

MALOY / VEROCK / EDWARDS / TRUST

# Transforming Learning with New Technologies

FOURTH EDITION



# Transforming Learning with New Technologies

**Fourth Edition**

**Robert W. Maloy**

*University of Massachusetts Amherst*

**Ruth-Ellen Verock**

*University of Massachusetts Amherst*

**Sharon A. Edwards**

*University of Massachusetts Amherst*

**Torrey Trust**

*University of Massachusetts Amherst*

**Director of Product Management:** Linea Rowe  
**Product Manager:** Drew Bennett  
**Product Management Analyst:** Brooke Warner  
**Content Manager:** Jenifer Niles  
**Senior Content Analyst:** Rebecca Fox-Gieg  
**Senior Development Editor:** Jeffery Johnston  
**Senior Content Producer:** Yagnesh Jani  
**Managing Producer:** Autumn Benson  
**Manufacturing Buyer:** Deidra Headlee, LSC  
**Text Designer:** Integra Software Services Pvt. Ltd.  
**Full-Service Project Management:** Patricia H. Walcott, Integra Software Services Pvt. Ltd.  
**Cover Design:** SPi Global, Inc.  
**Cover Art:** Hero Images/Getty Images; Klaus Vedfelt/Digital Vision/Getty Images; Freer/Shutterstock; Rido/Shutterstock  
**Text Credits (throughout):** Acknowledgments of third-party content appear on the page with the material, which constitutes an extension of this copyright page.

Copyright © 2021, 2017, 2014 by Pearson Education, Inc. or its affiliates. All Rights Reserved. This digital publication is protected by copyright, and permission should be obtained from the publisher prior to any prohibited reproduction, storage in a retrieval system, or transmission in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise except as authorized for use under the product subscription through which this digital application is accessed. For information regarding permissions, request forms and the appropriate contacts within the Pearson Education Global Rights & Permissions Department, please visit [www.pearsoned.com/permissions/](http://www.pearsoned.com/permissions/).

Many of the designations by manufacturers and sellers to distinguish their products are claimed as trademarks. Where those designations appear in this book and the publisher was aware of a trademark claim, the designations have been printed in initial caps or all caps.

Between the time website information is gathered and then published, it is not unusual for some sites to have closed. Also, the transcription of URLs can result in typographical errors. The publisher would appreciate notification where these errors occur so that they may be corrected in subsequent editions.

#### **Library of Congress Cataloging-in-Publication Data:**

Names: Maloy, Robert W., author. | Verock-O'Loughlin, Ruth-Ellen, author. | Edwards, Sharon A., author. | Trust, Torrey, author. | Pearson (Firm)  
Title: Transforming learning with new technologies / Robert W. Maloy, University of Massachusetts Amherst, Ruth-Ellen Verock, University of Massachusetts Amherst, Sharon A. Edwards, University of Massachusetts Amherst, Torrey Trust, University of Massachusetts Amherst.  
Description: Fourth Edition. | Hoboken, New Jersey : Pearson, [2019] | Third edition published in 2017. | Includes bibliographical references and index.  
Identifiers: LCCN 2019026254 (print) | ISBN 9780134054889 (Loose-leaf) | ISBN 9780134020631 (Paperback) | ISBN 9780133960556 (eBook) | ISBN 9780134044125 (PDF) | ISBN 9780134044057 (ePUB)  
Subjects: LCSH: Internet in education.  
Classification: LCC LB1044.87 .T73 2019 (print) | LCC LB1044.87 (ebook) | DDC 378.1/7344678—dc23  
LC record available at <https://lcn.loc.gov/2019026254>  
LC ebook record available at <https://lcn.loc.gov/2019026255>

ScoutAutomatedPrintCode



#### **Access Code Card**

ISBN-10: 0-13-577302-4  
ISBN-13: 978-0-13-577302-4

#### **Rental**

ISBN-10: 0-13-577316-4  
ISBN-13: 978-0-13-577316-1

#### **Instructor's Review Copy**

ISBN-10: 0-13-577324-5  
ISBN-13: 978-0-13-577324-6

*To the students we are learning from and  
the students they are learning from,  
the teachers of today and tomorrow.*

## About the Authors

**Robert W. Maloy** is a senior lecturer in the Department of Teacher Education and Curriculum Studies in the College of Education at the University of Massachusetts Amherst, where he coordinates the history and political science teacher education programs. He also co-directs the TEAMS Tutoring Project, a community engagement/service learning initiative in which university students provide academic tutoring to culturally and linguistically diverse students in public schools throughout the Connecticut River Valley region of western Massachusetts. His research focuses on technology and educational change, teacher education, democratic teaching, and student learning. He is coauthor of eight other books: *Kids Have All the Write Stuff: Revised and Updated for a Digital Age*; *Wiki Works: Teaching Web Research and Digital Literacy in History and Humanities Classrooms*; *We, the Students and Teachers: Teaching Democratically in the History and Social Studies Classroom*; *Ways of Writing with Young Kids: Teaching Creativity and Conventions Unconventionally*; *Kids Have All the Write Stuff: Inspiring Your Child to Put Pencil to Paper*; *The Essential Career Guide to Becoming a Middle and High School Teacher*; *Schools for an Information Age*; and *Partnerships for Improving Schools*. Robert has received a University of Massachusetts Amherst Distinguished Teaching Award (2010), the University of Massachusetts President's Award for Public Service (2010), a School of Education Outstanding Teacher Award (2004), a University Distinguished Academic Outreach Award (2004), and the Chancellor's Certificate of Appreciation for Outstanding Community Service (1998 and 1993).



**Ruth-Ellen Verock** is a senior lecturer in the Department of Teacher Education and Curriculum Studies in the College of Education at the University of Massachusetts Amherst. She coordinates *Bridges to the Future*, a one-year intensive master's degree and secondary teacher license program serving school systems in western Massachusetts. Prior to joining the university, Ruth was an elementary school classroom and reading teacher in Virginia and Massachusetts. Her academic research focuses on new teacher education, technology in teaching, and community service learning in K–12 schools. She is coauthor with Robert W. Maloy and Sharon A. Edwards of *Ways of Writing with Young Kids: Teaching Creativity and Conventions Unconventionally*. She received the School of Education's Outstanding Teacher Award in 2007. She served as coordinator of the 2003 University of Massachusetts/WGBY National Teacher Training Institute (NTTI) and was an educational researcher for the 1999–2000 Harvard University Evidence Project.





**Sharon A. Edwards** is a clinical faculty member in the Department of Teacher Education and Curriculum Studies in the College of Education at the University of Massachusetts Amherst. Retired from public school teaching, she taught primary grades for 32 years at the Mark's Meadow Demonstration Laboratory School, a public laboratory school in Amherst, Massachusetts. As a clinical faculty member, she mentors undergraduate students and graduate student interns in the early childhood teacher education, constructivist teacher education, and secondary teacher education programs. Her college teaching and workshop presentations focus on children's writing, reading, and math learning; curriculum development; instructional methods; and diversity and equity in education. She also co-directs the university's TEAMS Tutoring Project. In 1989, Sharon was the inaugural recipient of the national Good Neighbor

Award for Innovation and Excellence in Education given by the State Farm Insurance Companies and the National Council of Teachers of English for her work with young children's writing. She received her Doctor of Education degree from the University of Massachusetts Amherst in 1996. She is coauthor with Robert W. Maloy of two other books: *Ways of Writing with Young Kids* and *Kids Have All the Write Stuff*.



**Torrey Trust, Ph.D.**, is an associate professor of Learning Technology in the Department of Teacher Education and Curriculum Studies in the College of Education at the University of Massachusetts Amherst, where she is the co-coordinator of the Learning, Media and Technology master's degree program. Her research and teaching focus on how technology can support teachers in designing contexts that enhance student learning. Dr. Trust is the past president of the Teacher Education Network for the International Society for Technology in Education (ISTE) (2016–2018). Her research, teaching, and service to the field of educational technology have received noticeable recognition, including the 2016 ISTE Online Learning Network Award, 2017 Outstanding Research Paper Award for the *Journal of Digital Learning in Teacher Education*, 2017 American Educational Research Association (AERA) Instructional Technology Special Interest Group Best Paper Award, 2017 ISTE Emerging Leader Award, 2017 Association for Educational Communication & Technology Division of Distance Learning Crystal Award (sec-

ond place), 2018 Making IT Happen (ISTE) Award, and 2019 AERA Technology as an Agent of Change for Teaching & Learning (Special Interest Group) Early Career Scholar Award.

# Brief Contents

<b>Part I</b>	Inspiring Student Learning with Technology	1
<b>1</b>	Becoming a 21st Century Teacher	1
<b>2</b>	Understanding Educational Technology Issues and Trends	23
<b>3</b>	Transforming Learning with Unique, Powerful Technologies	50
<b>4</b>	Designing Instruction with Technology	78
<b>5</b>	Applying Technology as Teacher Leaders and Innovators	103
<b>Part II</b>	Engaging Learners with Digital Tools	131
<b>6</b>	Teaching Information Literacy and Digital Citizenship	131
<b>7</b>	Engaging in Virtual Learning with Online Resources	161
<b>8</b>	Solving Problems and Designing Solutions Through Coding, Makerspaces, and Serious Gaming	186
<b>9</b>	Communicating and Collaborating with Social Technologies	209
<b>10</b>	Expressing Creativity with Multimedia Technologies	238
<b>11</b>	Differentiating Instruction with Technology	267
<b>12</b>	Empowering Learners Through Performance Assessments and Reflection	296

*This page is intentionally left blank*

# Contents

About the Authors

Preface

## Part I Inspiring Student Learning with Technology

### 1 Becoming a 21st Century Teacher

Two New Teachers and Their Technologies

Teaching and Students Today

A Rapidly Changing and Diversifying Society

A Generation of Technology Users

■ DIGITAL DIALOG 1.1

Technology Today

Computer Technologies

■ DIGITAL DIALOG 1.2

From Web 1.0 to Web 2.0/3.0

■ TECH TOOL 1.1 Tablets, Smartphones, and Laptops

Highly Interactive, Inquiry-Based Teaching and Learning with Technology

Updating Bloom's Taxonomy with Technology

21st Century Skills

Technological Pedagogical Content Knowledge

ISTE Standards for Educators and Students

■ IN PRACTICE Envisioning New Water Conservation Technologies: An ISTE Standards for Students Learning Activity

