser University (SFU), Canada. She was one of SFU's most outstanding graduate students from the Faculty of Education and was awarded the Dean of Graduate Studies Convocation Medal. For her dissertation entitled "Pedagogical Efficacy of Argument Visualization Tools", Dr Niu developed a new online argumentation visualization tool called the dialectical map. Students create dialectical maps by identifying and composing claims, evidence, and warrants and filling them in an online map. They then draw an integrated conclusion by evaluating arguments and counterarguments in a visually hierarchical structure. Findings from her empirical research showed that the dialectical map fostered learning and comprehension from text and increased the quality of writing about the topic in a post-test. Between 2006 and 2010, she worked as a research analyst at the Canadian Council on Learning she developed grant proposal, wrote reports for various audiences and educational stakeholders, and managed research projects and provided leadership and research consultation for clients.

Justin Reich is the Executive Director of the MIT Teaching Systems Lab and a research scientist in the MIT Office of Digital Learning. Justin is also an affiliate of the Berkman Center for Internet and Society at Harvard University and a lecturer in the MIT Scheller Teacher Education Program. Justin was the inaugural Richard L. Menschel HarvardX Research Fellow at Harvard University and he is the co-founder of EdTechTeacher, a professional learning consultancy devoted to helping teachers leverage tech-

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Marina Shapiro holds her BS and MS from Towson University and a PhD from George Mason University. Her background is in Science Education Research (Chemistry) and Learning Technologies. Her research interests are implementing game-based learning environments into undergraduate college chemistry curricula in order to facilitate methods for active and experiential learning, particularly in the context of lecture settings where students are often passive learners. The focus of her dissertation research was on evaluating the implementation of a chemistry video game into an undergraduate General Chemistry course where she concentrated on evaluating knowledge gains of chemistry content and attitudinal increase toward chemistry. The results of the dissertation showed that the chemistry serious educational game (SEG) led to a significant increase in students' knowledge of chemistry concepts, thereby indicating the potential for implementing SEGs into undergraduate college chemistry curricula. Additional research interests include investigating how SEGs can be used to increase motivation, engagement, and how they can be implemented as tools for measurement of assessment as research shows that

SEGs can serve as tools for assessment and that there is a link between engagement, motivation, attitude, and knowledge gains in science class. By increasing attitude toward chemistry the goal is to also see an increase in engagement and motivation to learn chemistry. She teaches General Chemistry, Foundations of Analytical Chemistry, Biochemistry, and Food Science lecture and laboratory courses.

David Vallett earned his PhD in Education from George Mason University. He also possesses a BA in Biology and a MAT in Science Education from the University of North Carolina at Wilmington. His current research interests are in learner cognition with an emphasis on misconceptions and evolved heuristics for cognition, educational neuroscience, and the intersection of cognitive science investigations in student learning with classroom instruction. Dr Vallett's prior research has examined visual-spatial reasoning in the design of Serious Educational Games for science learning, and individual differences in misconceptions of Newtonian mechanics.

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Philip H. Winne is a professor of educational psychology and former Canada Research Chair in Self-Regulated Learning and Learning Technologies at Simon Fraser University. A Fellow of the American Educational Research Association, the American Psychological Association, the Association for Psychological Science, and the Canadian Psychological Association, Winne has made significant contributions to research on self-regulated learning. He is the principal investigator of the Learning Kit Project, which has developed educational software, now called nStudy, founded on the principles of self-regulated learning. Before earning a PhD from Stanford University in 1976, Winne received undergraduate and master's degrees from Bucknell University. He has served as the President of the Canadian Educational Researchers Association (1984–1986), the Canadian Association for Educational Psychology (1988–1990), and Division 15-Educational Psychology of the American Psychological Association (2001–2003). He co-edited the *Educational Psychologist* and serves as associate editor of the *British Journal of Educational Psychology*. Winne has authored (or co-authored) over 85 peer-reviewed journal articles, over 50 book chapters, and 5 books including an introductory textbook on educational psychology that is widely used in Canada (Woolfolk et al. *Educational psychology: Canadian edition* (3rd ed.). Scarborough: Allyn & Bacon, 2006).

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tigations of the ways in which educational practices are being reshaped as students and instructors have access to new sources of data about their own teaching and learning. She has also conducted influential research on the design of computer-supported collaborative learning systems in both online and physical environments and is particularly known for her pioneering work conceptualizing and researching learners' online listening behaviors. She is editor-in-chief of the *Journal of Learning Analytics* and an associate editor of the *Journal of the Learning Sciences*. She served as a member of the Executive Committee of the Society for Learning Analytics Research from 2012 to 2018 and on the Computer-Supported Collaborative Learning Committee within in the International Society of the Learning Sciences from 2012 to 2016. Previously she was Associate Professor and Coordinator of the Educational Technology & Learning Design Programs at Simon Fraser University in Canada. Her work has been extensively funded by the Social Sciences and Humanities Research Council of Canada and widely recognized for its contributions to the learning sciences and learning analytics literature.

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