



The Digital Youth Network

Cultivating Digital Media Citizenship in Urban Communities

Brigid Barron, Kimberley Gomez, Nichole Pinkard, and Caitlin K. Martin



THE DIGITAL YOUTH NETWORK

The John D. and Catherine T. MacArthur Foundation Series on Digital Media and Learning

Engineering Play: A Cultural History of Children's Software, by Mizuko Ito

Hanging Out, Messing Around, and Geeking Out: Kids Living and Learning with New Media, by Mizuko Ito, Sonja Baumer, Matteo Bittanti, danah boyd, Rachel Cody, Becky Herr-Stephenson, Heather A. Horst, Patricia G. Lange, Dilan Mahendran, Katynka Martínez, C. J. Pascoe, Dan Perkel, Laura Robinson, Christo Sims, Lisa Tripp, with contributions by Judd Antin, Megan Finn, Arthur Law, Annie Manion, Sarai Mitnick, David Schlossberg, and Sarita Yardi

The Civic Web: Young People, the Internet, and Civic Participation, by Shakuntala Banaji and David Buckingham

Connected Play: Tweens in a Virtual World, by Yasmin B. Kafai and Deborah A. Fields

The Digital Youth Network: Cultivating Digital Media Citizenship in Urban Communities, by Brigid Barron, Kimberley Gomez, Nichole Pinkard, and Caitlin K. Martin

INAUGURAL SERIES VOLUMES

These edited volumes were created through an interactive community review process and published online and in print in December 2007. They are the precursors to the peer-reviewed monographs in the series.

Civic Life Online: Learning How Digital Media Can Engage Youth, edited by W. Lance Bennett

Digital Media, Youth, and Credibility, edited by Miriam J. Metzger and Andrew J. Flanagin

Digital Youth, Innovation, and the Unexpected, edited by Tara McPherson

The Ecology of Games: Connecting Youth, Games, and Learning, edited by Katie Salen

Learning Race and Ethnicity: Youth and Digital Media, edited by Anna Everett

Youth, Identity, and Digital Media, edited by David Buckingham

THE DIGITAL YOUTH NETWORK

Cultivating Digital Media Citizenship in Urban Communities

Brigid Barron, Kimberley Gomez, Nichole Pinkard, and Caitlin K. Martin

with contributions by Kimberly Austin, Tene Gray, Amber Levinson, Jolie Matthews,
Véronique Mertl, Kimberly A. Richards, Maryanna Rogers, Daniel Stringer,
and Jolene Zywica

The MIT Press
Cambridge, Massachusetts
London, England

© 2014 Massachusetts Institute of Technology

All rights reserved. No part of this book may be reproduced in any form by any electronic or mechanical means (including photocopying, recording, or information storage and retrieval) without permission in writing from the publisher.

MIT Press books may be purchased at special quantity discounts for business or sales promotional use. For information, please email special_sales@mitpress.mit.edu.

This book was set in ITC Stone by the MIT Press. Printed and bound in the United States of America.

Library of Congress Cataloging-in-Publication Data

The Digital Youth Network : cultivating digital media citizenship in urban communities / Brigid Barron, Kimberley Gomez, Nichole Pinkard, and Caitlin K. Martin; with contributions by Kimberly Austin, Tene Gray, Amber Levinson, Jolie Matthews, Véronique Mertl, Kimberly A. Richards, Maryanna Rogers, Daniel Stringer, and Jolene Zywica.

p. cm — (The John D. and Catherine T. MacArthur Foundation series on digital media and learning)

Includes bibliographical references and index.

ISBN 978-0-262-02703-8 (hardcover : alk. paper)

1. Computer literacy—Illinois—Chicago. 2. Digital Youth Network (Chicago, Ill.) 3. Social media—Study and teaching (Middle school)—Illinois—Chicago. 4. Middle school students—Counseling of—Illinois—Chicago. I. Barron, Brigid. II. Digital Youth Network (Chicago, Ill.)

QA76.9.C64D524 2014

004.009773'11—dc23

2013034774

10 9 8 7 6 5 4 3 2 1

CONTENTS

SERIES FOREWORD vii

ACKNOWLEDGMENTS ix

NOTES ON THE TEXT AND FIGURES xi

INTRODUCTION: THE DIGITAL MEDIA LANDSCAPE 1

Kimberley Gomez, Brigid Barron, and Nichole Pinkard

I BRIDGING DIVIDES BY DESIGN: DEFINING A RESEARCH AGENDA 15

1 THE DIGITAL YOUTH NETWORK LEARNING MODEL 17

Nichole Pinkard and Kimberly Austin

2 DOCUMENTING PATHWAYS TO DIGITAL MEDIA PRODUCTION THROUGH
LONGITUDINAL AND MULTISETTING RESEARCH METHODS 41

Brigid Barron, Caitlin K. Martin, and Kimberley Gomez

II FINDINGS FROM THE FIELD: CATALYSTS, CHALLENGES, AND SOURCES OF VARIABILITY 55

3 PROFESSIONAL DEVELOPMENT REMIXED: ENGAGING ARTISTS AS MENTORS
AND TEACHERS 57

Kimberly A. Richards, Kimberly Austin, Kimberley Gomez, and Tene Gray

CASE NARRATIVE A INTRODUCING THE NINE FOCAL CASE LEARNERS 87

4 STEPPING INTO PRODUCTION: SEEDING CREATIVE PROJECT WORK 97

Maryanna Rogers, Brigid Barron, Caitlin K. Martin, Amber Levinson, and Jolie Matthews

CASE NARRATIVE B CALVIN: FOCUSING IN ON A FUTURE IN ENGINEERING 117

5 "BE A VOICE, NOT AN ECHO": SUPPORTING IDENTITIES AS DIGITAL MEDIA CITIZENS 131

Amber Levinson, Daniel Stringer, Jolene Zywicca, Brigid Barron, Jolie Matthews, Caitlin K. Martin,
and Maryanna Rogers

CASE NARRATIVE C MAURICE: CREATING FOR SOCIAL CHANGE 157

6	APPROPRIATING THE PROCESS: CREATIVE PRODUCTION WITHIN INFORMAL INTERACTIONS AND ACROSS SETTINGS	167
	Brigid Barron, Véronique Mertl, and Caitlin K. Martin	
	CASE NARRATIVE D RUBY: STEPPING INTO THE SPOTLIGHT	191
7	PATTERNS OF ENGAGEMENT: HOW DEPTH OF EXPERIENCE MATTERS	203
	Caitlin K. Martin, Brigid Barron, Jolie Matthews, and Daniel Stringer	
	CASE NARRATIVE E MICHAEL: NAVIGATING INDIVIDUAL PURSUITS	237
8	CHALLENGES AND OPPORTUNITIES OF DEVELOPING DIGITAL MEDIA CITIZENS	249
	Kimberly Austin, Kimberley Gomez, and Kimberly A. Richards	
III	LOOKING AHEAD: IMPLICATIONS FOR DESIGN AND RESEARCH	271
9	CREATIVE LEARNING ECOLOGIES BY DESIGN: INSIGHTS FROM THE DIGITAL YOUTH NETWORK	273
	Brigid Barron, Caitlin K. Martin, Kimberley Gomez, Nichole Pinkard, and Kimberly Austin	
10	ADVANCING RESEARCH ON THE DYNAMICS OF INTEREST-DRIVEN LEARNING	285
	Brigid Barron	
11	SCALING UP	297
	Nichole Pinkard and Caitlin K. Martin	
	NOTES	309
	REFERENCES	313
	INDEX	325

SERIES FOREWORD

In recent years, digital media and networks have become embedded in our everyday lives and are part of broad-based changes to how we engage in knowledge production, communication, and creative expression. Unlike the early years in the development of computers and computer-based media, digital media are now *commonplace* and *pervasive*, having been taken up by a wide range of individuals and institutions in all walks of life. Digital media have escaped the boundaries of professional and formal practice and of the academic, governmental, and industry homes that initially fostered their development. Now they have been taken up by diverse populations and noninstitutionalized practices, including the peer activities of youth. Although specific forms of technology uptake are highly diverse, a generation is growing up in an era when digital media are part of the taken-for-granted social and cultural fabric of learning, play, and social communication.

This book series is founded upon the working hypothesis that those immersed in new digital tools and networks are engaged in an unprecedented exploration of language, games, social interaction, problem solving, and self-directed activity that leads to diverse forms of learning. These diverse forms of learning are reflected in expressions of identity, in how individuals express independence and creativity, and in their ability to learn, exercise judgment, and think systematically.

The defining frame for this series is not a particular theoretical or disciplinary approach, nor is it a fixed set of topics. Rather, the series revolves around a constellation of topics investigated from multiple disciplinary and practical frames. The series as a whole looks at the relation between youth, learning, and digital media, but each contribution to the series might deal with only a subset of this constellation. Erecting strict topical boundaries would exclude some of the most important work in the field. For example, restricting the content of the series only to people of a certain age would mean artificially reifying an age boundary when the phenomenon demands otherwise.

This would become particularly problematic with new forms of online participation, where one important outcome is the mixing of participants of different ages. The same goes for digital media, which are increasingly inseparable from analog and earlier media forms.

The series responds to certain changes in our media ecology that have important implications for learning. Specifically, these changes involve new forms of media *literacy* and developments in the modes of media *participation*. Digital media are part of a convergence between interactive media (most notably gaming), online networks, and existing media forms. Navigating this media ecology involves a palette of literacies that are being defined through practice but require more scholarly scrutiny before they can be fully incorporated pervasively into educational initiatives. Media literacy involves not only ways of understanding, interpreting, and critiquing media, but also the means for creative and social expression, online search and navigation, and a host of new technical skills. The potential gap in literacies and participation skills creates new challenges for educators who struggle to bridge media engagement inside and outside the classroom.

The John D. and Catherine T. MacArthur Foundation Series on Digital Media and Learning, published by the MIT Press, aims to close these gaps and provide innovative ways of thinking about and using new forms of knowledge production, communication, and creative expression.