Building a Professional Learning Network

Your "Must Know About" Technologies

Push and Pull Technologies

Components of a Professional Learning Network

Chapter Summary 21 • Key Terms 22 • For Reflection and Discussion 22

### 2 Understanding Educational Technology Issues and Trends

Three Future Teachers Discuss Technology

Motivations for Using Technology

Enhancing Teaching with Technology

Motivating and Inspiring Students

■ DIGITAL DIALOG 2.1

Approaches to Student Engagement

Barriers to Technology Use

Digital Inequalities and Achievement Gaps

■ DIGITAL DIALOG 2.2

Schedules, Skills, and Supports

Critics of Technology in Schools

Maintaining Online Safety and Digital Privacy

iii	Roles for Technology in Teaching	35
xiii	Competency and Confidence with Technology	36
	■ DIGITAL DIALOG 2.3	37
	Teachers Using Technology in Classrooms	37
1	Apps for Teaching and Learning	38
	■ TECH TOOL 2.1 APPS for Educators	39
1	Approaches for Teaching with Technology	39
2	Considering Your Teaching Philosophy	39
3	Mapping Instruction to the Common Core and the ISTE Standards	41
4		
6	■ IN PRACTICE Student-Centered Math Learning with iPads and Online Resources	42
8		
8	How Students Are Using Technology	44
10	Student-Initiated vs. Teacher-Chosen Technology Use	44
11	Learning with Technology to Overcome Digital Disconnects	46
11		
	■ DIGITAL DIALOG 2.4	46
12	Chapter Summary 47 • Key Terms 48 • For Reflection and Discussion 48	
12		
13		
14	<b>3 Transforming Learning with Unique, Powerful Technologies</b>	50
15		
16	A Parent-Teacher Conference	51
	UPT Learning 1: Thinking Critically and Solving Problems with Technology	53
17		
18	Online Problem-Solving Environments and Learning Games	53
18	■ IN PRACTICE Making and Reading Graphs with Software and Apps	54
19		
19	The Role of Feedback	56
20	Personalized Learning	56
	UPT Learning 2: Developing Digital Literacies	58
	Information Literacy and the Internet	59
	Media Literacy and Multimodal Learning	60
23	■ DIGITAL DIALOG 3.1	61
24		
24	UPT Learning 3: Communicating and Collaborating with Technology	63
25		
26	Engaging Students through Active Learning	63
27	Digital Writing with Social Technologies	64
28	Groupwork and Cooperative Learning	65
28	UPT Learning 4: Expressing Creativity with Digital Tools	66
29		
29	Seymour Papert's Vision of Technology Learning Environments	67
31	Visual Thinking and Concept Mapping for Creative Thinking	68
31	Building and Inventing with Creative Tools	69
32	UPT Learning 5: Becoming Digital Citizens	71
33	■ DIGITAL DIALOG 3.2	71



Elements of Digital Citizenship	72	Interactive Digital Textbooks	115
Empowering Students to Use Technology Wisely	73	Technology and Educational Change	115
Civic Engagement and Service Learning with Technology	73	Technology and the Culture of Schools	116
Chapter Summary 75 • Key Terms 76 • For Reflection and Discussion 76		■ DIGITAL DIALOG 5.2	116
<b>4 Designing Instruction with Technology</b>	78	■ TECH TOOL 5.1 Mindtools for Learning <i>with</i> Technology	117
A New Teacher Designs Curriculum	79	Automate and Informate	117
Research on the Science of Learning	80	Flipped Learning in Student-Centered Classrooms	118
Constructivist Approaches to Learning	81	Involving Students in Technology Rule-Making	120
■ IN PRACTICE Walking Back in Time with Technology: A Constructivist Learning Activity	82	Using the Technology You Have: Change Strategies for Teachers	121
Active Learning and Metacognitive Thinking	83	INFORMATION 122 • INTERACTION 122 • ROTATION 122	
Student-Centered Learning with Technology	84	Becoming a Technology-Leading Teacher	123
Teacher-Centered and Student-Centered Approaches	84	Building Your Digital Reputation	123
■ TECH TOOL 4.1 Types of Educational Websites and Apps	85	Tracking Technology Trends	124
Locating High-Quality Websites and Apps	86	Grant Writing and Crowdfunding	125
Elements of Instructional Design	86	Working with Technology-Using Colleagues and Organizations	126
Academic Content (What to Teach)	88	Earning Digital Badges	126
Teaching Goals, Methods, and Procedures (How to Teach)	89	Celebrating Digital Learning Day	127
Learning Assessments (Knowing What Students Have Learned)	90	Adopting a Technology-Leading Mind-set	128
Instructional Design in Action: Two Science Learning Plans	91	Becoming an Advocate for Equity and Change	128
Identifying Curriculum Frameworks and Learning Standards	92	Chapter Summary 128 • Key Terms 129 • For Reflection and Discussion 130	
Choosing an Approach to Lesson Development	93	<b>Part II Engaging Learners with Digital Tools</b>	131
■ DIGITAL DIALOG 4.1	94	<b>6 Teaching Information Literacy and Digital Citizenship</b>	131
Selecting Test or Performance Assessments	96	A Library of Unimaginable Size	132
TEST ASSESSMENTS 96 • STANDARDS-BASED ASSESSMENTS 97 • PERFORMANCE ASSESSMENTS 98		Literacy in an Information Age	133
■ DIGITAL DIALOG 4.2	96	Becoming Digitally Literate	134
Chapter Summary 100 • Key Terms 101 • For Reflection and Discussion 102		Gaining Fluency with Technology	134
<b>5 Applying Technology as Teacher Leaders and Innovators</b>	103	Note-Taking Tools and Apps	135
Three New Teachers Become Leaders with Technology	104	Internet Information Challenges and Responses	137
Integrating Technology into Teaching	105	Four Types of Online Information	137
Inclusion or Infusion	107	Uncovering Fake and False News	138
The SAMR Model	107	■ DIGITAL DIALOG 6.1	139
Factors Impacting Technology Integration	108	Utilizing Wikipedia: An Online Encyclopedia	140
Addressing Digital Inequalities and the Participation Gap	110	COMPARE WIKIPEDIA WITH OTHER ONLINE ENCYCLOPEDIAS 141 • FACT-CHECK WIKIPEDIA ENTRIES 141 • ROLE-PLAY ENCYCLOPEDIA DEVELOPMENT 141	
A Digital Inequality Perspective	110	■ IN PRACTICE Researching Extinction Events in Biology Class: A Web Search Learning Activity	142
■ DIGITAL DIALOG 5.1	111	Researching and Retrieving Online Information	143
One-to-One Computing and BYOD/T Programs	111	Using Search Engines Effectively	144
One/Two/Three Time	113	INTRODUCE SEARCH SITES DESIGNED FOR STUDENTS 145 • USE VISUAL SEARCH TOOLS 145 • ENSURE SAFE ONLINE EXPERIENCES FOR STUDENTS 145	
■ IN PRACTICE When Every Student Has a Computer: Teaching in a One-to-One Classroom	114	Evaluating Web Resources	146
		START WITH “WHO, WHAT, WHEN, WHY, AND HOW” AS WEB EVALUATION CRITERIA 146 • PROVIDE WEB RESEARCH GUIDELINES AND PROCEDURES 147 • HAVE STUDENTS IDENTIFY	

THE URL AND DOMAIN NAME 147 • HAVE STUDENTS GO BEYOND THE FIRST PAGE OF SEARCH RESULTS 148 • HAVE STUDENTS EVALUATE COGNITIVE LOAD 148	
Open Educational Resources and Public Domain Materials	148
■ <b>TECH TOOL 6.1 Open Access Textbooks, Materials and Courses</b>	150
Using Technology as Digital Citizens	151
Copyright, Fair Use, and Creative Commons	152
COPYRIGHT 152 • FAIR USE AND CREATIVE COMMONS 152 • STRATEGIES FOR USING PUBLIC DOMAIN AND CREATIVE COMMONS MATERIALS 153	
Plagiarism and Cheating	154
Standing Up against Bullying and Cyberbullying	155
■ <b>DIGITAL DIALOG 6.2</b>	156
■ <b>TECHNOLOGY TRANSFORMATION LEARNING PLAN From Text Sets to Media Sets</b>	157
Chapter Summary 159 • Key Terms 160 • For Reflection and Discussion 160	
<b>7 Engaging in Virtual Learning with Online Resources</b>	161
What a Student Teacher Discovers about the Web	162
Curating Information with Technology	164
Bookmarking, Social Bookmarking, and Cloud Computing	165
■ <b>DIGITAL DIALOG 7.1</b>	165
■ <b>TECH TOOL 7.1 Social Bookmarking Tools and Apps</b>	166
Google Tools for Teachers and Students	166
■ <b>IN PRACTICE Exploring Social Change Movements with Social Bookmarking Tools</b>	168
Learning Management Systems	169
Organizing Web Resources to Address Standards	170
Information Alerts, e-Newsletters, and RSS Feeds	170
Building a Standards Connector	170
Curating Standards-Based Academic Content	172
Designing Inquiry-Based Learning Using WebQuests and HyperDocs	173
Online Learning and Virtual Schools	174
■ <b>DIGITAL DIALOG 7.2</b>	175
Debates over Virtual Schools	175
Massive Open Online Courses (MOOCs)	176
Interactive Videoconferencing	177
Exploratory Learning with Websites and Apps	178
Features of Exploratory Learning Resources	178
MYSTERIES OF ÇATALHÖYÜK! AN ARCHAEOLOGICAL INVESTIGATION 179 • FAVORITE POEM PROJECT 179 • NATIONAL LIBRARY OF VIRTUAL MANIPULATIVES (NLVM) 180 • MUSEUM IN A BOX (MIAB) 180	
Virtual Reality and Augmented Reality	180
Virtual Field Trips	181
■ <b>TECHNOLOGY TRANSFORMATION LEARNING PLAN Weather Station WebQuest</b>	182
Chapter Summary 184 • Key Terms 185 • For Reflection and Discussion 185	
<b>8 Solving Problems and Designing Solutions Through Coding, Makerspaces, and Serious Gaming</b>	186
Afternoons at Engineering School	187
Teaching Problem Solving	188
Problem-Based Learning	189
■ <b>IN PRACTICE Stop Disasters! Teaching Problem Solving with a Simulation Game</b>	190
Computational Thinking, Coding, and Robotics	191
Learning to Code	191
Coding for All Students	192
Robotics in the Classroom	193
Digital Games and Game-Based Learning	194
Games in Schools	195
■ <b>DIGITAL DIALOG 8.1</b>	195
■ <b>TECH TOOL 8.1 Digital Games, Simulations, and Interactive Activities</b>	196
Serious Games and Online Simulations	197
Virtual Reality and Virtual Worlds	199
■ <b>DIGITAL DIALOG 8.2</b>	200
Evaluating Games for Learning	200
Makerspaces, 3-D Printing, and Students as Inventors	201
Maker-Based Learning	202
3-D Printing and How It Works	203
Learning through 3-D Modeling and Printing	204
■ <b>TECHNOLOGY TRANSFORMATION LEARNING PLAN Recreating Pre-Contact First American Houses with a Makerspace and 3-D Printing</b>	205
Chapter Summary 206 • Key Terms 207 • For Reflection and Discussion 207	
<b>9 Communicating and Collaborating with Social Technologies</b>	209
Microblogging and Backchanneling in a High School Classroom	210
Digital Communications between Teachers and Students	211
Synchronous and Asynchronous Communications	213
■ <b>IN PRACTICE Writing with Social Technologies</b>	213
Integrating Digital Communications into Teaching	214
TEACHING BEYOND THE SCHOOL DAY 214 • ENGAGING STUDENTS 215 • SHARING INFORMATION WITH FAMILIES 215 • BUILDING LEARNING COMMUNITIES 216 • PROVIDING AUTHENTIC AUDIENCES FOR STUDENT WRITERS 216 • PUBLISHING STUDENT WORK 216	
Social Networking for Educators	217
Communicating Using E-mail and Texting	218
■ <b>DIGITAL DIALOG 9.1</b>	218
USE E-MAIL OR MESSAGING APPS FOR OFFICIAL COMMUNICATIONS 219 • OPEN E-MAIL CONNECTIONS TO LIBRARIES, MUSEUMS, AND UNIVERSITIES 220 • HOLD ONLINE OFFICE HOURS 220	
Teaching and Learning with Twitter	220
■ <b>TECH TOOL 9.1 Using Twitter for Professional Learning</b>	221

