Preface

Changes in the world economy, specifically toward information industries, have changed the skillset demand of many jobs (Organization for Economic Development [OECD], 2012a). Information is created, acquired, transmitted, and used—rather than simply learned—by individuals, enterprises, organizations, and communities to promote economic and social development. Major employers and policy makers are increasingly asking teachers and educators to help students develop so-called real-world skills (Gallup, 2013). While learning basic numeracy and literacy skills still is crucial to success in the job market, developing real-world skills also is essential to success in the job market and worldwide economic development.


Because of the importance of promoting these skills, we have embarked on a journey to create a Handbook of Research on Technology Tools for Real-World Skill Development. Because conceptions and educational applications of real-world skills are evolving rapidly, we have welcomed a wide range of skills in the Handbook. The following four strands of skills are represented in the chapters: Thinking skills refer to higher-order cognition and dispositions such as critical thinking, complex problem solving, metacognition, and learning to learn. Social skills refer to attitudes and behaviors that enable successful communication and collaboration. Global skills refer to attitudes and behaviors that emphasize the individual’s role in, and awareness of, the local as well as the global and multicultural environment. Digital skills emphasize information and digital literacies needed in the technology-rich world in which we live. Similarly, the chapters in this Handbook describe a range of technology tools to support teaching, learning, assessment for learning (e.g., Stiggins, 2005; Wiliam, 2011), feedback for learning (e.g., Hattie, & Timperley, 2007; Shute, 2008), and scoring of student responses. For example, section 1 includes chapters on curricula and frameworks for teaching real-world skills; the chapters in section 2 describe specific technology tools for teaching, learning, and assessing real-world skills; the chapters in
section 3 describe automated scoring tools for assessment and learning; and section 4 contains chapters on techniques for analyzing data from technology-based performance assessments. Helping students learn real-world skills—that is, to internalize them and use them flexibly across a range of challenges and contexts in their everyday and work lives—is a significant educational challenge. Real-world skills cannot be taught in a single course or in a single year of schooling. And assessing real-world skills to provide feedback to guide development of those skills cannot be accomplished using conventional, large-scale assessment and score reporting methods alone. The technology tools described here represent the range of current and developing capabilities of technology tools to support teaching, learning, assessment, and feedback for learning.

As technology-rich environments for teaching, learning, assessment, and feedback are being integrated into educational processes, there is much to be learned about how to leverage advances in technology, learning sciences, and assessment to develop real-world skills for the 21st century. Research findings on what works best are just emerging, possibly due to the strong multi-disciplinary approaches required to extract the greatest value. This Handbook is intended to serve as a first body of research in the expanding area of technology tools for teaching, learning, assessment, and feedback on real-world skills that educators can turn to in the coming years as a reference. Our aim is to bring together top researchers to summarize concepts and findings. The Handbook contains contributions of leading researchers in learning science, educational psychology, psychometrics, and educational technology. Assuming that many readers will have little grounding in those topics, each chapter outlines theory and basic concepts and connects them to technology tools for real-world skill development. We see this as one of the most crucial contributions of the Handbook, seeking to establish strong theoretical principles that can inform educational research and practice and future research and development. The Handbook also provides brief overviews in each topic section for more knowledgeable readers. The Handbook is organized into four sections.

SECTION 1: DEFINING REAL-WORLD SKILLS IN TECHNOLOGY-RICH ENVIRONMENTS

The seven chapters in Section 1 explore conceptualization of real-world skills and the role of technology. The section includes chapters on curricula and frameworks for teaching real-world skills. To aid readers in selecting specific chapters to study, we list the technology tools described in these chapters.

Chapter 1: A principled approach for developing digital competency.
Chapter 2: A model for teaching digital competency.
Chapter 3: A model for measuring problem solving skills in science, technology, engineering, and mathematics (STEM).
Chapter 4: A model for teaching Internet research skills.
Chapter 5: Another model for teaching Internet research skills.
Chapter 6: A matrix for evaluating technology integration in K-12 instructional settings, and teacher-related professional development.
Chapter 7: An online team-based learning model in nursing education.
SECTION 2: TECHNOLOGY TOOLS FOR LEARNING AND ASSESSING REAL-WORLD SKILLS

Chapters 8 through 21 deal with the core topic of technology tools and a wide range of applications aimed at learning and assessing of real-world skills. The technology tools described in these chapters include the following.