ACKNOWLEDGMENTS

This work is the result of years of sustained collaboration, including many people and organizations beyond the authors and contributors. The editors and authors recognize foremost the students, parents, teachers, and administration of the Renaissance Academy school site. Without their enthusiasm for the Digital Youth Network (DYN) program, their flexibility throughout design implementations and iterations, and their willingness to have researchers in and out of the classroom, this work would not have been possible.

Over the three years of our research, DYN mentors allowed us access to their classrooms, after-school spaces, and online learning environments; helped us to collect and understand students' work; and connected us with students and their families. The mentors also participated in the research efforts, adding material to our case portraits and reading the chapters in this book, strengthening the story through their insights, additions, and corrections. They were co-presenters of the work at conferences and were the first to turn research findings into redesigns and iterations of the DYN program. Though many of the mentors are named in the book, we again thank them here for their invaluable contributions: Mike Hawkins, Benjamin Shapiro, Pierre Tchetgen, Asia Roberson, Raphael Nash, Simeon Viltz, Rob Price-Guma, Tiffanie Jackson, Jeanine Holmes, Paula Hooper, Karla Thomas, Hondo Lawrence, Jennifer Steele, Erica Vaughn, Avri Coleman, Jovia Armstrong, and LeAnne Sawyers. Special thanks are due Tene Gray, the director of professional development, and Akili Lee, a cofounder of DYN.

The research in this book was initially funded by the John D. and Catherine T. MacArthur Foundation as part of the digital media and learning initiative. We thank in particular our program officer and director of education at the foundation, Constance M. Yowell, for her recognition of the value of supporting the systematic documentation of the environment and learning outcomes in projects such as DYN. A

midproject research workshop held at Stanford University and attended by DYN mentors, two teachers, and members of both research teams was made possible with funds from a National Science Foundation CAREER award (REC-238524) given to Brigid Barron that included funds for teacher-educator workshops focused on learning across setting and time. Finally, from 2009 to 2013 funding for the analysis of data and the writing of this book was also provided by the National Science Foundation through the Learning in Informal and Formal Environments (LIFE) Center (REC-0354453, REC-0835854), which is co-led by Brigid Barron.

The inception and implementation of the DYN program at Renaissance Academy was funded by the John D. and Catherine T. MacArthur Foundation. DYN was made possible at the school as a direct result of the leadership of the University of Chicago's Urban Education Institute, including Tim Knowles and Linda Wing, who helped to create an environment supportive of DYN. Special thanks are owed to Tony Bryk for creating the initial conditions for a center focused on the intersection of research and practice that enabled the creation of school environments inviting to design-based research.

We thank all members of the stellar research team that came together from the University of Illinois at Chicago, the University of Chicago, Stanford University, and DePaul University, including the chapter authors as well as contributors Paula Hooper, Lori Takeuchi, Hongmei Dong, and Sandra Vaughan. We also acknowledge the following people for their contribution to this work: Stacy Beardsley, Jared Washington, Shayne Evans, Rodney Bly, Connie Clark, Kristen Hernandez, Darrell Johnson, Tracy Lee Edwards, Carol Love, Katrina Salaam, Will Spots, and Cynthia Taitt.

Karen Jarsky helped us to maintain a consistent voice across authors and to ensure that the content was accessible to a range of readers from different perspectives. Editors and designers at MIT Press helped to make the production of this book possible. Colleagues and anonymous reviewers—including Susan Goldman, Shirley Brice Heath, Na'ilah Nasir, Jane Margolis, Jean Ryhoo, Roy Pea, Lissa Soep, Joseph Polman, and Heather Horst—provided encouragement and feedback along the way, and we thank them. We thank Mimi Ito for her support of the research program reported in this manuscript. A special word of thanks goes to Alan Collins, who was the first to encourage us to put the research in book form and who has been a cheerleader throughout.

Finally, the contributing authors thank their individual families for their patience and support through the numerous night and weekend writing sessions required to bring this project to completion, particularly in the final months, when substantial work took place to incorporate the advice from both named and anonymous reviewers.

NOTES ON THE TEXT AND FIGURES

This is not a traditional edited volume that brings together contributions from a set of independent scholars around a cohesive topic. Each author was a member of the core research team, and the form and content of the majority of chapters were collaboratively constructed. Lead chapter authors typically took on more writing responsibility, but the effort involved in writing and rewriting was frequently distributed among the entire writing team. The case material that connects chapters represents the most coordinated analysis, so we don't identify individual case writers, although there were several for each. When possible, we had Digital Youth Network case learners and mentors review the case material for accuracy and to approve the content.

DYN chose to use the names of the adult mentors, teachers, and administrators mentioned in this book, while all students mentioned and the school are referred to by pseudonyms. All adults are identified first by their full name, and then referred to as they were within the DYN environment: mentors were commonly referred to by their first names while school teachers and program administrators were usually addressed more formally.

The conceptualization and design of the technobiographical timeline representations (found in case narratives B–E) came out of prior research by the Stanford team in 2000 as part of Barron's Learning in Informal and Formal Environments Center research. These representations were developed as theory-building tools based on an ecological perspective on learning and came out of a need to represent and account for the strikingly social and distributed nature of learning activities across time and home, school, community, and online settings. The content for these representations is based on observational and interview data and the visualizations were initially drafted with paper and pencil and then re-represented in a professional design program. The elegance of these representations could not have been achieved without the graphic design talent of Caitlin K. Martin, one of the authors and lead researchers

on the project. These representations evolved again for this project, and we have found them to be a useful tool to coordinate our collaboration with the mentors and to communicate with our research communities. Members of the research team took the photographs used throughout the book.

Because DYN is an ongoing, dynamic, and constantly evolving program, we refer to it in the past tense when we are talking about our research findings and the model of the program at the time of the three years of research.

INTRODUCTION: THE DIGITAL MEDIA LANDSCAPE

Kimberley Gomez, Brigid Barron, and Nichole Pinkard

There is an emerging cultural image of a “digital native”—most often portrayed as a technically savvy, digitally empowered teen, deeply immersed, often simultaneously, in activities mediated by an array of devices, from cell phones and iPods to gaming equipment, cameras, and computers. Some believe that members of the “Net generation” are more creative, dynamic, socially networked, and technologically sophisticated than earlier generations. This idea is fueled by powerful exemplars of young people who have staked a claim as innovators and entrepreneurs within rapidly expanding networked systems. Take the case of Heather Lawver, who at age fourteen launched the *Daily Prophet*, a Web-based newspaper dedicated to the production and editing of original fictional material related to J. K. Rowling’s *Harry Potter* series. Or consider Ashley Qualls, who at age fourteen started whateverlife.com, a site offering layout templates and HTML tutorials to help other teens personalize their MySpace pages. She left high school to run the business full time, repeatedly turned down purchasing offers of more than a million dollars, and at the age of seventeen was able to use advertising revenue from the site to buy a house for her family. And there is Blake Ross, who built his first website at age ten, began programming in middle school, and secured an internship with Netscape when he was fifteen. He and his collaborators later developed the popular open-source Web browser Firefox and launched it when he was nineteen years old. Finally and perhaps most famously, there is Mark Zuckerberg, who drew on years of programming experience—including the creation of an intranet for his father’s dental office when he was a teen—to create Facebook while a sophomore at Harvard.

These impressive stories, portrayed widely in the media, demonstrate how technologies can set the stage for significant levels of creative agency. What they leave mostly unexplained is how these young people managed to develop both their vision and the expertise that allowed them to achieve it. A close look at the life histories of

other young innovators reveals the essential role of access to learning opportunities, a range of tools, and networks of collaborators. However, recent research suggests that not many teens have access to opportunities, tools, and/or networks of collaborators to develop these kinds of skills and particularly not in underserved communities. In this book, we make the argument that this need not be the case. We do so by telling the story of a creative community intentionally designed to bridge divides in access to learning opportunities. We suggest that this access can increase the odds that youth are able to employ diverse digital tools to advance their own goals and those of their communities. Before turning to a more detailed discussion of the Digital Youth Network, we provide a snapshot of what recent research tells us about equity and learning, emerging definitions of new literacies, and why all this matters.

THE MYTH OF THE DIGITAL NATIVE

Our own research led us to a high-tech community in Silicon Valley, where we found some young people like Blake Ross and Ashley Qualls who helped us to understand on a deeper level how they found pathways to expertise (Barron, Martin, Takeuchi, et al. 2009). For example, we met Jonathan, who at age thirteen managed two online businesses, ran a computer consulting business, and served as the back-end web developer for a nonprofit educational organization. At home, he had sixteen computers in various states of working order, shelves full of programming books, and office space—shared only by the family’s pet hamster—to house these resources. He learned to program from his father, his school classes, an online course, and reading and playing around on his own. We also met twelve-year-old Layla, who began participating in an online math community during middle school, which encouraged her to participate in a programming elective at her school and to establish her own math club once she entered high school. She maintained her interests in programming and mathematics, combining them in a substantial project that was recognized in a national science competition.

Despite the fact that it was not difficult to find young people such as Jonathan and Layla in Silicon Valley, we found very different stories in a neighboring community only ten miles away (Barron, Walter, Martin, et al. 2010). The teens we interviewed there had the creativity, interest, and ideas that we saw in the technologically immersed subcommunities in Silicon Valley, but they had minimal home access to computer technology and attended schools that did not offer opportunities to learn about subjects such as programming or web design. In fact, we were impressed with how resourceful some of these teens were in exploiting the tools they did have access to in order to create, amplify, and share broadly what they imagined despite the lack of both social and material resources. Most schools in the United States have been slow to embrace new technologies, and when technologies are available in schools,

the use is uneven (Gomez, Gomez, and Gifford 2010; Warschauer and Matuchniak 2010) so home is still the most frequent access site for most teens (Lenhart and Madden 2005). In a study of highly engaged youth in Silicon Valley, we found that their development of expertise is closely linked to the breadth and depth of expertise within their social network, including their families (Barron, Martin, Takeuchi, et al. 2009). Parents in particular play a number of significant roles in advancing their children's technological fluency. They advance their children's learning when they collaborate with them, learn from them, broker outside learning opportunities, provide nontechnical support, or hire them to do technical work. They also play instrumental roles when they share their technical expertise through informal teaching processes or provide their children with learning resources such as books or digital media tools.