Strategies for Moderating Online Discussions	222	PICTURES 256 • UTILIZE INTERACTIVE VIDEOS TO STIMULATE INTERACTION AND LEARNING 256 • CREATE YOUR OWN VIDEO CHANNEL AS A TEACHER 257	
FOCUS ON ISSUES THAT HAVE MEANING TO STUDENTS 222 • STRESS ACTIVE, THOUGHTFUL PARTICIPATION 222 • PROVIDE THOUGHTFUL AND SUPPORTIVE FEEDBACK 222 • CHOOSE LANGUAGE THOUGHTFULLY 223 • ESTABLISH ETIQUETTE FOR ONLINE COMMUNICATION 223 • DEVELOP AN ONLINE READING RESPONSE FORM FOR STUDENTS 223			
Blogs for Teachers and Students	224		
Creating a Teacher Blog	225		
■ DIGITAL DIALOG 9.2	225		
Design Decisions for Blogging Teachers	226		
Wikis and Google Sites for Collaborative Project-Based Learning	227		
Project-Based and Team-Based Learning	230		
Addressing Educational Standards Collaboratively	230		
Wikitexts and WikiQuests	231		
Using Wikis and Google Sites with Students	232		
CHOOSE STUDENT ROLES 233 • PAIR WITH TEXTBOOKS 233 • WATCH FOR INAPPROPRIATE OR PLAGIARIZED MATERIAL 233 • PROVIDE ASSESSMENT CRITERIA FOR STUDENT WORK 233			
■ TECHNOLOGY TRANSFORMATION LEARNING PLAN Blogging the News from Room 145	234		
Chapter Summary 236 • Key Terms 236 • For Reflection and Discussion 237			
<b>10</b> Expressing Creativity with Multimedia Technologies	238		
Lights, Camera, History	239		
Multimedia Technologies for Multimodal Learning	240		
Minimal and Multimedia Classroom Technologies	242		
Digital Projectors, Document Cameras, and Projection Apps	243		
Other Digital Tools: e-Books and e-Readers	244		
Podcasts and Presentation Tools	245		
Locating Educational Podcasts	246		
■ TECH TOOL 10.1 Creating Podcasts with Students	246		
Presentation Software	247		
Tufte’s Critique of PowerPoint	248		
■ DIGITAL DIALOG 10.1	249		
Next-Generation Presentation Tools and Apps	249		
Designing Memorable Presentations	250		
USE IMAGES TO GENERATE DISCUSSION 250 • PROMOTE VISUAL ANALYSIS 250 • DISPLAY QUESTIONS OR COMMENTS FOR SHORT WRITING ASSIGNMENTS 251 • STORYBOARD PRESENTATIONS IN ADVANCE 251 • USE SCREENCASTING TO PRESENT MATERIAL 251			
Video in the Classroom	252		
■ IN PRACTICE The Doomsday Seed Vault: Viewing Video Interactively	253		
YouTube, Common Craft, and Streaming Video	254		
■ DIGITAL DIALOG 10.2	255		
Using Video with Students	256		
PAUSE AND REPLAY FOR VIDEO REVIEWING 256 • ASK STUDENTS TO WRITE RESPONSES 256 • INTEGRATE SHORT VIDEO SEGMENTS AND STUDENT RESPONSES INTO LESSONS 256 • MODIFY THE USE OF SOUND OR			
PHOTO TAKING AND MOVIE MAKING 257			
PHOTO SHARING WITH STUDENTS AND FAMILIES 258			
LITERACY LEARNING WITH HANDHELD DEVICES 258			
ALPHABETS AND ALPHABET BOOKS 258 • CONCEPT AND INFORMATION BOOKS 259			
DIGITAL STORYTELLING AND DIGITAL ART 259			
RECORDING CLASSROOM LEARNING WITH DIGITAL TECHNOLOGIES 261			
RECORD CLASSROOM ACTIVITIES WHILE THEY HAPPEN 262 • ENCOURAGE, EDIT, AND PUBLISH STUDENT WRITING 262 • UTILIZE THE KEN BURNS EFFECT 262 • TEACH THE PROCESSES OF FILMMAKING 262 • CREATE ANIMATIONS WITH STUDENTS 263			
■ TECHNOLOGY TRANSFORMATION LEARNING PLAN The Shortest Motion Picture You Can Make in Words	263		
Chapter Summary 265 • Key Terms 266 • For Reflection and Discussion 266			
<b>11</b> Differentiating Instruction with Technology	267		
A Teacher’s Dilemma	268		
Differentiated Instruction and Universal Design for Learning	269		
Differentiated Instruction	270		
■ IN PRACTICE Differentiating Learning for Women’s History Month	271		
Universal Design for Learning	272		
■ DIGITAL DIALOG 11.1	273		
Designing Successful Learning Experiences	273		
Digitally Accessible Learning Assignments	274		
Technology and Diverse Learners	276		
Culturally Responsive Teaching in 21st Century Schools	276		
REVEALING UNKNOWN HISTORIES AND UNTOLD STORIES 277 • SUPPORTING CULTURALLY RESPONSIVE CURRICULUM AND INSTRUCTION 277 • EXPANDING TEACHING METHODS AND APPROACHES 277 • CONNECTING CLASSROOMS WITH COMMUNITIES AND CULTURES 278			
Using Technology with Linguistically Diverse Learners	278		
SPELLING, PRONUNCIATION, AND GRAMMAR APPS 278			
■ DIGITAL DIALOG 11.2	279		
MULTILINGUAL WEB RESOURCES 279 • ONLINE READING RESOURCES 280 • INTERNATIONAL NEWSPAPERS AND INTERACTIVE MAPS 280 • ENGLISH LANGUAGE WORD ORIGINS 280 • DUAL LANGUAGE PICTURE BOOKS AND YOUNG ADULT LITERATURE 280 • WORD CLOUDS 281 • DIGITAL TRANSLATORS 281			
■ TECH TOOL 11.1 Language Learning with Interactive Online Dictionaries	282		
Uses of Assistive Technologies	284		
Matching Learners and Technologies	284		
Speech-to-Text Software and Apps	285		
Text-to-Speech Software and Apps	285		
Interactive Whiteboards for Classroom Learning	286		

Young Writers and Technology	287	Student Feedback Surveys	306
Process Approaches to Writing	288	Digital Tools and Apps for Assessment	309
Technology Throughout the Writing Process	289	Pre-Assessment Surveys	309
Apps for Poetry Writing	291	Student Participation Technologies	310
■ TECHNOLOGY TRANSFORMATION LEARNING PLAN Measuring Shadows: Differentiating Science Learning Using Technology	292	■ DIGITAL DIALOG 12.2	311
Chapter Summary 294 • Key Terms 295 • For Reflection and Discussion 295		Organizing Online Quiz Games	312
		■ TECH TOOL 12.1 Interactive Participation Tools	313
		Grading Software and Apps	314
		Digital Portfolios for Teachers and Students	315
		Elements of Digital Portfolios for Teachers	316
		Portfolios and Reflection	317
		Self-Tutoring for New Teachers	317
		Digital Portfolios for Students	318
		■ TECHNOLOGY TRANSFORMATION LEARNING PLAN Constructing an Encyclo-ME-dia: Recording Student Learning in a Digital Portfolio	320
		Chapter Summary 322 • Key Terms 322 • For Reflection and Discussion 323	
		Glossary	324
		References	331
		Index	341
<b>12 Empowering Learners Through Performance Assessments and Reflection</b>	<b>296</b>		
A Teacher and Students Make Digital Portfolios	297		
Assessment in Teaching and Learning	299		
Dimensions of Educational Assessment	299		
■ DIGITAL DIALOG 12.1	300		
Different Types of Assessments for Learning	300		
Student-Centered Assessment Practices	301		
Student Performance Rubrics	302		
Partnering Pedagogies and Democratic Classrooms	304		
■ IN PRACTICE Assessing Student Learning with Smartphones and Tablets	305		

*This page is intentionally left blank*

# Preface

Welcome to the fourth edition of *Transforming Learning with New Technologies*. We have written this book to demonstrate the limitless ways teachers and students can use desktops, laptops, smartphones, tablets, apps, interactive websites, coding, maker-spaces, 3-D modeling and printing, serious learning games, assistive technologies, performance assessments, and many more new and emerging technologies to create highly interactive, inquiry-based teaching and learning experiences in K–12 schools.

Our goal is to help you transform classrooms into technology-infused places of learning where teachers and students are active educational partners, working together to use and understand technology. Focusing on day-to-day realities of elementary and secondary schools, each chapter addresses the needs of future educators. We provide thoughtful perspectives, instructional examples, descriptions of technology tools and apps, and technology-integrated lesson plans from across the curriculum and for all grade levels as starting points for new teachers to use in developing technology-based learning for students.