Chapter 8: Technology-rich simulations for learning and assessing science skills.
Chapter 9: The Collegiate Learning Assessment, a test to evaluate the critical thinking and written communication skills of college students.
Chapter 10: Guidance, based on lessons learned from developing rich-media simulations, for assessment for organization staff promotion and development.
Chapter 11: A personalized learning platform for developing early reading.
Chapter 12: Computer agent technology for assessing collaborative problem solving skills.
Chapter 13: A model for assessing cognitive and social skills through online collaboration.
Chapter 14: An approach for technology-rich learning and formative assessment of collaborative problem solving skills.
Chapter 15: A framework for principled thinking about a construct map assessment of a higher-order thinking skills.
Chapter 16: Computer-based and computer-assisted approaches for assessment of knowledge and skills.
Chapter 17: Technology tools for learning for students with moderate and severe development and intellectual disabilities.
Chapter 18: Strategies for mitigating bias for a computer-administered performance-based assessment of higher-order skills.
Chapter 19: An evidence-centered concept map for a critical thinking assessment.
Chapter 20: Facebook as a social network for learning.

SECTION 3: AUTOMATED ITEM GENERATION AND AUTOMATED SCORING TECHNIQUES FOR ASSESSMENT AND FEEDBACK

The five chapters in Section 3 address a range of technologies for automated scoring, automated item generation, and learner feedback. The technology tools described in these chapters include the following.

Chapter 22: Procedures for automated generation of science items.
Chapter 23: Automated scoring approaches for development of writing proficiency.
Chapter 24: A principled framework for designing automated scoring of multicomponent assessment tasks.
Chapter 25: Automated scoring as the basis for feedback to support improvement of writing skills.
Chapter 26: Automated feedback to improve writing quality.
SECTION 4: ANALYSES OF PROCESS DATA IN TECHNOLOGY-RICH PERFORMANCE TASKS

Chapters 27 through 31 deal with analysis, interpretation, and use of learning and assessment data in technology environments. The technology tools described in these chapters include the following.

**Chapter 27**: Analysis of solution paths in a technology-rich problem solving assessment.
**Chapter 28**: Analysis of solution paths in technology-rich critical thinking assessment.
**Chapter 29**: Use of a chi-square features selection algorithm (i.e., sequential pattern mining) and N-grams representation model to analyze process data in technology-rich problem solving tasks.
**Chapter 30**: Analytic methods to induce a persistence measure from game play click stream data and a design pattern to guide future development of persistence measures in digital environments.
**Chapter 31**: An Item Engagement Index (IEI) and Student Engagement Index (SEI) for assessing engagement during the online assessment of real-world skills.

Our goal in collecting and organizing these excellent chapters is to begin a process of crystalizing what our field has accomplished to date and what it knows, collectively, about technology tools and how those tools can be used to support and enhance teaching and learning of real-world skills. Knowing what we know should help us identify what we need to know. And it should guide further development of practical applications and empirical research on the efficacy of using technology tools for teaching, learning, assessing, and providing feedback as learners work to develop the skills they need for today’s high-tech, higher-order knowledge and skills world. We hope this *Handbook* will serve as a tool to encourage collaborations among researchers, educators, policy makers, employers, and the general public to promote learning, assessment, and personalized feedback technologies. By compiling the rich research and knowledge in this *Handbook*, we hope to spark innovation in education.

The *Handbook* is a recommended reading source to the following audiences:

*Educators*: This book will share essential insights for policy makers, principals, curriculum experts, and teachers who are interested in better understanding the practical challenges and opportunities in introducing new technology-rich programs aimed to promote learning, assessment, and feedback on real-world skills.

*Researchers*: This book will provide a valuable springboard to researchers in psychology, education, assessment, and computer science to engage with the concept of technology-rich assessment and learning of higher-order thinking skills and work on new research directions. This will be aided by the emphasis of key gaps in existing research and providing details on what areas need more careful research and empirical validation.

*General audiences* with interest in upcoming trends in learning, assessment, and feedback: This book will cover a range of topics related to real-world skills and value of real-world skills in next-generation education.
REFERENCES