Many youth do not have families who possess deep levels of technical expertise, so schools are an important site for bridging the digital experience divide. However, when it comes to building high-level computing knowledge, schools do not seem to be meeting that need for youth. Jane Margolis and her colleagues (2008) offer a compelling and highly nuanced glimpse into the continuing disparities across ethnicity, gender, and family income. In a study of three Southern California high schools, they address concerns around access to and use of technology. In keeping with the late 1990s hue and cry regarding racial disparities in opportunities for access to computers in schooling, they investigated the availability of computers and other technologies to students as well as the nature of students' interactions with technological tools and ideas.

Consistent with other research (e.g., Warschauer 2003, 2006), Margolis and her colleagues found that physical access to computers (the original disparity that spurred calls for reduction of the "digital divide") is less of an issue than it was a decade ago. However, they also found that although minority students participate in computer classes, these students are more likely to be in classes that offer only low-level intellectual and social experiences with computers. They argue that real access—access that prepares students to communicate, produce, and design with technology—should be a clear goal for all students. The pattern they saw in Southern California shows these opportunities available primarily to students in well-funded schools in affluent, predominately white communities. Margolis and her colleagues frame their argument with an analogy to segregation policies that blocked opportunities for African American children to learn to swim. Just as the opportunity to participate regularly in safe swimming was critical in saving the lives of minority children and freeing them from the shallow end of the pool, equal access to high-quality experiences with computers is essential if they are to participate meaningfully in many occupations, educational arenas, and society in general—things that exist well beyond the figurative shallow end of opportunity. Recent uprisings in the Middle East were in large part organized and sustained through social media—ordinary citizens in the Middle East who had

access to technology, and the skills to leverage that access, gave voice to their dream of a different world. The opportunity to give voice to hopes and dreams and to critique the governmental and entertainment media hegemony is an important, empowering, and, we would argue, necessary experience for all students. Knowing how, knowing when, and knowing where to access and build important technological skills are perhaps more critical than ever for this generation.

Lisa Delpit has argued that minority students need opportunities to develop their critical thinking skills and to have opportunities to be trained in knowledge economy skills. "Let there be no doubt: a 'skilled' minority person who is not capable of critical analysis becomes the trainable, low-level functionary of the dominant society, simply the grease that keeps the institutions which orchestrate his or her oppression running smoothly. On the other hand, a critical thinker who lacks the 'skills' demanded by employers and institutions of higher learning can aspire to financial and social status only within the disenfranchised underworld" (1995, 19).

A recently published study by Mizuko Ito and colleagues (2010) confirms wide disparities in how youth participate in digital media landscapes. This broad-based ethnography affirms that today's young people are constantly connected but do not necessarily have clear understandings of the potential power of this connectedness. It found that youth primarily leverage digital media to extend their social worlds, explore information, expand their understandings, and direct their learning. The online world provides them places to determine independently what they want to know, who they want to befriend, and how they want to be known. Some enter virtual worlds and outfit avatars as a means of trying on alternate selves. Some use Twitter to follow the latest news from their friends and celebrities. Some chat with online friends in other countries. Through this "messaging around," according to the researchers, they begin to develop new technical and literacy skills. A minority of these young people, such as Ashley Qualls and Blake Ross, go beyond messaging around and learn to create new uses and spaces within existing technologies as well as their own tools. Ito and her colleagues refer to this genre of participation as "geeking out."

The Ito study does not directly consider issues of race/ethnicity, socioeconomic status, or any other demographic variable relative to experiences with technology; the authors' goal was to paint a broad portrait of youth engagement. However, a review of empirical studies of computing and access confirms the variability among both youth and adults in how digital resources are used. Like many other resources, computing goods are not distributed equally across socioeconomic groups in the United States. Although this "digital divide" was originally defined in terms of physical access to computers, more recent definitions reflect a multidimensional construct that also captures inequities in use of and expertise in computing tools (DiMaggio, Hargittai, Celeste, et al. 2004; Hargittai and Hinnant 2008). The ways that technologies are used have been shown to vary by family income, age, ethnicity, gender, education level,

and geographic location. These variables are frequently associated with differences in access to tools, formal or informal learning opportunities, and a knowledgeable social network (Barron, Walter, Martin, et al. 2010; Hargittai and Hinnant 2008; McFarlane 2010; Purcell, Heaps, Buchanan, et al. 2013; Warschauer and Matuchniak 2010). Patterns of participation in engineering or computer science college majors also reveal persistent disparities between males and females and between majority and minority ethnic groups (Camp 1997; National Science Board 2012).

DEFINING NEW LITERACIES AND THE ACTIVITIES THAT NURTURE THEM

The New London Group (1996), an interdisciplinary group of scholars, has suggested that our understanding of literacy must move far beyond text-based reading and writing and traditional oral communication forms. Pointing to the sociocultural nature of language, the group argues that we must consider the social outcomes of learning and making use of multiple forms of literacy (e.g., reading and writing text and using or creating images and graphics), or multiliteracies, particularly with respect to the global nature of twenty-first-century work and interactions. Social outcomes of learning include but are not limited to opportunities to create words and images for personal benefit or to share with others, opportunities to communicate with those who are close by or far away, and opportunities to participate in civic and community activities.

Members of the New London Group urged researchers, designers, and practitioners in particular to provide opportunities for students to learn and make use of what they describe as “available designs.” If children are well versed in the languages of film, photography, and gesture, for example, they will have these languages to call upon as they make choices about who they want to communicate with and what they would like to draw on to effectively communicate thoughts, feelings, and ideas. In some cases, for example, written language may take a backseat to oral and visual representations of information. Members of the New London Group and likeminded researchers contend that the twenty-first-century global landscape will increasingly require young people to be producers and transformers of information in order to demonstrate their facility with digital technologies and with the grammars of available designs.

Related concerns about defining new skills led the National Science Foundation to ask the Computer Science and Telecommunications Board of the National Research Council to initiate a study of information technology literacy. The increasing ubiquity of information technology in daily life underscores the importance of empowering all citizens to participate actively in this new era, and the National Science Foundation was interested in understanding how to reach this goal. The result of the committee’s work is a report entitled *Being Fluent with Information Technology* (National Research

Council 1999). Here, the committee defines a tripartite approach to fluency with information technology—for which they use the term *FITness*. *FITness* gives equal attention to intellectual capabilities, domain-general information technology concepts, and contemporary information technology skills rather than conflating the term *literacy* with current understandings of skill development and skillful use of technologies. Areas of *FITness* range from higher-level thinking (including sustained reasoning, management of complexity, and collaboration) to understanding basic principles and ideas of computers, networks, and information and using today's computer applications and hardware.

Carol Disalvo and Jonathan Lukens (2009) seek to expand the definition of technological fluency to include another critical dimension—speculative design. Speculative design is focused on the exploration and investigation of possible social and political futures. At base, it provides a starting point for design. From this starting point, images, text, and other representations may emerge as well as a process for communicating using these representations. Through speculative design, students and others can connect to community information that may stimulate discussion, critique, imitation, and new ways of thinking.

Since the advent of the seminal New London Group and National Research Council reports, multiple efforts have been made to define and distill the new literacies (or fluencies), skills, and capabilities that students will need as communication technologies continue to advance. These literacies, skills, and capabilities have been referred to as “twenty-first-century learning skills” (e.g., Binkley, Erstad, Raizen, et al. 2012; North Central Regional Educational Laboratory and the Metiri Group 2003; Partnership for 21st Century Skills 2009), “twenty-first-century competencies” (Pelligrino and Hilton 2012), and “digital media literacies” (Jenkins 2009). What these efforts share is their aim to capture the important intersection of knowledge and the ever-increasing presence of new technologies. A recent National Research Council synthesis report offers a tripartite classification scheme of twenty-first-century competencies that include cognitive, interpersonal, and intrapersonal domains (Pellegrino and Hilton 2012). Within each of these categories, multiple clusters of competencies are defined—including creativity, critical thinking, collaboration, appreciation for diversity, and information literacy. Although these skills can certainly be employed using text-based tools, youth are increasingly leveraging the affordances of Web 2.0 visualization technologies, social media sites, and social learning networks (Richards and Gomez 2011) as well as creating videos and blogs online. In this vein, Henry Jenkins (2009) outlines the necessary skills for what he terms “participatory culture,” including a willingness to engage in collaborative work, knowledge of how to manage information, self-direction

of one's own learning, meaningful interaction with valuable tools, and the building of collective intelligence.

NEW LITERACIES AND THE FUTURE OF WORK

The relationship between these new literacies and the future of work is becoming increasingly clear. Frank Levy and Richard Murnane's volume *The New Division of Labor: How Computers Are Creating the Next Job Market* (2004), describes a growing employment sector across the globe referred to as "information labor." The US workforce—and arguably the international work force—is becoming increasingly digitalized, and information-processing skills will be essential for certain segments of it. Contrary to concerns that many jobs (in particular low-level jobs) will be replaced by computers and robots, Levy and Murnane argue that some jobs are not easily performed by computers and thus will continue as they are now. However, they do suggest that computers and other digital technologies will now augment many forms of work. If their predictions hold true, then we will see a new form of digital divide around technology use separating those who know what to do with these technologies (how to communicate, how to engage in high-level intellectual tasks, etc.) from those with the rudimentary skills often taught in schools (Margolis, Estrella, Goode, et. al. 2008; Warschauer and Matuchniak 2010).

For the foreseeable future, job growth will be dominated by two sectors: professional and related occupations, on the one hand, and service occupations, on the other. Both of these sectors, Levy and Murnane (2004) argue, will demand strong communication skills for sharing complex ideas across diverse communities. Workers will need to be skillful in expert thinking: the twenty-first-century economy will require its members to think creatively and critically while responding and adapting to rapidly changing situations. "Knowledge workers," as Peter Drucker (1998) has described them, must be able to engage in complex communication across social, cultural, and geographic boundaries. They will be expected to be skillful in collaboration and will have regular opportunities and expectations to do so.