As technology transforms every aspect of our lives and our society—from science, medicine, and business to family, entertainment, and education—this fourth edition seeks to support future teachers as they re-envision the roles of technology in schools. Our highly technological, knowledge-based society demands that teachers and students possess new knowledge and expanded talents to be successful in careers and life—what the Partnership for 21st Century Skills calls the “3 Rs and the 4 Cs” of our digital age.

The 3 Rs refer to the academic curriculum content that is taught across the grade levels where teachers add problem solving and inquiry learning to the time-honored skills of reading, writing, and number operations in the subject fields of reading/language arts, mathematics, the sciences, world languages, the arts, economics, geography, history, and government/civics. The 4 Cs are the skills and talents of critical thinking, communication, collaboration, and creativity that every teacher and student must have to understand and succeed in the world of today and tomorrow.

Teaching and learning with the 3 Rs and the 4 Cs mean teachers prepare, deliver, and assess lessons differently while students participate by thinking critically and creatively about all learning they do and what technologies they use, transforming themselves from passive consumers of information *from* technology to active creators of knowledge and understanding *with* technology.

Each of us—young and old, novice or experienced technology user—is living through social, economic, and technological revolutions that are remaking every aspect of our lives, including education. Learning about technology is the essential step in using it successfully both as a teacher and as a learner. Digital technologies directed by the

creative ideas that you bring to the art and craft of teaching will continue changing K–12 schools throughout your career. You are only just beginning. In that spirit, we invite you to join us in exploring how *new technologies* create *new opportunities to transform teaching and learning* in schools.

## New to This Edition

This edition has been substantially revised and updated to incorporate the latest developments in educational technology and digital learning. In it, you will find:

- **Chapters aligned to the newest International Society for Technology in Education (ISTE) Standards**—the first five chapters are aligned to the 2017 ISTE Standards for Educators; the final seven chapters are aligned to the 2016 ISTE Standards for Students. The ISTE Standards for Educators and Students (formerly called NETS for Teachers and NETS for Students) describe and illustrate ways for teachers and students to use technology to achieve learning goals and outcomes. Each chapter supports ISTE’s broad vision of technology-infused learning by providing examples, models, and strategies for using interactive technologies to create new patterns of teaching and learning at every grade level.
- **Material on the latest highly interactive technologies and strategies for teaching and learning**—tablets and apps, flipped classrooms, computational thinking, learning to code, 3-D printing, microblogging, online learning, virtual schools, open educational resources, digital citizenship, performance assessments, and using technology with culturally and linguistically diverse learners. An emphasis on highly interactive tools and strategies reflects the changing nature of educational technology from singular devices used by individuals to collaborative tools used by groups and communities.
- **Online Application Exercises in each chapter** focus on having readers utilize digital technologies and apply them directly to their development as educators. Readers are invited to explore technology tools in more depth to experience how they might use these tools in their future classrooms.
- **Technology Transformation Plans** at the end of chapters have been renamed and refocused as “Technology Transformation Learning Plans” to emphasize the educational outcomes for students that result from the ways teachers integrate technology into classroom lessons and learning activities.
- **Designing Instruction with Technology**—the focus of Chapter 4 has been re-envisioned and re-organized to more directly address instructional design with technology. The chapter includes material on different

types of educational websites and apps, as well as a step-by-step presentation of the instructional design process in action using two science lessons—one for elementary age learners, the other for middle and high school students.

- **Teachers as Technology Leaders**—a chapter on teacher leadership has added material on the SAMR Model of Technology Integration, one-to-one computing and BYOD/T programs, and the role of teachers in addressing digital inequalities facing low-income and culturally and linguistically diverse youngsters. There are also strategies for how new teachers can most effectively manage their online presence and digital reputation on social media.
- **Digital Literacies**—Expanded coverage of digital literacy includes new material on open educational resources (OERs) and public domain materials, as well as strategies for teaching students how to do online research, evaluate the quality of web materials, and recognize and reject fake and false news.
- **Problem Solving and Inquiry Learning**—An entirely revised chapter focuses on using coding, robotics, makerspaces, and 3-D printing with students in schools. The chapter features new material on serious educational games and game-based learning along with a new Technology Transformation Learning Plan: *Recreating Pre-Contact Native American Houses with a Makerspace and 3-D Printing*.
- **Technology for Diverse Learners**—A substantially reorganized chapter emphasizes using technology to support learning for culturally and linguistically diverse students as well as youngsters with special educational needs. There is material on culturally responsive teaching, teaching students who are learning English as a new language, creating digitally accessible assignments for students, and using technology to support a writing process fit for young writers.

- **Self-Checks.** In each chapter, self-check quizzes help assess how well learners have mastered the content. The self-checks are made up of self-grading multiple-choice items that not only provide feedback on whether questions are answered correctly or incorrectly, but also provide rationales for both correct and incorrect answers.
- **Application Exercises.** Every chapter in the fourth edition includes three interactive Application Exercises called “Application Exercises offer hands-on, technology-based opportunities to explore tools and resources that technology-using educators will want to know about and be able to use with K-12 students. Tech Tool exercises are ways to “test-drive” digital tools, experiencing first-hand how they can function instructionally in school settings. Building Your PLN exercises feature digital technologies that future teachers can add to their professional resume of skills and understandings. Growing and Leading with Technology exercises invite readers to develop their own “what would you do” responses to actual classroom scenarios. Application Exercises have thought questions to answer, after which readers can view our author feedback for each question.

#### 1. Becoming a 21st Century Teacher

- Application Exercise 1.1: Tech Tool: *Transforming Technology Tools for Tablets, Smartphones and Laptops*
- Application Exercise 1.2: Building Your PLN: *Selecting Professional Pull and Push Resources*
- Application Exercise 1.3: Growing and Leading with Technology: *Marco’s “PLN Building” Activity*

#### 2. Understanding Educational Technology Issues and Trends

- Application Exercise 2.1: Building Your PLN: *Examining Apps for Safety and Privacy*
- Application Exercise 2.2: Tech Tool: *Writing a Review of an Educational App*
- Application Exercise 2.3: Growing and Leading with Technology—*Cherelle’s “Using Technology in the Classroom” Activity*

#### 3. Transforming Learning with Unique, Powerful Technologies

- Application Exercise 3.1: Building Your PLN: *Web Resources and Apps for Critical Thinking and Problem Solving*
- Application Exercise 3.2: Building Your PLN: *Web Resources and Apps for Digital Literacy Learning*
- Application Exercise 3.3: Building Your PLN: *Web Resources and Apps for Digital Communication and Collaboration*
- Application Exercise 3.4: Building Your PLN: *Web Resources and Apps for Creativity*
- Application Exercise 3.5: Building Your PLN: *Web Resources and Apps for Digital Citizenship*

4. Designing Instruction with Technology
  - Application Exercise 4.1: Tech Tool: *Exploring Educational Websites and Apps*
  - Application Exercise 4.2: Building Your PLN: *Designing a Classroom Learning Activity with Technology*
  - Application Exercise 4.3: Growing and Leading with Technology—*Tony’s “Planets in the Solar System” Learning Activity*
5. Applying Technology as Teacher Leaders and Innovators
  - Application Exercise 5.1: Tech Tool: *Using Technology as Mindtools*
  - Application Exercise 5.2: Building Your PLN: *Managing Your Online Presence as A Teacher*
  - Application Exercise 5.3: Growing and Leading with Technology—*Kate’s “Becoming a Technology Leader in Her First Teaching Job”*
6. Teaching Information Literacy and Digital Citizenship
  - Application Exercise 6.1: Tech Tool: *Exploring the Interactive Features of an OER e-Textbook*
  - Application Exercise 6.2: Building Your PLN: *The Multiple Dimensions of Digital Citizenship*
  - Application Exercise 6.3: Growing and Leading with Technology—*Erich’s “Researching the First Thanksgiving” Learning Activity*
7. Engaging in Virtual Learning with Online Resources
  - Application Exercise 7.1: Tech Tool: *Assembling a Social Bookmarking Collection*
  - Application Exercise 7.2: Building Your PLN: *Curating Multimedia Standards-based Content*
  - Application Exercise 7.3: Growing and Leading with Technology—*Irene and Stacy’s “Thinking Globally, Acting Locally” Learning Activity*
8. Solving Problems and Designing Solutions through Coding, Makerspaces and Serious Gaming
  - Application Exercise 8.1: Building Your PLN: *Evaluating Apps for Learning to Code*
  - Application Exercise 8.2: Tech Tool: *Reviewing a Digital Game for Learning*
  - Application Exercise 8.3: Growing and Leading with Technology: *Sharon’s “Inventions and Technologies” Learning Activity*
9. Communicating and Collaborating with Social Technologies
  - Application Exercise 9.1: Tech Tool: *Doing Twitter-based Learning Activities with Students*
  - Application Exercise 9.2: Building Your PLN: *Locating Multimodal Resources for a Collaborative Project-Based Wiki or Google Site*
  - Application Exercise 9.3: Growing and Leading with Technology—*Brook’s “Who Came Down That Road?” Learning Activity*
10. Expressing Creativity with Multimedia Technologies
  - Application Exercise 10.1: Tech Tool: *Selecting a Podcast Learning Source for Students*
  - Application Exercise 10.2: Building Your PLN: *Creating a Teacher Channel for Video Resources*
  - Application Exercise 10.3: Growing and Leading with Technology—*Drew’s “Physics of Projectile Motion” Learning Activity*
11. Differentiating Instruction with Technology
  - Application Exercise 11.1: Building Your PLN: *Differentiating Instruction through Low Tech/Mid Tech/High Tech Accommodations*
  - Application Exercise 11.2: Tech Tool: *Interactive Vocabulary Learning Tools in a Writing Process Fit for Young Writers*
  - Application Exercise 11.3: Growing and Leading with Technology: *Shannon’s “This I Believe Essay” Learning Activity*
12. Empowering Learners through Performance Assessments and Reflection
  - Application Exercise 12.1: Building Your PLN: *Developing Student Feedback Survey Questions*
  - Application Exercise 12.2: Tech Tool: *Reviewing an Online Quiz Game*
  - Application Exercise 12.3: Growing and Leading with Technology—*Mayalyn’s “Math Review” Learning Activity*

## Author-Created Companion Site

To provide ongoing updates and resources for the 4th edition, we have developed a companion Google site, also called transforming learning with new technologies. It replaces transformingtch, our companion wiki for the 3rd edition. At the new site you will find material related to key topics in each chapter. As new research, materials, and resources become available, our plan is to post them on the site so everyone can find up-to-date news and information about technology, schools, and learning. THE SITE IS FREE ONLINE AT <https://sites.google.com/view/transformlearningwithtech>

## Chapter Organization and Updates

Each chapter is organized around specific learning goals designed to provide teachers and students with information to create successful, technology-infused learning environments in K–12 schools and classrooms.