Researchers are beginning to find that disparities in computing expertise shape life options over time. As with other forms of literacy, it is possible that those who already have the most skills and knowledge will continue to accrue more, while others are left behind (Barron, Walter, Martin, et al. 2010; Warschauer and Matuchniak 2010). The so-called Matthew effect—that is, the rich get richer and the poor get poorer—has been amply documented in educational settings (Adams 1990; Rigney 2010; Stanovich 1986). With respect to reading, for example, children who struggle to learn to read continue to read less than their classmates, and as a consequence their vocabulary, background knowledge, and fluency in decoding and comprehension are hindered. In turn, the divide between the more and less literate grows wider. With

computing, deep engagement in digital media hobbies can similarly lead to expertise development, self-efficacy, and new forms of creative agency—all critical pieces of necessary twenty-first-century skills. In the absence of these interests and of the opportunities to develop them, these skills cannot emerge. Ensuring equitable access for all is essential.

ADDRESSING DIVIDES THROUGH INTENTIONAL DESIGN: THE DIGITAL YOUTH NETWORK

In this volume, the Digital Youth Network (DYN) is offered as an object lesson for illustrating what it means to create structures, materials, pedagogy, and experiences that support technology use for all and to provide opportunities for youth to develop the critical and technical skills (Watkins 2012) necessary to participate in the emerging knowledge economy. As we argued earlier in this introduction, few students around the country have little more than very limited and aperiodic opportunities to engage in productive and intellectually rigorous digital media experiences—that is, ones that involve collaboration, critique, debate, and analysis. Even fewer have opportunities to engage in such interactions and experiences while actually using the digital technologies that increasingly predominate the early-twenty-first-century landscape. Recent studies of economically disadvantaged and minority students' technology-related schooling experiences suggest that there is a mismatch between the technology they experience, however infrequently, and the advanced technology dominating the employment landscape. What seems clear is that many students generally and poor and many minority students more specifically will not be prepared for the particular types of work that now dominate the employment landscape (Margolis, Estrella, Goode, et al. 2008; Warschauer and Matuchniak 2010).

There has been a fundamental organizational failure in this country to bridge spaces where youth can or do use digital tools. Youth view school, after-school, home, and community spaces (e.g., the library) as separate domains that by and large do not interact with or impact each other. Though these spaces may be technically connected through broadband and wireless access, they have not been linked in ways that meaningfully allow youth to span them conceptually and artifactually. DYN was designed to build bridges across settings. Its aim is to create access and equitable opportunities to computation that can be leveraged if kids and parents so desire. Using in-school and out-of-school programs as well as an online social learning network tool, Remix World (Richards and Gomez 2011; Zywic, Richards, and Gomez 2011), DYN has reached across spaces and beyond the constraints of the school day to address these inequities for African American youth attending public schools on the South Side of Chicago.

In her 2002 essay arguing for more politically aware information technology development practice and theory, Norwegian educational researcher Eevi Beck posed the question “What constitutes political action through computing?” The DYN response has been to provide opportunities for youth to become part of a community that helps them view technology critically, create it on their own, and use their creations to advocate for better futures for themselves and their communities—in short to “produce creative expressions of issues of concern” (Disalvo and Lukens 2009). DYN program developers equate skill development with opportunity, access, and knowledge building. They have determined that preparing students for the twenty-first century means creating an environment in which they can demonstrate literacy with new forms of media, in which knowledge and skill development are expected, and in which the audience that these students will interact with is, and will be, the world.

Projects that involve the production of personally meaningful artifacts can offer motivation that drives persistence and the setting of learning goals as designers work to create what they have imagined (Barron 2006). Today’s youth are often drawn to projects involving web design, game design, robotics, programming, animation, and video production, which are likely to nurture these capabilities (Barron 2006; Resnick, Rusk, and Cooke 1998; Walter, Forssell, Barron, et al. 2007). Design-oriented activities play a special role in learning to adapt computing tools for one’s own purposes (Bers 2006; Kafai 1995; New London Group 1996; Papert 1980); during design projects, learners frequently encounter implementation challenges that provide them with opportunities to develop the knowledge, skills, and intellectual capabilities that underlie the technological fluency we described earlier (National Research Council 1999). These authentic challenges also frame the development of a set of dispositions and capabilities that are so necessary in today’s workforce, including prototyping, modeling, and iterating (Balsamo 2010).

In this volume, we offer evidence that it is possible through intentionally designed programs such as the DYN to begin to bridge the participation gap (Jenkins 2009; Watkins 2012) by increasing students’ experiences with conceptualizing and producing digital media artifacts. However, we also claim that to move students beyond consumption of the myriad messages and images that exist in print and digital form requires support for and access to examples, guidance, and tools. In this regard, we discuss in later chapters DYN’s model of leveraging pedagogically and artistically skilled adults to support students’ experiences with a number of different types of design, including design that is grounded in critical perspectives on media and design that reflects students’ developing skills in using and creating technology. In learning to make use of available designs, DYN students engage in reflective analysis and interpretation of issues that are of cultural, civic, and social concern. They engineer solutions for planning and troubleshooting during game design and robotics projects. As described in the remainder of this volume, DYN participants learn how to use

technology skillfully to produce multimedia artifacts and to reflect on and critique the work produced by others in their local and online communities. Armed with digital media knowledge and skills, they are able to use technology to express their ideas, hopes, dreams, concerns, and passions—they become digital media citizens.

DOCUMENTING DYN

Reports of unequal access to and uses of technology are generally not coupled with new ideas for solutions. To develop a more equal technological playing field, we need empirical accounts of contexts that provide students with intellectually challenging access to computers and other technologies. Rich descriptions of *what is possible* as well as theoretical accounts of *how it comes to be possible* are critical if we are to move underserved children out of the shallow end of computing. This book provides such an analysis, and we hope it speaks to an unusually broad audience. Through detailed narratives of learners, mentors, and activities, we hope to inspire others who participate in the design of learning environments, whether as designers, educators, or policymakers. In addition, we intend the book to speak to the research communities we are part of and, with this in mind, we include a great deal of data analysis as well as recent scholarship on learning. Our theoretical goal was to better understand the social conditions and consequences of persistent engagement in technologically mediated design activities. A focus on engagement, in contrast to an exclusive focus on knowledge acquisition, is consistent with contemporary theories of learning that conceptualize moments of learning as part of a process of identity development rather than as isolated, discrete events (Beach 1999; Nasir 2002; Wenger 1998). Practice-linked identities typically emerge when learners view their own engagement in a practice as an important part of who they are (Nasir and Hand 2006), and when this connection is made, learners often adopt observable, self-sustaining strategies of continued learning (Barron 2006). This kind of persistence, along with a host of other dispositional qualities and interpersonal capacities, is increasingly recognized as important for learning. To make progress on documenting how these hard-to-measure qualities changed with experience, we designed a longitudinal study that followed the entire cohort of learners for three years. We collected qualitative and quantitative data that would inform our accounts of the development of expertise, social learning dispositions, and creator identities. We report our measures and findings in detail in order to contribute to broader efforts focused on expanding the field's repertoire of assessment methods (e.g., see National Research Council 2012). We also carried out more detailed observations of nine learners and their participation in DYN. Our research is guided by a learning ecology framework (Barron 2006) that foregrounds the fact that adolescents are simultaneously involved in many settings and are active in creating activity contexts for themselves within and across these settings.

This definition of a learning ecology shares with that of information ecologies the idea that both relational and material resources are important in any sociotechnical ecology (J. Brown 2000; Nardi and O'Day 1999). In order to investigate these highly personalized learning dynamics, we considered it important to document and represent choices about participation across time and place, the evolution of projects, and the establishment of learning partnerships. We share these detailed narratives and visualizations of facets of engagement as complements to our quantitative metrics and broader accounts of learning interactions. It is our intent to represent these facets of engagement in a form that might speak to educators and researchers alike.

Using this combination of methods has been time and resource intensive. We were fortunate to have funding from the MacArthur Foundation, supplemented with funds from the National Science Foundation through the Learning in Informal and Formal Environments (LIFE) Science of Learning Center. This combined funding supported our interdisciplinary, multisite team as we spent three years documenting the DYN environment and student development and another three years analyzing our data and writing up the results in book form.

THE CHAPTERS AHEAD

Our book is organized into three main sections. In the first section, this introduction is followed by an account of the history of DYN and this research project. In chapter 1, we lay out the programmatic goals and pedagogical stance for developing digital media literacies, and we describe the use of school-day classes, after-school “pods,” and a virtual social networking environment designed to achieve these goals. In chapter 2, we share our research questions and strategies. In the second section of the book, we introduce the nine students we followed closely from sixth through eighth grade and present the findings from our three-year study. In chapter 3, we discuss the role of mentors who lead the DYN program and highlight how a model of professional development emerged to help them become flexible in their hybrid roles as teachers-mentors. In chapter 4, we focus on the practices DYN mentors developed to engage learners in identifying major catalysts for participation. In chapter 5, we focus on the ways that learner identities as social, critical, and constructive digital media citizens were supported. In chapter 6, we turn to the less planned but equally important processes that sustained learning, including the development of personal projects and learning relationships. In chapter 7, we report on the quantitative data that we collected from the whole cohort, focusing on change over time for more-engaged and less-engaged DYN participants, and from a comparative study involving a sample of eighth graders from Silicon Valley. Chapter 8 describes some of the challenges we documented and the opportunities that these challenges present for future designers. Interspersed among the chapters in this section, we provide expanded narratives of

DYN members that help illustrate the chapter themes and the variability in interests we saw. The learning portraits of Calvin, Maurice, Ruby, and Michael show the unique ways that DYN participants' families, friends, prior interests, and future goals came to play a part in how they chose to engage with the DYN. We share the ways that the relationships they built with mentors were consequential for their learning and report on the self-created projects and roles that sustained their development inside and outside the DYN. In the third section of the book, we summarize our findings and discuss implications for future research and practice. Chapter 9 provides suggestions for designers of informal spaces or hybrid programs. Chapter 10 summarizes what was learned from our dual analytic focus on learners and the DYN environment and draws out implications for future research. Chapter 11 concludes the book with a progress report on duplicating the DYN program on a larger scale and bridging the divides associated with access to tools, a knowledgeable social network, and learning opportunities for large numbers of urban minority and disadvantaged teens.

INTERPRETATION OF THIS WORK

In the end, these chapters illustrate that careful attention to the design of technology-driven in-school and out-of-school learning environments creates a set of important opportunities where youth are able to leverage technology to express their societal understandings creatively, to develop an awareness of their work in the broader community, and to make media designed to critique societal and civic issues. At the same time, there are many lenses one can use to understand the DYN. One can view it as a hybrid program spanning both in-school and after-school spaces; a unique approach to bridging pop culture and the development of multiple digital literacies; a model for one-to-one computing designed to address the digital divide; or a exemplar of the use of new technologies. Although each of these lenses provides a perspective on the work, the DYN team viewed the work primarily through the lens of community development. The founding goal for DYN was to create a community that needed the literacies they were developing on a daily basis. DYN is an example of the importance of building communities where all members view the literacies being taught as essential tools for developing and possessing the social capital valued in the multitude of communities they inhabit on a daily basis. The DYN team believed that by focusing on developing literacies that the students found immediately valuable, the students would put in the time and effort to deepen these literacies and as a consequence develop literacies that would serve them in the future. To achieve this goal, DYN needed to create bridges that linked the different communities where students spent their time (e.g., in-school classrooms, after-school programs, online social networks, friendships groups, home). In this way, students were able to view their digital literacies as valuable tools for interacting across all of these spaces rather than yet another

form of literacy that they needed to switch on and off as they moved through their day. Hence, the unique aspect of DYN wasn't the development of workshops, but the development of multiple performance spaces where students' work was celebrated, showcased, and discussed, simultaneously enabling the student creators to earn social capital and encouraging them to expand their horizons of what is possible and valued in the intersecting spaces that occupied their day from their first design activities in the morning to their last Remix World posting of the night.

The DYN's ability—collectively with school leaders, teachers, and parents—to create links across these spaces allowed urban youth with varied identities (e.g., the academic, the rapper, the gamer, the musician, the writer, the dreamer, the builder, the social activist, the critic, etc.) to find some aspect of digital media that engaged them individually and connected them to one another. Because this work was done with African American youth on the South Side of Chicago and the positive results of the effort shared in this book stand in contrast to research descriptions of the contemporary digital divide, it may be tempting to summarize this model as a successful approach to meeting minority youth's digital literacy needs. Although we believe this focus on urban youth in underserved communities to be one aspect of the model, we also strongly believe the model has resonance for the development of literacies, both digital and traditional, for all youth.

At its core, the DYN model issues the challenge of breaking down long-term educational outcomes into near-term achievable milestones that students find desirable and actionable today. Building the skills, knowledge, and dispositions to achieve these milestones will lead the students down pathways of learning that allow them to reside proudly in all the communities they call home.

REFERENCES

- Adams, Marilyn J. 1990. *Beginning to Read: Thinking and Learning about Print*. Cambridge, MA: MIT Press.
- Amabile, T. 1996. *Creativity in Context: Update to the Social Psychology of Creativity*. Boulder, CO: Westview Press.
- Amabile, T. 1998. How to kill creativity. *Harvard Business Review* 76 (5): 76–87.
- Amabile, T., C. Hadley, and S. Kramer. 2002. Creativity under the gun. Special issue on the innovative enterprise: Turning ideas into profits. *Harvard Business Review* 80 (8): 52–61.
- American Association of University Women (AAUW). 2000. Educational software and games: Rethinking the “girls’ game.” In *Tech-Savvy: Educating Girls in the New Computer Age*, ed. AAUW, 29–37. Washington, DC: AAUW Educational Foundation.
- Annenberg Institute for School Reform. 2004. *Professional Learning Communities: Professional Development Strategies That Improve Instruction*. Providence, RI: Brown University. Retrieved August 7, 2011, from <http://www.annenberginstitute.org/pdf/ProfLearning.pdf>.
- Armenta, A., A. Serrano, M. Cabrera, and R. Conte. 2012. The new digital divide: The confluence of broadband penetration, sustainable development, technology adoption, and community participation. *Information Technology for Development* 18 (4): 345–353.
- Attewell, P., and H. Winston. 2003. Children of the digital divide. In *Disadvantaged Teens and Computer Technologies*, ed. P. Attewell and N. M. Seel, 117–136. Münster, Germany: Waxmann.
- Azevedo, F. 2012. The tailored practice of hobbies and its implication for the design of interest-driven learning environments. *Journal of the Learning Sciences* 22 (3): 1–49.
- Balsamo, A. 2010. Design. *International Journal of Learning and Media* 1 (4): 1–10.
- Bambino, D. 1995. Blooming questions. Retrieved April 29, 2011, from http://www.nsrffharmony.org/protocol/doc/blooming_questions.pdf.
- Bandura, A. 1997. *Self-Efficacy: The Exercise of Control*. New York: Freeman.
- Banks, J., K. Au, A. Ball, P. Bell, E. Gordon, K. Gutiérrez, S. Brice Heath, C. Lee, Y. Lee, J. Mahiri, N. Nasir, G. Valdes, and M. Zhou. 2007. *Learning in and out of school in diverse environments: Life-long, life-wide, life-deep*. Seattle, WA: Center for Multicultural Education, University of Washington.

- Bargh, J. A., and Y. Schul. 1980. On the cognitive benefits of teaching. *Journal of Educational Psychology* 72 (5): 593–604.
- Barron, B. 2003. When smart groups fail. *Journal of the Learning Sciences* 12: 307–359.
- Barron, B. 2004. Learning ecologies for technological fluency: Gender and experience differences. *Journal of Educational Computing Research* 31 (1): 1–36.
- Barron, B. 2006. Interest and self-sustained learning as catalysts of development: A learning ecology perspective. *Human Development* 49 (4): 193–224.
- Barron, B. 2010. Conceptualizing and tracing learning pathways over time and setting. *NSSE Yearbook* 109 (1): 113–127.
- Barron, B., and L. Darling-Hammond. 2008. How can we teach for meaningful learning? In *Powerful Learning: What We Know about Teaching for Understanding*, ed. L. Darling-Hammond, B. Barron, P. D. Pearson, A. H. Schoenfeld, E. K. Stage, T. D. Zimmerman, G. N. Cervetti, et al., 11–70. San Francisco: Jossey-Bass.
- Barron, B., C. K. Martin, and E. Roberts. 2007. Sparking self-sustained learning: Report on a design experiment to build technological fluency and bridge divides. *International Journal of Technology and Design Education* 17 (1): 75–105.
- Barron, B., C. K. Martin, E. Roberts, A. Osipovich, and M. Ross. 2002. Assisting and assessing the development of technological fluencies: Insights from a project-based approach to teaching computer science. In *Proceedings of the Conference on Computer Support for Collaborative Learning: Foundations for a CSCL Community*, 668–669. Hillsdale, NJ: Laurence Erlbaum Associates, Inc.
- Barron, B., C. K. Martin, L. Takeuchi, and R. Fithian. 2009. Parents as learning partners in the development of technological fluency. *International Journal of Learning and Media* 1 (2): 55–77.
- Barron, B., S. Walter, C. K. Martin, and C. Schatz. 2010. Predictors of creative computing participation and profiles of experience in two Silicon Valley middle schools. *Computers & Education* 54 (1): 178–189.
- Baumeister, R. F., and M. R. Leary. 1995. The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin* 117: 497–529.
- Beach, K. 1999. Consequential transitions: A sociocultural expedition beyond transfer in education. *Review of Research in Education* 24 (1): 101–139.
- Beal, S. J., and L. J. Crockett. 2010. Adolescents' occupational and educational aspirations and expectations: Links to high school activities and adult educational attainment. *Developmental Psychology* 46: 258–265.
- Beck, E. E. 2002. P for political: Participation is not enough. *Scandinavian Journal of Information Systems* 14: 77–92.
- Bell, P., L. A. Bricker, S. Reeve, and H. T. Zimmerman. 2010. Understanding families' educational decision making along extended learning pathways. In *Learning in the Disciplines: Proceedings of the 9th International Conference of the Learning Sciences*, vol. 2, ed. K. Gomez, L. Lyons, and J. Radinsky, 141–148. Chicago: International Society of the Learning Sciences.
- Bers, M. U. 2006. The role of new technologies to foster positive youth development. *Applied Developmental Science* 10 (4): 200–219.
- Binkley, M., O. Erstad, J. Herman, S. Raizen, M. Ripley, M. Miller-Ricci, and M. Rumble. 2012. Defining twenty-first century skills. In *Assessment and Teaching of Twenty-First Century Skills*, ed. P. Griffin, B. McGaw, and E. Care, 17–66. New York: Springer.