- Chapter 1 introduces the changing context of education in an increasingly multicultural, multilingual society, along with what it means to be a 21st century teacher who uses technology for teaching and learning. There is material updating Bloom’s taxonomy with technology, an introduction to the newest ISTE Standards for Educators and Students, and ideas for how to use this book to begin building a PLN (professional learning network) as a new teacher.
- Chapter 2 identifies the latest issues, developments, and trends in the field of educational technology. There is material on using technology to engage students as well as the impacts of digital inequalities on student achievement gaps. Overcoming differences between student-initiated and teacher-chosen technology use is



a key to addressing a persistent digital disconnect that many students feel at school.

- Chapter 3 discusses how technology can generate unique, powerful, and transforming learning (UPT) as defined by the ISTE Standards for Students and 21st Century Student Outcomes. There are technology-based learning activities, web resources and apps for critical thinking and problem solving, digital literacy, communication and collaboration, creativity, and digital citizenship.
- Chapter 4 reviews learning theories and design processes for incorporating technology into lesson planning, classroom teaching, and student assessment, including constructivist and student-centered approaches to the essential elements of instructional design. Two science lessons, one each for elementary school and high school students, provide a step-by-step overview of the instructional design process in action.
- Chapter 5 discusses the dynamics of integrating technology into teaching while creating educational change in schools. There is a focus on using technology to address digital inequalities and student participation gaps in school classrooms, including one-to-one computing, flipped learning, and interactive educational materials. There are also strategies for college students to utilize to become technology-leading educators.
- Chapter 6 examines the multiple dimensions of information literacy and digital citizenship. Beginning with the importance of digital literacy for teachers and students, there is material on identifying fake and false news, using search engines effectively, critically assessing online materials, and utilizing open educational resources (OERs) and public domain materials. There are also strategies for teaching students how to act responsibly as digital citizens.
- Chapter 7 focuses on using online digital content for teaching and learning while also examining the growth and development of blended learning and virtual schools. Technologies and strategies for curating information include an overview of Google's collection of tools for teachers. There is also material on the strengths and drawbacks of online learning and the importance of using exploratory learning websites and apps to engage students in academic learning.
- Chapter 8 shows ways to develop students' inquiry-learning and problem-solving skills using technology. Teaching coding and robotics engages students in problem-based learning. Serious learning games, online simulations, and virtual reality applications offer students open-ended ways to practice problem solving by thinking critically. Makerspaces and 3-D modeling and printing place students in the roles of inventors, creators, and engineers of creative learning experiences.
- Chapter 9 explains how teachers and students can use digital communication technologies to enhance collaboration, share information, and promote new learning. There are strategies for utilizing e-mail, text messaging,

Twitter, and online discussions as a teacher. Blogs, wikis, and Google sites are discussed as technologies for engaging students and implementing collaborative project-based learning activities.

- Chapter 10 explores multimedia technologies and their roles in promoting multimodal learning and student creativity. There are strategies for utilizing e-books and e-readers, educational podcasts, and next-generation presentation tools. There are also ideas and tools for incorporating video in the classroom and supporting students as they engage in photo taking, digital storytelling, and movie-making.
- Chapter 11 explains how technology supports differentiated instruction and universal design for learning by emphasizing educational success for all students. There are tools and strategies for engaging culturally and linguistically diverse learners; an overview of assistive technologies that support students with special educational challenges; and tools for teaching writing within a writing process fit for young writers.
- Chapter 12 demonstrates how teachers and students can become active participants in evaluating and assessing their own growth as learners using technology. The role of assessment in K–12 education is explored along with different types of technology-based, student-centered assessments, including student performance rubrics, democratic classrooms, student feedback surveys, and student participation tools. Digital portfolios for students and teachers are also highlighted as ways for individuals to self-assess personal learning.

## In-Chapter Features

**CHAPTER-OPENING PEDAGOGY** Each chapter begins with learning outcomes connected to each major heading in the chapter. This establishes the framework for what students should know and be able to do when they complete the chapter. Following the learning outcomes is a graphic organizer outlining the chapter's learning goals; ISTE standards connections; and apps and tools that appear in the chapter. Learning goals offer a guide for students' reading and brief vignettes of real-life situations in schools that introduce the chapter's main theme.

**END-OF-CHAPTER ACTIVITIES** The following materials provide a thorough review of the chapter and extend student thinking beyond the chapter focus:

- **Chapter Summaries** of the major ideas correspond to the learning outcomes found at the beginning of the chapter.
- **Key Terms** list the important terminology found in the chapter. Terms are found in bold within the chapter text and are defined in the glossary at the end of the book.
- **For Reflection and Discussion** offers end-of-the-chapter questions and exercises for the purpose of individual reflection, group dialogue, and personal writing to reinforce chapter content and its learning goals.

- **Chapter Learning Outcomes** have been consolidated to reflect the evolving emphasis on social media, apps, online digital content, and new interactive tools for teaching and learning. Each learning outcome corresponds to a section within the chapter, arranged from the conceptual to the practical so readers receive an introduction to concepts and learning goals and are then shown ways to implement them in school classrooms.
- **In Practice** is a boxed feature in every chapter that offers classroom-based examples of teachers and students using new technologies for classroom learning. Every In Practice showcases one of the key ideas or technologies being discussed in the chapter by focusing on its practical applications in K–12 schools.

**TECH TOOLS** Tech Tools in each chapter profile high-quality, easy-to-use, and easy-to-obtain digital tools, apps, and web-based resources that can enhance your work as a teacher, both instructionally and professionally. We describe each tool, how it can be used educationally, and why it is important for teaching and learning. In the eText edition, each Tech Tool includes an interactive, learner-centered Application Exercise designed to help readers of the book explore tools and apps in greater depth. All Tech Tool resources have been class-tested by the authors and students.

**DIGITAL DIALOG** A boxed feature in each chapter invites readers to use social media and in-class conversations to explore issues raised throughout the book. Brief questions focus attention on current thinking and future plans. From their own and other students' written reflections, readers learn ways to use new technologies for teaching and learning.

**TECHNOLOGY TRANSFORMATION LEARNING PLANS** Found at the end of Chapters 6–12, Technology Transformation Learning Plans show teachers how to infuse technology in a substantive and meaningful way using a standard lesson plan template with objectives, methods, assessment strategies, national subject area curriculum standards, and the ISTE Standards for Students. Relating directly to the learning goals and new technologies featured in the chapter, each lesson plan offers “before-and-after” insights via a table that includes one column, “Minimal Technology” (the “before” mode), describing how teachers might conduct a lesson without a significant role for technology, and a second column, “Infusion of Technology” (the “after” mode), illustrating how technologies can fundamentally enhance and transform learning for students and teachers. The Technology Transformation Learning Plans are correlated to the ISTE Standards for Students.

### Tech Tool 1.1

#### Tablets, Smartphones, and Laptops

As a college student, you may own a smartphone as well as a laptop, desktop, or tablet computer. By 2018, 95% of all Americans owned a cell phone; 75% had smartphones; three in four owned a desktop or laptop computer; half had a tablet; one in five had an e-reading device (Pew Research Center, 2018). Mobile and digital technologies provide anywhere, anytime online access to ideas, information, and learning resources—essential features of educational life for teachers and students. The three basic mobile devices include:

##### Tablets

Tablets are small, powerful machines that use touch-screen controls and Internet access to promote interactive learning among teachers and students who can collaborate on projects, share information, access multimedia resources, compute and calculate numbers, and perform many other learning activities. The Apple iPad (multiple models), Microsoft Surface Pro, Samsung Galaxy Tab S4, and Asus ZenPad are all highly rated tablets. The definition of what is or what is not a tablet is evolving, giving rise to a new term, *phablet*, meaning a device that combines features of a tablet and a mobile phone. Its larger size screen hosts full high definition with superior resolution for online browsing, music listening, photo taking, movie and video viewing, and e-reading.

##### Smartphones

Smartphones are mobile telephones that perform a range of information communication functions, including Internet access, voice communication, text messaging, and video viewing. As historian Paul Ceruzzi (2012) noted, smartphones blend the functions of technologies from the past—telephone, radio, television, phonograph, camera, and teletype—to create a multifunctional handheld device. Apple's iPhone propelled the development of smartphone technology, and now there are numerous competing models from multiple companies.

The smartphone's popularity opens up many possibilities as a learning technology. First, smartphones support anywhere,

anytime learning. Teachers and students can access a wealth of audio and video educational resources whenever they choose. Second, the portability of a smartphone lets students take course content wherever they go. Third, teachers and students can record their own podcasts and then listen to them on their phones. Although not yet total substitutes for desktops and laptops, smartphones offer on-the-go teacher options such as rapid note taking, quick texting and e-mail communicating, and easy information searching. Like tablets, smartphones run many apps for educational learning.

##### Laptops

Laptops (also called notebooks, netbooks, or ultrabooks) weigh between 2 and 8 pounds. Although their lightness is a significant bonus, the computing power of these machines makes them vitally useful for teachers. High-quality laptops offer long battery life, an easy-to-read screen display in all kinds of light, sufficient memory to run multiple applications, and enough processing speed to handle downloading information and processing files. They have enough storage to be filling cabinets and virtual libraries. Ask yourself, “What kind of laptop user am I?” If you are a frequent note taker, you may want to consider battery life. If you do lots of traveling, weight may be your number-one concern. If you store lots of data, memory may be your purchasing focus.

Tablets, smartphones, and laptops run apps, support software, and access interactive websites that can be used for thousands of instructional purposes:

- Supporting learning in every subject area—interactive world maps in social studies, online dictionaries and poetry collections in language arts, calculators and problem-solving activities in math
- Asking students to research existing apps that specifically address the needs of people in local communities
- Inviting students to envision new smartphone apps to explore pressing social or environmental problems.

### Digital Dialog 1.1

Looking at the Harris Poll survey findings in Table 1.1, college students who are planning to become teachers may find their experiences with technology are closer to the older generation of Millennials than the generation of students you will be teaching when you enter the classroom. Consider whether you align more closely with Gen Z or Millennials in the categories of the survey, then connect and comment online about the following questions:

- Based on what you now know about Gen Z and Gen Alpha, what digital tools might you consider using for teaching to engage your students? Explain why.
- Students use technology in so many parts of their lives outside of school. Should they be constantly connected to technology in the classroom? Why or why not?