- Birch, S. H., and G. W. Ladd, eds. 1996. *Interpersonal Relationships in the School Environment and Children's Early School Adjustment: The Role of Teachers and Peers*. Cambridge: Cambridge University Press.
- Bohnert, A., J. Fredricks, and E. Randall. 2010. Capturing unique dimensions of youth organized activity involvement: Theoretical and methodological considerations. *Review of Educational Research* 80 (4): 576–610.
- Booker, K. 2004. Exploring school belonging and academic achievement in African American adolescents. *Curriculum and Teaching Dialogue* 6 (2): 131–143.
- Braasch, J., K. Lawless, S. Goldman, F. Manning, K. Gomez, and S. MacLeod. 2009. Evaluating search results: An empirical analysis of middle school students' use of source attributes to select useful sources. *Journal of Educational Computing Research* 41 (1): 63–82.
- Bransford, J. D., B. Barron, R. Pea, A. Meltzoff, P. Kuhl, P. Bell, R. Stevens, et al. 2006. Foundations and opportunities for an interdisciplinary science of learning. In *The Cambridge Handbook of the Learning Sciences*, ed. K. Sawyer, 19–34. New York: Cambridge University Press.
- Brown, A. 1994. The advancement of learning. *Educational Researcher* 23 (8): 4–12.
- Brown, J. S. 2000. Growing up digital: How the web changes work, education, and the way people learn. *Change: The Magazine of Higher Learning* 32 (2): 11–20.
- Bruner, J. S. 1994. The “remembered self.” In *The Remembering Self: Construction and Accuracy in the Self-Narrative*, ed. U. Neisser and R. Fivush, 41–54. Cambridge: Cambridge University Press.
- Bryk, A., L. Gomez, D. Joseph, N. Pinkard, L. Rosen, and L. Walker. 2006. Activity theory framework for the information infrastructure system. Unpublished manuscript.
- Burguillo, J. C. 2010. Using game theory and competition-based learning to stimulate student motivation and performance. *Computers & Education* 55 (2): 566–575.
- Busch, T. 1995. Gender differences in self-efficacy and attitudes toward computers. *Journal of Educational Computing Research* 12: 147–158.
- Calabrese-Barton, A., and E. Tan. 2010. We be burnin: Agency, identity, and learning in a green energy program. *Journal of the Learning Sciences* 19 (2): 187–229.
- Calkins, L. M. 1994. *The Art of Teaching Reading*. Portsmouth, NH: Heinemann Press.
- Camp, T. 1997. The incredible shrinking pipeline. *Communications of the ACM* 40 (10): 103–110.
- Castells, M. 1996. *The Rise of the Network Society*, Volume 1 of *The Information Age: Economy, Society and Culture*. Malden, MA: Blackwell Publishing.
- Cecil, N. L. 1995. *The Art of Inquiry: Questioning Strategies for K–6 Classrooms*. Winnepeg, CA: Peguis.
- Center for Children and Technology. 2002. *Evaluation of the Intel Computer Clubhouse Network Year 2 Report*. New York: Education Development Center, Inc.
- Chan, C., J. Rhodes, W. Howard, S. Schwartz, S. Lowe, and C. Herrera. 2012. Pathways of influence in school-based mentoring: The mediating role of parent and teacher relationships. *Journal of School Psychology* 51 (1): 129–142.
- Cheryan, S., V. C. Plaut, P. Davies, and C. M. Steele. 2009. Ambient belonging: How stereotypical cues impact gender participation in computer science. *Journal of Personality and Social Psychology* 97: 1045–1060.
- Chetty, R., N. Hendren, P. Kline, and E. Saez. 2013. *The Economic Impacts of Tax Expenditures: Evidence from Spatial Variation across the US*. Retrieved on January 5, 2014, from http://obs.rc.fas.harvard.edu/chetty/tax_expenditure_soi_whitepaper.pdf.

- Ching, C. C., and Y. B. Kafai. 2008. Peer pedagogy: Student collaboration and reflection in a learning through design project. *Teachers College Record* 110: 2601–2632.
- Cochran-Smith, M. 2002. Inquiry and outcomes: Learning to teach in the age of accountability. *Teacher Education and Practice* 15 (4): 12–34.
- Cochran-Smith, M., and S. L. Lytle. 1999. Relationships of knowledge and practice: Teacher learning in communities. *Review of Research in Education* 24 (1): 249–305.
- Cole, M. 1996. *Cultural Psychology: A Once and Future Discipline*. Cambridge, MA: Harvard University Press.
- Cole, M. 2006. *The Fifth Dimension: An After-School Program Built on Diversity*. New York: Russell Sage Foundation.
- Cosmic Log. 2007. Kids rule in robotics. *MSNBC.com*, April 16. Retrieved January 15, 2012, from http://cosmiclog.msnbc.msn.com/_news/2007/04/16/4350784-kids-rule-in-robotics.
- Cross, S., and H. Markus. 1991. Possible selves across the lifespan. *Human Development* 34: 230–255.
- Czaja, R., and R. Cummings. 2009. Designing competitions: How to maintain motivation for losers. *American Journal of Business Education* 2 (7): 91–98.
- Darling-Hammond, D., and M. McLaughlin. 1995. Policies that support professional development in an era of reform. *Phi Delta Kappan* 76 (8): 597–604.
- DeBell, M., and C. Chapman. 2006. *Computer and Internet Use by Students in 2003*. Washington, DC: National Center for Education Statistics.
- Delpit, L. 1995. *Other People's Children: Cultural Conflict in the Classroom*. New York, NY: The New Press.
- DiMaggio, P., E. Hargittai, C. Celeste, and S. Shafer. 2004. Digital inequality: From unequal access to differentiated use. In *Social Inequality*, ed. K. Neckerman, 355–400. New York: Russell Sage Foundation.
- DiSalvo, C., and J. Lukens. 2009. Towards a critical technological fluency: The confluence of speculative design and community technology programs. In *DAC '09: Proceedings of the 2009 Digital and Arts and Culture Conference*, 1–5. Davis, CA: University of California at Davis.
- Drucker, P. F. 1998. *On the Profession of Management*. Cambridge, MA: Harvard Business School Press.
- DuBow, W. 2011. *NCWIT Scorecard: A Report on the Status of Women in Information Technology*. Boulder: National Center for Women & Information Technology.
- Duncan, G. J., and R. J. Murnane. 2011. The American dream, then and now. In *Wither Opportunity?*, ed. G. J. Duncan and R. J. Murnane. New York: Russell Sage.
- Elder, G. H. 1995. Time, human agency, and social change: Perspectives on the life course. *Social Psychology Quarterly* 57 (1): 4–15.
- Engle, R. A. 2006. Framing interactions to foster generative learning: A situative explanation of transfer in a community of learners classroom. *Journal of the Learning Sciences* 15 (4): 451–498.
- Engle, R. A., and F. C. Conant. 2002. Guiding principles for fostering productive disciplinary engagement: Explaining an emergent argument in a Community of Learners classroom. *Cognition and Instruction* 20 (4): 399–483.
- Erickson, L. D., S. McDonald, and G. H. Elder. 2009. Informal mentors and education: Complementary or compensatory resources? *Sociology of Education* 82 (4): 344–367.

- Esmonde, I. 2009. Ideas and Identities: Supporting Equity in Cooperative Mathematics Learning. *Review of Educational Research* 79 (2): 1008–1043.
- Furrer, C., and E. Skinner. 2003. Sense of relatedness as a factor in children's academic engagement and performance. *Journal of Educational Psychology* 95: 148–162.
- Gee, J. P. 2000. Identity as an analytic lens for research in education. *Review of Research in Education* 25 (1): 99–125.
- Gee, J. P. 2004. *Situated Language and Learning: A Critique of Traditional Schooling*. New York: Routledge.
- Gee, J. P. 2008. A sociocultural perspective on opportunity to learn. In *Assessment, Equity, and Opportunity to Learn*, ed. P. Moss, 76–108. Cambridge, UK: Cambridge University Press.
- George, J. M. 2007. Creativity in organizations. *Academy of Management Annals* 1 (1): 439–477.
- Goldman, S., A. Booker, and M. McDermott. 2008. Mixing the digital, social, and cultural: Learning, identity and agency in youth participation. In *Youth, Identity, and Digital Media*, ed. D. Buckingham, 185–206. Cambridge, UK: Cambridge University Press.
- Gomez, L. M., K. Gomez, and B. R. Gifford. 2010. Educational innovation with technology: A new look at scale and opportunity to learn. Aspen Institute Congressional Conference Program Papers, Education Reform Seventeenth Conference, "Transforming America's Education through Innovation and Technology," August 16–21, Whistler, British Columbia.
- Goodenow, C. 1993. The psychological sense of school membership among adolescents: Scale development and educational correlates. *Psychology in the Schools* 30: 79–90.
- Gray, T., N. Pinkard, K. Gomez, and K. Richards. 2008. Developing instructional practices of mentors through the creation of professional learning communities. Paper presented at the annual meeting of the American Educational Research Association, New York, March 24–28.
- Green, M. 1995. *Releasing the Imagination: Essays on Education, the Arts, and Social Change*. San Francisco, CA: Josey-Bass Publishers.
- Green, P. J., B. L. Dugoni, and S. J. Ingels. 1995. *Trends among High School Seniors, 1972–1992*. Washington, DC: US Department of Education, Office of Educational Research and Improvement, National Center for Education Statistics.
- Greenhow, C., B. Robelia, and J. E. Hughes. 2009. Learning, teaching, and scholarship in a digital age. *Educational Researcher* 38 (4): 246–259.
- Griffin, P., B. McGaw, and E. Care, eds. 2012. *Assessment and Teaching of Twenty-First Century Skills*. New York: Springer.
- Grimes, S., and D. Fields. 2012. *Kids Online: A New Research Agenda for Understanding Social Networking Forums*. New York: Joan Ganz Cooney Center.
- Grover, S., and R. Pea. 2013. Computational thinking in K–12: A review of the state of the field. *Educational Researcher* 42 (1): 38–43.
- Gutiérrez, K. D. (2011). Teaching toward possibility: Building cultural supports for robust learning. *PowerPlay: A Journal of Educational Justice* 3 (1): 22–38.
- Gutiérrez, K. D., and W. R. Penuel. 2014. Relevance to practice as a criterion for rigor. *Educational Researcher* 43 (1): 19–23.
- Haney, W. 1985. Making testing more educational. *Educational Leadership* 43 (2): 4–13.
- Hargittai, E. 2005. Survey measures of Web-oriented digital literacy. *Social Science Computer Review* 23 (3): 371–379.

- Hargittai, E. 2011. Minding the digital gap: Why understanding digital inequality matters. In *Media Perspectives for the 21st Century*, ed. S. Papathanassopoulos, 231–239. New York: Routledge.
- Hargittai, E., and A. Hinnant. 2008. Digital inequality: Differences in young adults' use of the Internet. *Communication Research* 35 (5): 602–621.
- Hargittai, E., and Y. P. Hsieh. 2012. Succinct survey measures of Web-use skills. *Social Science Computer Review* 30 (1): 95–107.
- Harré, R., and L. Van Langenhove, eds. 1999. *Positioning Theory: Moral Contexts of Intentional Action*. Oxford: Blackwell Publishers.
- Heath, S. B. 1983. *Ways with Words: Language, Life, and Work in Communities and Classrooms*. Cambridge, UK: Cambridge University Press.
- Heath, S. B. 1991. "It's about winning!": The language of knowledge in baseball. In *Perspectives on Socially Shared Cognition*, ed. L. B. Resnick, J. M. Levine, and S. D. Teasley, 101–124. Washington, DC: American Psychological Association.
- Heath, S. B. 1997. *Language and Work: Learning and Identity Development of Older Children in Community Settings*. George Miller Committee Lecture. Urbana: University of Illinois.
- Heath, S. B. 1999. Dimensions of language development: Lessons from older children. In *Cultural Processes in Children Development: The Minnesota Symposium on Child Psychology, 29*, ed. A.S. Masten, 59–75. Mahwah, NJ: Lawrence Erlbaum Associates.
- Heath, S. B. 2004. Risks, rules, and roles: Youth perspectives on the work of learning for community development. In *Joining Society: Social Interaction and Learning in Adolescence and Youth*, ed. A. N. Perret-Clermont, C. Pontecorvo, L. B. Resnick, T. Zittoun, and B. Burge, 41–70. New York: Cambridge University Press.
- Heath, S. B. 2005. Strategic thinking, learning environments, and real roles: Suggestions for future work. *Human Development* 48 (6): 350–355.
- Heath, S. B. 2012. Seeing our way into learning science in informal environments. In *Research on Schools, Neighborhoods, and Communities: Toward Civic Responsibility*, ed. W. F. Tate, 249–268. New York: Roman & Littlefield and American Educational Research Association.
- Heath, S. B. 2014. Creative "garages" for community and economic youth development. In *Designing Educational Programs with Children and Youth: Alternative and Flexible Contexts for Learning*. NSSE Yearbook, ed. J. Vadeboncoeur. New York: Teachers College Press.
- Henwood, F., H. Kennedy, and N. Miller. 2001. *Cyborg Lives: Women's Technobiographies*. York, UK: Raw Nerve Books.
- Herrenkohl, L. R., and V. Mertl. 2010. *How Students Come to Be, Know, and Do: A Case for a Broad View of Learning*. New York: Cambridge University Press.
- Hetland, L., E. Winner, S. Veenema, and K. M. Sheridan. 2007. *Studio Thinking: The Real Benefits of Visual Arts Education*. New York: Teachers College Press.
- Hidi, S., and K. A. Renninger. 2006. The four-phase model of interest development. *Educational Psychologist* 41 (2): 111–127.
- Hirsch, B. J., N. Deutsch, and D. DuBois. 2011. *After-School Centers and Youth Development: Case Studies of Success and Failure*. New York: Cambridge University Press.
- Hirsch, B. J., M. Mekinda, and J. Stawicki. 2010. More than attendance: The importance of after-school program quality. *American Journal of Community Psychology* 45: 447–452.
- Hitlin, P., and L. Rainie. 2005. Teens, technology, and school. Washington, DC: Pew Internet & American Life Project, August 2.

- Holland, D., W. Lachicotte Jr., D. Skinner, and C. Cain. 1998. *Identity and Agency in Cultural Worlds*. Cambridge, MA: Harvard University Press.
- Holland, D., and K. Leander. 2004. Studies of positioning and subjectivity: An introduction. *Ethos* 32 (2): 127–139.
- Humphrey, N. 2004. The death of the feel-good factor? Self-esteem in the educational context. *School Psychology International* 25 (3): 347–360.
- Hurn, C. 1985. Changes in authority relationships in schools 1960–1980. *Research in Sociology of Education and Socialization* 5: 31–57.
- Ito, M., S. Baumer, M. Bittanti, d. boyd, R. Cody, B. Herr-Stephenson, H. A. Horst, et al. 2010. *Hanging Out, Messing Around, and Geeking Out: Kids Living and Learning with New Media*. Cambridge, MA: MIT Press.
- Ito, M., K. Gutiérrez, S. Livingstone, B. Penuel, J. Rhodes, K. Salen, J. Schor, J. Sefton-Green, and S. C. Watkins. 2013. *Connected Learning: An Agenda for Research and Design*. Digital Media and Learning Research Hub.
- Jenkins, H., K. Clinton, R. Purushotma, and A. J. Weigel. 2009. *Confronting the Challenges of Participatory Culture: Media Education for the 21st Century*. Cambridge, MA: MIT Press.
- Jocson, K. M. 2009. Steering legacies: Pedagogy, literacy, and social justice in schools. *Urban Review* 41 (3): 269–285.
- John-Steiner, V. 2000. *Creative Collaboration*. New York: Oxford University Press.
- Kafai, Y. B. 1995. *Minds in Play: Computer Game Design as a Context for Children's Learning*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Kafai, Y. B., D. A. Fields, and W. Q. Burke. 2010. Entering the clubhouse: Case studies of young programmers joining the online Scratch communities. *Journal of Organizational and End User Computing* 22 (2): 21–35.
- Kafai, Y. B., and K. A. Pepler. 2011. Youth, technology, and DIY developing participatory competencies in creative media production. *Review of Research in Education* 35 (1): 89–119.
- Kafai, Y. B., K. A. Pepler, and R. N. Chapmen, eds. 2009. *The Computer Clubhouse: Constructionism and Creativity in Youth Communities*. New York: Teachers College Press.
- Kahne, J., N. Lee, and J. T. Feezell. 2011. Digital media literacy education and online civic and political participation. *International Journal of Communications* 6 (1): 1–24.
- Kapur, M. 2008. Productive failure. *Cognition and Instruction* 26 (3): 379–424.
- Kapur, M., and C. K. Kinzer 2009. Productive failure in CSCL groups. *International journal of CSCL* 4 (1): 21–46.
- Kerawalla, L., and C. Crook. 2002. Children's computer use at home and at school: Context and continuity. *British Educational Research Journal* 28 (6): 751–771.
- Kruse, S., K. S. Louis, and A. S. Bryk. 1994. *Building Professional Community in Schools: Issues in Restructuring Schools*. Madison: Wisconsin Center for Education Research.
- Larson, R. 2000. Toward a psychology of positive youth development. *American Psychologist* 55: 170–183.
- Lee, C. D. 2010. Soaring above the clouds, delving the ocean's depths: Understanding the ecologies of human learning and the challenge for education science. *Educational Researcher* 39 (9): 643–655.
- Lenhart, A., and M. Madden. 2005. *Teen Content Creators and Consumers*. Washington, DC: Pew Internet & American Life Project, November 2.

- Lepper, M. R., G. Sagotsky, J. L. Dafoe, and D. Greene. 1982. Consequences of superfluous social constraints: Effects on young children's social inferences and subsequent intrinsic interest. *Journal of Personality and Social Psychology* 42 (1): 51–65.
- Levy, F., and R. Murnane. 2004. *The New Division of Labor: How Computers Are Creating the Next Job Market*. Princeton, NJ: Princeton University Press.
- Linde, C. 1993. *Life Stories: The Creation of Coherence*. New York: Oxford University Press.
- Livingstone, S. 2002. *Children's Use of the Internet: Reflections on an Emerging Research Agenda*. New York: Sage.
- Livingstone, S. 2012. Critical reflections on the benefits of ICT in education. *Oxford Review of Education* 38 (1): 9–24.
- Margolis, J., R. Estrella, J. Goode, J. J. Holme, and K. Nao. 2008. *Stuck in the Shallow End: Education, Race, and Computing*. Cambridge, MA: MIT Press.
- Margolis, J., and A. Fischer. 2003. *Unlocking the Clubhouse: Women in Computing*. Cambridge, MA: MIT Press.
- Markus, H., and P. Nurius. 1986. Possible selves. *American Psychologist* 41 (9): 954–969.
- Martin, C. K., and B. Barron. 2009. Learning to collaborate through multimedia composing: Repertoires of Collaborative Practice Symposium In *Computer Supported Collaborative Learning Practices: CSCL 2009 Conference Proceedings*, ed. C. O'Malley, D. Suthers, P. Reimann, and A. Dimitracopoulou, 25–27. New Brunswick, NJ: International Society of the Learning Sciences.
- McFarlane, A. 2010. Behind the public face of Kew: Education and conservation in the Millennium Seed Bank. *School Science Review* 91 (336): 43–47.
- McLaughlin, M., M. Irby, and J. Langman. 1994. *Urban Sanctuaries: Neighborhood Organizations in the Lives and Futures of Inner-City Youth*. San Francisco: Jossey-Bass.
- McLaughlin, M., and J. Talbert. 2001. *Professional Communities and the Work of High School Teaching*. Chicago: University of Chicago Press.
- Mercier, E. M., B. Barron, and K. M. O'Connor. 2006. Images of self and others as computer users: The role of gender and experience. *Journal of Computer Assisted Learning* 22 (5): 35–348.
- Mercier, E. M., K. Tyson, V. Mertl, B. Barron, L. Herrenkohl, N. Nasir, and R. Pea. 2008. Repertoires of collaborative practice: A theoretical introduction. In K. Tyson (chair) *Meta-Collaboration: The Role of Individuals' Theories of Collaboration in the Development of Collaborative Capabilities*. Symposium presented at the annual meeting of the American Educational Research Association, New York, NY, March 24–28.
- Mertl, V. 2009. "Don't touch anything, it might break!" Adolescent musicians' accounts of collaboration and access to technologies seminal to their musical practice: Repertoires of Collaborative Practice Symposium. In *Computer Supported Collaborative Learning Practices: CSCL 2009 Conference Proceedings*, ed. C. O'Malley, D. Suthers, P. Reimann, and A. Dimitracopoulou, 25–27. New Brunswick, NJ: International Society of the Learning Sciences.
- Messick, S. 1994. The interplay of evidence and consequences in the validation of performance assessments. *Educational Researcher* 23 (2): 13–23.
- Miller, B., J. Sun, X. Wu, and R. C. Anderson. 2013. Child leaders in collaborative groups. In *International Handbook of Collaborative Learning*, ed. C. Hmelo-Silver, A. O'Donnell, C. Chan, and C. Chinn, 268–278. London: Taylor & Francis.
- Nanotechnology Now*. 2007. More than 10,000 students from 23 countries combine sports and technology at the FIRST Championship. *Nanotechnology Now*. Retrieved August 25, 2013, from http://www.nanotech-now.com/news.cgi?story_id=21915.