## Technology Transformation Learning Plan

### Weather Station WebQuest

*Investigating Science Using Interactive Web Resources*

<b>Grade(s)</b>	Elementary and middle school
<b>Subject(s)</b>	Science/social studies
<b>Key Goal/Enduring Understanding</b>	Weather is a naturally occurring phenomenon that may appear unpredictable but is actually a group of interconnected elements that can be studied, understood, and predicted.
<b>Essential Question</b>	What types of patterns do we see in weather, and how can we use those patterns to make our own weather predictions?
<b>Academic Discipline Learning Standards</b>	<p><b>National Science Teachers Association:</b> <i>Next Generation Science Standards</i> Earth and Space Sciences</p> <p>Earth and Human Activity</p> <p><b>National Council for the Social Studies:</b> <i>Curriculum and Content Area Standards</i> <b>Theme III:</b> People, Places, and Environment <b>Theme VIII:</b> Science, Technology, and Society</p>
<b>Learning Objectives</b>	<p>Students will know how and be able to:</p> <ul style="list-style-type: none"> <li>• Recognize patterns in weather</li> <li>• Use tools that simulate weather patterns</li> <li>• Disseminate weather-related information using web-based tools</li> <li>• Make predictions about future weather based on weather pattern data</li> </ul>

**PROFESSIONAL LEARNING NETWORK (PLN)** An expanded inside-the-chapter Application Exercise provides readers with technology exploration activities to complete as they read the book. These hands-on activities are designed to help readers develop a portfolio of knowledge and skills to use when entering the teaching job market and throughout their career. PLNs are a popular concept for new teachers, for as technology educator Torrey Trust (2012, p. 133) noted: “PLNs connect teachers to other individuals worldwide who can offer support, advice, feedback, and collaboration opportunities.” PLNs also allow teachers to collect information from various websites so they can stay up-to-date on the latest teaching techniques, pedagogies, and changes in the field of education.

### Support Materials for Instructors

The following resources are available for instructors to download on [www.pearsonhighered.com/educators](http://www.pearsonhighered.com/educators). Instructors enter the author or title of this book, select this particular edition of the book, and then click on the “Resources” tab to log in and download textbook supplements.

### Instructor’s Resource Manual and Test Bank

The Instructor’s Resource Manual and Test Bank includes suggestions for learning activities, additional Experiencing Firsthand exercises, supplementary lectures, case study analyses, discussion topics, group activities, and a robust collection of test items. Some items (lower-level questions) simply ask students to identify or explain concepts and principles they have learned. But many others (higher-level questions) ask students to apply those same concepts and principles to specific classroom situations—that is, to actual student behaviors and teaching strategies.

### PowerPoint Slides

The PowerPoint slides include key concept summarizations, diagrams, and other graphic aids to enhance learning. They are designed to help students understand, organize, and remember core concepts and theories.

### TestGen

TestGen is a powerful test generator that instructors install on a computer and use in conjunction with the TestGen testbank file for the text. You install TestGen on your personal computer (Windows or Macintosh) and create your own tests for classroom testing and for other specialized delivery options, such as over a local area network or on the web. A test bank, which is also called a Test Item File (TIF), typically contains a large set of test items, organized by chapter and ready for use in creating a test based on the associated textbook material. Assessments may be created for both print and online testing.

The tests can be downloaded in the following formats:

TestGen Testbank file: PC

TestGen Testbank file: MAC

TestGen Testbank: Blackboard 9 TIF

TestGen Testbank: Blackboard CE/Vista (WebCT) TIF

Angel Test Bank (zip)

D2L Test Bank (zip)

Moodle Test Bank

Sakai Test Bank (zip)

## Acknowledgments

We were inspired to write *Transforming Learning with New Technologies* by collaborating and learning with hundreds of teachers and students during the past four decades of teaching at the University of Massachusetts Amherst. Their drive to inspire, support, and engage students motivates us to envision technology-infused schools in which every learner can realize her or his fullest potentials.

We would like to thank the following individuals whose ideas and insights contributed to the fourth edition of this book: Trevor Takayama, Heather Dahl-Hansen, Jerry & Beverly Trust, Irene LaRoche, Dave Hale, Stacey Chapley, Brianna Ball, Erich Leaper, Emily Chandran, Marissa Best, Sinead Meaney, Stephany Pallazolla, Shannon Hirsch, Joel Flores, Brook Hansel, Colin Conkey, Allison Malinowski, Leah Mermelstein, Fred Zinn, Daryl Essensa, Jeromie Whalen, Chris Gaudreau, Lauren Goodman, Mario Valdebenito Rodas, and Maria Fabozzi.

As in any project, realizing this point would not have been possible without the assistance of numerous individuals who helped sharpen the focus and improve the content of this edition. We would like to thank the reviewers of previous editions: Stephen Cebik, who wrote the PowerPoint supplements; Agnes Helen Belle, Alabama State University; David Bullock, Portland State University; Craig Cunningham, National-Louis University; Carrie Dale, Eastern Illinois University; Jane Eberle, Emporia State University; Loretta Enlow, Indiana Wesleyan University; Sonja Heeter, Clarion University of Pennsylvania; Barbara Jones, Golden West College; Bernadette Kelley, Florida A&M University; Valerie Larsen, University of Virginia; Ashley Navarro, Seminole Community College; Robert Perkins, College of Charleston; Andrew B. Polly, University of North Carolina-Charlotte; Ken Rushlow, Middle Tennessee State University; Diana Santiago, Central New Mexico Community College; Shannon Scanlon, Henry Ford Community College; Patricia Weaver, Fayetteville Technical Community College; Pavlo D. Antonenko, Oklahoma State University; Tracey L. Sheetz Bartos, Seton Hill University; Richard L. Holden, Mississippi University for Women; Carol L. Martin, Harrisburg Area Community College; Inge Schmidt, Ursuline College; Rebecca Fredrickson, Texas Woman’s University; Dr. Elisa Beth McNeill, Texas A&M University; Steven Smith, Ed.D., Clayton State University; and Jeffrey S. Trotter, Anderson University.

Finally, we thank our editors: Product Manager Drew Bennett, Senior Development Editor Jeff Johnson, and other editors, design, and production staff. Their guidance and suggestions have crafted this edition into print and digital formats that convey our vision for technology and change.





## Chapter 1

# Becoming a 21st Century Teacher



SOURCE: Hquality/Shutterstock

## Chapter Overview

Chapter 1 introduces skills, talents, and technologies 21st century teachers will be using to create interactive, engaging learning experiences for themselves and students. We open with an overview of technology's centrality in the lives of students and families and its integration in the work of teachers. The current International Society for Technology in Education (ISTE) Standards for Students and Educators as well as Bloom's taxonomy of educational objectives, the technological pedagogical content knowledge (TPACK), and 21st century skills are introduced to frame how new teachers think about technology's role in teaching and learning. In a final section, we introduce a professional learning network (PLN) as a framework for how new teachers can continually expand and document what they know and can do as technology-leading and learning educators. The chapter addresses the "Leader" domain of the ISTE Standard for Educators, which urges teachers to continually look for and learn about new ways for technology to improve successful learning for students.



## Learning Outcomes

After reading this chapter, you will be able to:

- 1.1 Summarize the changing diversity of American education and the roles of technology in the lives of students and families.
- 1.2 Discuss ways teachers utilize digital technologies in their work as educators.
- 1.3 Analyze how 21st century technologies can be used to create highly interactive, inquiry-based learning environments.
- 1.4 Organize a professional learning network (PLN) as a technology-using educator.

## Chapter Learning Goal

Understand students, schools, and technologies as a 21st century technology-using teacher.

### Featured Technologies

Computers

Laptops

Tablets

Smartphones

Apps

Social media

Professional learning network (PLN)

Web 2.0/3.0

## Two New Teachers and Their Technologies

*Hilary remembers always wanting to be a teacher. From grade school on, she imagined herself in a classroom teaching her favorite subjects. She is from a family of teachers—her father taught and coached at a local high school, and her older sister is a speech therapist in a nearby elementary school. Going to college was always in her plans, and when she arrived at her four-year school, she majored in history and teacher education.*

*Becoming a teacher was the furthest thing from Anthony's mind when he graduated from high school and enrolled in a local community college as a part-time student. As he gradually earned the credits to transfer to a four-year school and major in biology, the idea of teaching science to younger students began to appeal to him as a career choice.*

*As diverse as these two appear to be, Hilary and Anthony are constant technology users. Neither goes anywhere without a smartphone. Both enjoy watching YouTube videos and downloading music on their handheld devices. While each has an e-mail account, texting, Instagram, and Snapchat are their preferred modes of communicating with friends. Playing video games, shopping online, watching television, doing mobile banking, and streaming movies are daily parts of their media lives.*

*Seeing technology influencing their own learning, Hilary and Anthony sought ways to use digital tools for teaching students. Hilary helped build and expand a wiki of multimodal web resources to assist history teachers in developing technology-infused learning plans. Anthony began bookmarking online simulations and games for students to play while making science-in-the-real-world videos on his smartphone and editing them as part of inquiry-based lessons. For both Hilary and Anthony, technology for teaching became a central part of becoming an educator.*

Although they took different routes to teaching, Hilary and Anthony consistently learned about technology through their use of it in their own lives. When they were in high school and college, technology meant texting, **social media**, and entertainment through **apps**, games, streaming videos, digital music, and online blogs and news sites. As teachers entering classrooms for the first time, however, they were not experienced with how to use the power of technology to transform learning. They had to learn new digital tools and discover unforeseen possibilities of technology-based learning to become 21st century teachers.

Our goal for you is to become a confident, thoughtful user of educational technologies in courses, classrooms, and professional settings while you develop your knowledge, skills, and talents as a technology-leading and learning teacher. In this opening chapter, we focus attention on four questions central to your growth and development as a teacher in the digital age:

1. What are the characteristics of today's rapidly changing, increasingly diverse schools?
2. What technologies are integral to your work as a 21st century teacher?
3. How might the ISTE Standards for Students and Educators, technological pedagogical content knowledge (TPACK), and 21st century skills shape your teaching practice?
4. How can you begin developing a professional learning network (PLN) as a teacher?

## Teaching and Students Today

### 1.1 Summarize the changing diversity of American education and the roles of technology in the lives of students and families.

Teaching is a career that matters to everyone—students, families, employers, and society. Filled with endless complexities, questions, and rewards, the profession is clearly committed to continuous professional development and academic learning. As a teacher, you are expected to:

- Convey essential academic material to students in ways they will understand, remember, and apply
- Educate, inspire, engage, and create success for every student, each of whom has a unique background of culture, social class, family income, gender, language, and individual exceptionalities
- Manage inside-the-classroom dynamics of interpersonal interactions, behavior, and community and daily routines to sustain academic learning in the lives of students, families, and communities.

As Philip Jackson (1968) chronicled five decades ago, a teacher handles some 200 separate interpersonal interactions every hour, 6 hours a day, for 180 school days each year—a huge endeavor. Faced with these multiple and often competing goals, beginning educators draw on years of personal experience as students to balance it all. They tend to teach as they have been taught, utilizing whole-group instruction with desks arranged in rows while students take notes, complete worksheets, write papers, and receive grades based on multiple-choice test scores. As a result of these established



Students of all ages use technology for learning and socializing.

**SOURCE:** Rob/Fotolia (top);

**SOURCE:** Pressmaster/Fotolia (bottom)



instructional routines, many classrooms feature large amounts of teacher talk while students passively listen to what teachers say.

Traditional practices, from before and throughout the 20th century, fail to engage large numbers of students, including students who are too far behind or ahead academically; students who prefer to learn by moving, drawing, or singing; and learners who are deeply connected with technology outside of school, but have to power down their devices in school. Todd Rose, in his TED talk “The Myth of Average” (2013), pointed out that “Even though we have one of the most diverse countries in the history of the world, and even though it’s the 21st century, we still design our learning environments, like textbooks, for the average student.” As a result, Rose concludes, “We’ve created learning environments that, because they are designed on average, cannot possibly do what we expected them to do, which is to nurture individual potential . . . Because every single student has a jagged learning profile, it means that the average hurts everyone, even our best and brightest.”

Creating interactive and inspiring learning experiences for students is today’s greatest educational challenge, made all the more complex in classrooms with students from many backgrounds, cultures, and languages who possess different levels of interest in the curriculum and have divergent learning preferences. To teach effectively, educators at every grade level must know how to utilize multiple technologies to promote and sustain student learning. Technology enables new ways to engage students by:

- Differentiating instruction to offer students diverse learning experiences
- Energizing learning with interactive tools
- Creating collaborative learning situations
- Enabling access to academic information from multiple sources
- Visiting places and observing processes that cannot be seen otherwise.

## A Rapidly Changing and Diversifying Society

As you prepare to teach, you do so within the context of a rapidly changing and diversifying society in which:

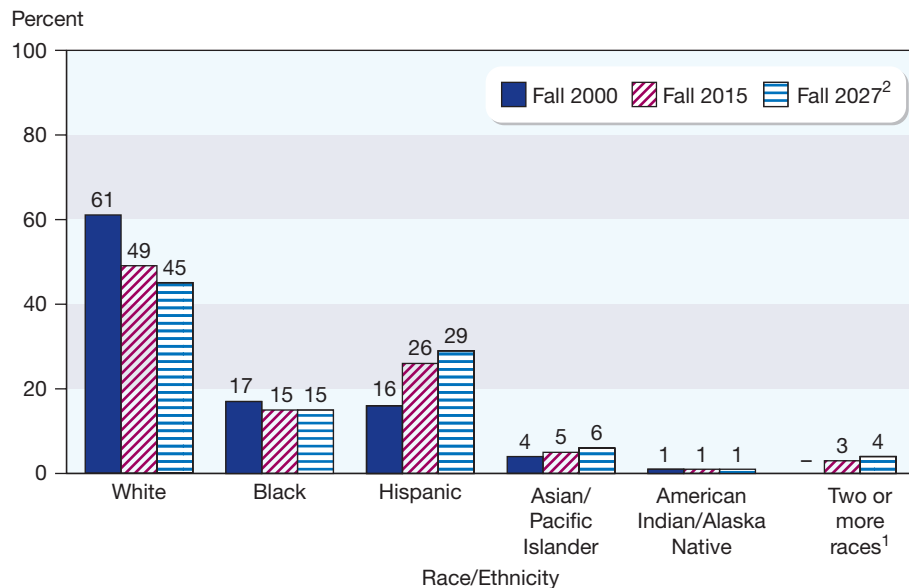
- *The K–12 school population is becoming more culturally and linguistically diverse.* Demographer William H. Frey (2018a, 2018b) refers to these changes as a “**diversity explosion.**” Hispanic, African American, Asian/Pacific Islander, and Native American students now make up more than 50% of the nation’s K–12 student population, and the National Center for Education Statistics (2019) is forecasting that the percentage of non-White students in the schools will continue to increase through at least the year 2027 (see Figure 1.1).

Cultural diversity is accompanied by linguistic diversity—the U.S. Census Bureau (2015) has reported that there are now more than 350 different languages spoken in U.S. homes. Spanish is the second-most spoken language besides English, with more than 40 million speakers, but Chinese (including Mandarin and Cantonese), Tagalog (including Filipino), Vietnamese, Arabic, French, and Korean have at least 1 million speakers as well. Nevada, Florida, California, New York, and Texas are the most diverse states. In California, half of the state’s students are Hispanic, and nearly half speak a language other than English at home (Ed100.org, 2018). Diversity is also reflected in the learning needs of students. Thirteen percent of the nation’s K–12 students receive special education services; more than half of those students have learning disabilities or speech and language impairments (National Center for Education Statistics, 2018a). Diverse classrooms mean that you can expect to teach in schools that will have many languages, family backgrounds, cultural traditions, and forms of gender expression in student populations.

- *Multiple achievement gaps persist among students in schools.* **Achievement gaps** are differences in educational outcomes among groups of students. Black, Hispanic, and Native American students, despite some improvements and gains, continue

**Figure 1.1** Percentage Distribution of Students Enrolled in Public Elementary and Secondary Schools, by Race/Ethnicity

**SOURCE:** U.S. Department of Education/National Center for Education Statistics (February 2019).



- Not available.

<sup>1</sup> In 2000, data on students of Two or more races were not collected.

<sup>2</sup> Projected.

to perform below White and Asian students in reading and math as measured by the National Assessment of Educational Progress (NAEP), the nation's report card (Hansen, et al., 2018). These youngsters lag behind White and Asian peers in graduating from high school, attending college, and graduating from college. In addition, significant numbers of English language learners, students in special education, and LGBTQ youth remain behind their peers in reading, writing, and math test scores; rates of high school graduation; and choice of math-, science-, and engineering-related careers. There are wide achievement gaps between youngsters from wealthy and poor families (defined as 90th vs. 10th percentiles of income). There are gender-based gaps as well. For instance, girls outperform boys on reading and writing in almost all school districts, while boys from affluent, predominantly White districts outperform girls in math (Reardon, et al., 2018). And even though more girls are taking the AP Computer Science test, girls are less likely than boys to pursue careers in science, technology, engineering, and math (STEM) after high school.

- Connectivity gaps remain a pervasive educational issue.** **Connectivity gaps** are a type of **digital inequality** in which children in low-income, Black, Hispanic, and American Indian/Alaskan Native households are technologically “underconnected” from the digital resources needed for successful life and learning (National Center for Education Statistics, 2018b; Moore, Vitale, & Stawinoga, 2018). Underconnected households either lack Internet access entirely or have broadband speeds too slow to run the latest software programs, and many face the threat of having Internet service cut off at any time for unpaid bills. Connectivity gaps are everywhere. A large majority of youngsters living in rural areas—about one out of every five elementary or secondary school students in the country—report either “terrible,” “unpredictable,” or just “OK” access to the Internet at home and at school (Croft & Moore, 2019).
- Connectivity gaps lead to homework gaps and reduced educational outcomes for students.** **Homework gaps** happen in many low-income households when students and adults must share a single, often outdated computer (Katz, Gonzalez, & Clark, 2017). Since 80% of eighth-graders use a computer at home for schoolwork, lack of up-to-date technology can result in severe educational disadvantages (National Center for Education Statistics, 2018b). One report documented that 13% of students have difficulty completing homework due to lack of Internet access (Evans, 2018). Another national survey found that fewer than 10% of all school

districts report that every student has access to a non-shared computing device at home. Students without their own device may have difficulty completing their homework (Mayalahn, 2017). By contrast, students from higher-income families are much more likely to have high-speed Internet, use multiple digital devices, and get news and conduct business online. Phone technology also imposes limitations on students' educational experience. While most less affluent youngsters have mobile phones for accessing social media and listening to music, it is not easy to write papers, analyze materials, record data, or view simulations and interactive websites on phones as compared to using the most up-to-date desktop or tablet computers.

- *Digital inequalities persist in how technology is used in schools as well.* In theory, youngsters with reduced access to new technologies at home can overcome any educational disadvantages by being able to use and learn with digital tools at school. However, there are persistent technology-based **participation gaps** in classrooms. The same technologies get used differently in different schools, so that even when schools provide access to learning technologies for all students, schools in wealthier communities have students using those technologies in more creative and expansive ways (Reich & Ito, 2017). Students in low-income community schools tend to use technology mainly for basic skills instruction, while students in more affluent districts use technology for more creative, hands-on, exploratory learning such as coding, making games and animations with digital media, and utilizing peer collaboration tools like blogs and wikis.
- *The role of the teacher is evolving from expert in front of a classroom to facilitator of small learning groups and project-based activities.* Traditional educational practices (teachers present information while students listen and learn) fail to engage at least half and often most of the students in any given classroom. In surveys and studies, students tell researchers that they want learning in schools to resemble the active, technology-driven learning environments they routinely experience in most other parts of their lives. Multiple educational policy organizations urge teachers to create more interactive, inspiring learning environments that will connect to learners who possess different levels of interest and divergent learning preferences.
- *Schools are changing in structure and format from traditional brick-and-mortar buildings to many different combinations of in-person and online learning environments.* Everywhere in the country, you will find widely varying types of schools, including public, private, independent, religious, homeschool, charter, single gender, vocational, agricultural, virtual/online, magnet, language immersion, extended day, year-round, GED preparation, school to college, Montessori, and Reggio Emilia. As a teacher, you are not just getting ready to teach in one type of school for the duration of your career, but preparing to succeed in many different schools with different approaches to teaching and learning.
- *Beyond the schoolhouse, the nature of jobs and work now places great emphasis on mental rather than physical labor.* Students today are entering the world of work, where the skills needed are constantly changing, as are the jobs themselves. Employers want employees who have learned how to learn and embrace the idea of "thinking for a living," in Ray Marshall and Marc Tucker's memorable phrase (1993). In every sector of the economy, technology-based professional, managerial, technical, and entrepreneurial careers are emerging all the time, including many that no one could have imagined even a decade ago (e.g., drone operator, 3-D printing specialist, nanotechnology designer, robot operator for surgery). One report on human-machine partnerships forecast that 85% of the jobs for workers in 2030 have not even been invented yet (Institute for the Future for Dell Technologies, 2017). You will be teaching students not only to enter the world of today, but to be prepared for discovering the exciting new opportunities of the future.

## A Generation of Technology Users

The students in your future classroom will be unlike any generation of students before them. Psychologists Howard Gardner and Katie Davis (2014) have labeled them the "app generation" because they have grown up using computers, the Internet,

smartphones, social media, and interactive digital technologies. The oldest of these students (those born between the mid-1990s and 2010) are members of **Generation Z** (Gen Z); they are also called “post-millennials,” “screeners,” or the “iGeneration” (Serafino, 2018; Caumont, 2014). The children of Gen Z are a new population cohort known as **Generation Alpha** (Gen Alpha) and includes youngsters born between 2010 and 2025. Knowing about these generations is vitally important for you as a teacher, because the more informed you are about students and technology, the better you will understand their interests, motivations, and goals, as well as the types of educational methodologies needed to successfully teach them in K–12 schools.

From the earliest ages, children from Gen Z and Gen Alpha live media-saturated lives, constantly receiving images and information from televisions, computers, video and picture sharing websites, video games, and smartphones as participants in what sociologists have called a **digital childhood** (Vandewater, et al., 2007). Growing up digital includes the following:

- Almost all infants, toddlers, and preschoolers watch television (nearly every U.S. home has one) while making increasing use of digital tablets, smartphones, and social networks (Donahue, 2015; Guernsey, 2014).
- On average, children ages 2 to 10 years spend more than 2 hours a day with screen media, about half that time viewing materials that parents consider “educational.” As they get older, children’s screen time increases, but the amount of educational viewing decreases (Common Sense Media, 2017).
- By 2013, nearly three of four children had access to mobile devices at home on which they spent time playing games, using apps, watching videos, and reading books (Common Sense Media, 2013).
- In their teenage years, nearly all 12- to 15-year-olds watch television (98.5%) and use computers (91%), but only one quarter of boys and one third of girls meet an American Academy of Pediatrics–recommended limit of 2 hours a day or less for television plus technology use outside of school (Herrick, et al., 2014).
- **Media multitasking** (using more than one form of media at a time) is another prominent technology use feature among teenagers. The much-publicized *Generation M2* study reported that teens and tweens averaged 7 hours and 38 minutes during a typical day using different types of digital and screen media (computers, video games, music players, television). However, media multitasking means these youngsters were actually experiencing 10 hours and 45 minutes of media time daily (Rideout, Foehr, & Roberts, 2010). Those numbers have not declined in the decade since the publication of the *Generation M2* study; in fact, children and adolescents continue to spend enormous amounts of time with digital and screen media at younger and younger ages.

In 2018, the Harris Poll found dramatic shifts in technology use between **Millennials**—those born after 1981—and those K–12 students who were born after 1996. The results are summarized in Table 1.1. Both groups are immersed in learning with technology, but members of Generation Z show greater preferences for visual media and video learning, interactive apps and websites, and, perhaps surprisingly, in-person group activities.

Increasingly, mobile phones are children and teenagers’ most widely accessed technology. Growth in phone technology use has been rapid. By 2013, nearly four out of five 12- to 17-year-olds (78% had a cell phone, while almost half (47%)) owned a smartphone (Lenhart, 2015). Teens use their phones when communicating with friends, using apps, and accessing the Internet for information and other educational purposes. One in four teens are “cell-mostly Internet users” who get information for school almost solely by using their phones; more than half of those youngsters download apps for entertainment or educational purposes. A majority of parents believe mobile devices are tools of the future that should be used to enrich and engage students’ learning. Although in about one in five households youngsters do not use any mobile or portable devices, by high school only 1 in 10 students is a non–technology user at home (Grunwald Associates LLC, 2013).

**Table 1.1** Technology Preferences for Generation Z and Millennial Learners

Generation Z	Millennials
<i>Social Media</i> <ul style="list-style-type: none"> <li>• YouTube (82%–67%)</li> <li>• Instagram (70%–45%)</li> <li>• Snapchat (69%–32%)</li> <li>• Twitter (43%–34%)</li> </ul>	<i>Social Media</i> <ul style="list-style-type: none"> <li>• Facebook (43%–34%)</li> </ul>
<i>Online Visual and Video Sites</i> <ul style="list-style-type: none"> <li>• Watching movies online (43%–27%)</li> <li>• Visiting video sharing sites (66%–55%)</li> <li>• Playing online games (53%–35%)</li> <li>• Sharing pictures, videos, music (66%–56%)</li> </ul>	<i>Online Visual and Video Sites</i> <ul style="list-style-type: none"> <li>• No preferences in this category</li> </ul>
<i>Tools for Learning</i> <ul style="list-style-type: none"> <li>• YouTube (59%–55%)</li> <li>• In-person group activities (57–47%)</li> <li>• Learning apps and interactive sites (47%–41%)</li> </ul>	<i>Tools for Learning</i> <ul style="list-style-type: none"> <li>• Books (60%–47%)</li> </ul>

**SOURCE:** Pearson. (2018, August). Beyond millennials: The next generation of learners.

## Digital Dialog 1.1

Looking at the Harris Poll survey findings in Table 1.1, college students who are planning to become teachers may find their experiences with technology are closer to the older generation of Millennials than the generation of students you will be teaching when you enter the classroom. Consider whether you align more closely with Gen Z or Millennials in the categories of the survey, then connect and comment online about the following questions:

- Based on what you now know about Gen Z and Gen Alpha, what digital tools might you consider using for teaching to engage your students? Explain why.
- Students use technology in so many parts of their lives outside of school. Should they be constantly connected to technology in the classroom? Why or why not?

## Technology Today

### 1.2 Discuss ways teachers utilize digital technologies in their work as educators.

New digital technologies can become essential teaching and learning tools for beginning teachers or experienced educators by creating learning experiences that would not be possible otherwise. Internet-connected computers, tablets, and smartphones offer unparalleled access to information, interactive games, streaming videos, real-world simulations, social media, online communication and collaboration tools, and many more exciting ways to expand the impact of learning in school for students and teachers.

Every **technology**, from simplest to most complex, ancient to most recent, is a tool, device, or material whose purpose is to solve human problems. Technology is a “practice, a technique, or a device for altering the experience of the world,” noted historian Rebecca Solnit (2004, p. 114) in her study of how the telegraph, the railroad, high-speed photography, and motion pictures transformed the American West in the late 19th century. Those technologies altered existing social, cultural, economic, and political patterns by extending the nation’s industrial base, displacing native peoples from ancestral lands, changing how people experienced the world, and setting a course for the future.

Creating technological solutions to problems facing humans has been happening since the beginnings of humankind. The wheel, stone tools, and rocks crafted into arrowheads are examples from the ancient past. The technology of writing in the form

of written record keeping changed patterns of trade and commerce in the Middle East, Asia, and the Americas thousands of years ago. Beginning in 1450, the printing press transformed European society by making books and newspapers available on a scale never before imagined (Wheeler, 2019). U.S. history is marked by the technological transformations brought about by the cotton gin, interchangeable manufacturing parts, the telegraph and telephone, electricity, television, and most recently, information-processing machines known as computers.

Technologies have continually transformed American education—the first widely used educational textbook, *The New England Primer*, was published in 1690; students in colonial one-room schoolhouses used hornbooks, wooden paddle-shaped devices with reading material pasted on them; the chalkboard dates back to the 1840s; mass-produced paper and lead pencils came into use after 1900; with support from Thomas Edison, among others, teachers started showing educational films as early as 1910; educational radio entered many schools in the 1930s; the first videotape premiered in 1951; the handheld calculator arrived in 1958; and the interactive whiteboard debuted in 1999 (Haran, 2015; Reynolds, 1976).

Importantly, the technologies that became widely used in schools and society before the 1980s were non-digital technologies; that is, they were not connected

**Figure 1.2** A Digital Technology Timeline

1980 to 1990	<ul style="list-style-type: none"> <li>First portable laptop computer (1981)</li> <li>Internet standards for sending and receiving messages (1982)</li> <li>Macintosh computer (1984)</li> <li>Cell phone goes on sale (1984)</li> <li>First one-on-one computing program (1985)</li> <li>Eudora e-mail (1988)</li> </ul>
1990 to 2000	<ul style="list-style-type: none"> <li>PowerPoint released (1990)</li> <li>First digital camera (1991)</li> <li>World Wide Web open to the public (1991)</li> <li>First website published (1991)</li> <li>Mosaic, first widely popular graphical web browser (1993)</li> <li>eBay started (1995)</li> <li>WikiWikiWeb, first wiki (1995)</li> <li>Interactive whiteboards (1997)</li> <li>NetLibrary provides e-books to libraries (1998)</li> <li>Blogs (1999)</li> </ul>
2000 to 2010	<ul style="list-style-type: none"> <li>Microsoft tablet PC (2000)</li> <li>Wikipedia launched (2001)</li> <li>First generation iPod introduced (2001)</li> <li>Skype, iTunes (2003)</li> <li>Facebook (2004)</li> <li>Podcasts online (2004)</li> <li>First YouTube video uploaded (2005)</li> <li>More text messages than telephone calls (2007)</li> <li>iPhone, Twitter, Tumblr, Kindle e-reader (2007)</li> <li>Android smartphone (2008)</li> </ul>
2010 to 2020	<ul style="list-style-type: none"> <li>iPad (2010)</li> <li>Instagram (2010)</li> <li>Digital music outsells CDs for the first time (2011)</li> <li>MOOCs (2012)</li> <li>Game-based learning</li> <li>Digital textbooks</li> <li>Open Education Resources (OERs)</li> <li>3-D Printing and the maker movement</li> <li>Flipped classrooms</li> <li>Adaptive technologies</li> <li>Digital badges</li> <li>Wearable technologies</li> <li>Augmented reality</li> <li>Virtual reality</li> <li>Mixed reality</li> <li>Adaptive learning</li> <li>Virtual and remote laboratories</li> </ul>
Emerging	<ul style="list-style-type: none"> <li>The Internet of Things (IoT)—devices talking to devices</li> <li>Artificial intelligence (Siri, Twitter bots)</li> <li>Robotics in the classroom</li> <li>Voice-based applications</li> </ul>