- Nardi, B. A., and V. O'Day. 1999. *Using Technology with Heart*. Cambridge, MA: MIT Press.
- Nasir, N. S. 2002. Identity, goals, and learning: Mathematics in cultural practice. *Mathematical Thinking and Learning* 4 (2–3): 213–248.
- Nasir, N. S. 2011. *Racialized Identities: Race and Achievement among African American Youth*. Stanford, CA: Stanford University Press.
- Nasir, N. S., and J. Cooks. 2009. Becoming a hurdler: How learning settings afford identities. *Anthropology & Education Quarterly* 40 (1): 41–61.
- Nasir, N. S., and V. Hand. 2006. Exploring sociocultural perspectives on race, culture, and learning. *Review of Educational Research* 76 (4): 449–475.
- Nasir, N. S., and V. Hand. 2008. From the court to the classroom: Opportunities for engagement, learning, and identity in basketball and classroom mathematics. *Journal of the Learning Sciences* 17 (2): 143–179.
- Nasir, N. S., and G. B. Saxe. 2003. Ethnic and academic identities: A cultural practice perspective on emerging tensions and their management in the lives of minority students. *Educational Researcher* 32 (5): 14–18.
- National Research Council. 2012. *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century*. Washington, DC: National Research Council.
- National Research Council, Computer Science and Telecommunications Board. 1999. *Being Fluent with Information Technology*. Washington, DC: National Academy Press.
- National Science Board. 2012. *Science and Engineering Indicators 2012*. Arlington, VA: National Science Foundation (NSB 12-01).
- New London Group. 1996. A pedagogy of multiliteracies: Designing social futures. *Harvard Educational Review* 66: 60–92.
- Newmann, F. M., and G. G. Wehlage. 1995. *Successful School Restructuring: A Report to the Public and Educators*. Madison: Wisconsin Center on Education Research.
- Newstetter, W. C. 2000. Guest editor's introduction. *Journal of the Learning Sciences* 9 (3): 247–298.
- Noddings, N. 1992. *The Challenge to Care in Schools*. New York: Teachers College Press.
- North Central Regional Educational Laboratory and the Metiri Group. 2003. *enGauge 21st Century Skills: Literacy in the Digital Age*. Naperville, IL: North Central Regional Educational Laboratory; Los Angeles: Metiri Group.
- Osterman, K. F. 2000. Students' need for belonging in the school community. *Review of Educational Research* 70: 323–367.
- Oyserman, D., D. Bybee, and K. Terry. 2006. Possible selves and academic outcomes: How and when possible selves impel action. *Journal of Personality and Social Psychology* 91 (1): 188–204.
- Oyserman, D., and S. Fryberg. 2006. The possible selves of diverse adolescents: Content and function across gender, race and national origin. In *Possible Selves: Theory, Research, and Applications*, ed. C. Dunkel and J. Kerpelman, 17–39. Hauppauge, New York: Nova Publishers.
- Oyserman, D., and L. James. 2011. Possible identities. In *Handbook of Identity Theory and Research*, ed. S. Schwartz, K. Luyckx, and V. Vignoles, 117–148. New York: Springer.
- Pace, J. L., and A. Hemmings. 2007. Understanding authority in classrooms: A review of theory, ideology, and research. *Review of Educational Research* 77: 4–27.
- Papert, S. 1980. *Mindstorms: Children, Computers, Powerful Ideas*. New York: Basic Books.

- Partnership for 21st Century Skills. 2004. *Learning in the 21st Century*. Washington, DC: Partnership for 21st Century Skills. Retrieved December 1, 2011, from <http://www.p21.org>.
- Partnership for 21st Century Skills. 2009. *P21 Framework Definitions*. Washington, DC: Partnership for 21st Century Skills. Retrieved August 13, 2013, from http://www.p21.org/storage/documents/P21_Framework_Definitions.pdf.
- Pellegrino, J. W., and M. L. Hilton, eds. 2012. *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century*. Washington, DC: National Academies Press.
- Penuel, W., B. Fishman, B. H. Cheng, and N. Sabelli. 2011. Organizing research and development at the intersection of learning, implementation, and design. *Educational Researcher* 40: 331–337.
- Pianta, R. C., and M. Steinberg. 1992. Teacher–child relationships and the process of adjusting to school. *New Directions for Child Development* 57: 61–80.
- Pinkard, N., and K. Austin. 2011. Digital Youth Network: Creating new media citizens through the affinity learning model. *International Journal of Learning and Media* 4 (2). Retrieved on September 1, 2013, from <http://www.mitpressjournals.org/toc/ijlm/2/4>.
- President’s Council of Advisers on Science and Technology. 2010. Prepare and inspire: K-12 education in science, technology, engineering and math (STEM) for America’s future. Report to the president, September 2010. Prepublication version retrieved on January 15, 2011, from <http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stemed-report.pdf>.
- Purcell, K., A. Heaps, J. Buchanan, and L. Friedrich. 2013. *How Teachers Are Using Technology at Home and in Their Classrooms*. Report. Washington, DC: Pew Internet & American Life Project, February 28.
- Reich, R. 2002. *Bridging Liberalism and Multiculturalism in American Education*. Chicago: University of Chicago Press.
- Renninger, K. A., and S. Hidi. 2011. Revisiting the conceptualization, measurement, and generation of interest. *Educational Psychologist* 46 (3): 168–184.
- Resnick, M., and N. Rusk. 1996. The computer clubhouse: Preparing youth for a digital world. *IBM Systems Journal* 35 (3–4): 431–439.
- Resnick, M., N. Rusk, and S. Cooke. 1998. The computer clubhouse: Technological fluency in the inner city. In *High Technology and Low-Income Communities: Prospects for the Positive Use of Advanced Information Technology*, ed. D. Schon, B. Sanyal, and W. Mitchell, 266–286. Cambridge, MA: MIT Press.
- Rhodes, J. E., and S. R. Lowe. 2008. Youth mentoring: Improving programmes through research-based practice. *Youth & Policy* 99: 9–16.
- Richards, K. A., and K. Gomez. 2011. Participant understandings of the affordances of Remix World. *International Journal of Learning and Media* 2 (2–3): 101–121.
- Riel, M. 2005. Building communities of learners online. In *Online Learning: Personal Reflections on the Transformation of Education*, ed. G. Kearsley, 309–320. Englewood Cliffs, NJ: Educational Technology Publications.
- Riel, M., and L. Harasim. 1994. Research perspectives on network learning. *International Journal of Machine-Mediated Learning* 4 (2–3): 91–114.
- Rigney, D. 2010. *The Matthew Effect: How Advantage Begets Further Advantage*. New York: Columbia University Press.
- Rios-Aguilar, C., J. Kiyama, M. Gravitt, and L. Moll. 2011. Funds of knowledge for the poor and forms of capital for the rich? A capital approach to examining. *Theory and Research in Education* 9 (2): 163–184.

- Rogoff, B. 2003. *The Cultural Nature of Human Development*. New York: Oxford University Press.
- Rogoff, B. 2008. Observing sociocultural activity on three planes: Participatory appropriation, guided participation, and apprenticeship. In *Pedagogy and Practice: Culture and Identities*, ed. P. Murphy, K. Hall, and J. Soler, 58–74. London: SAGE Publications, Ltd.
- Ruiz-del-Solar, J., and R. Avilés. 2004. Robotics courses for children as a motivation tool: The Chilean experience. *IEEE Transactions on Education* 47 (4): 474–480.
- Rutter, M. 2000. Resilience reconsidered: Conceptual considerations, empirical findings, and policy implications. In *Handbook of Early Childhood Intervention*, 2nd ed., ed. J. P. Shonkoff and S. J. Meisels, 651–682. New York: Cambridge University Press.
- Schank, R. 1994. Goal-based scenarios. In *Beliefs, Reasoning, and Decision Making: Psycho-logic in Honor of Bob Abelson*, ed. R. C. Schank and E. J. Langer, 1–32. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Schwartz, D. G. 2003. Agent-oriented epistemic reasoning: Subjective conditions of knowledge and belief. *Artificial Intelligence* 148 (1): 177–195.
- Sebring, P., E. Brown, S. Ehrlich, S. Sporte, E. Bradley, and L. Meyer. 2013. *Teens, Digital Media, and the Chicago Public Library*. Chicago: University of Chicago Consortium on Chicago School Research.
- Senge, P. M. 1990. *The Fifth Discipline*. London: Century Business.
- Shapiro, R. B., D. C. Nacu, and N. D. Pinkard. 2010. SPACE and RemixWorld: Tools to support a community of practice for new media education. Paper presented at the Games, Learning, and Society Conference, Madison, WI, June 9–11.
- Sheridan, K. M. 2011. Envision and observe: Using the Studio Thinking Framework for learning and teaching in the digital arts. *Mind, Brain, and Education* 5: 19–26.
- Smitherman, G. 1997. “The chain remains the same”: Communicative practices in the hip-hop nation. *Journal of Black Studies* 28 (1): 3–25.
- Soep, L., and V. Chavez. 2010. *Drop That Knowledge: Youth Radio Stories*. 1st American ed. Berkeley: University of California Press.
- Stanovich, K. E. 1986. Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly* 21 (4): 360–407.
- Steele, C. M., and J. Aronson. 1995. Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology* 69 (5): 797–811.
- Stokes, D. E. 1997. *Pasteur’s Quadrant: Basic Science and Technological Innovation*. Washington, DC: Brookings Institution Press.
- Sue, D. W. 2010. *Microaggressions in Everyday Life: Race, Gender, and Sexual Orientation*. Hoboken, NJ: Wiley.
- Tai, R. H., C. Q. Liu, A. V. Maltese, and X. Fan. 2006. Planning early for careers in science. *Science* 1: 1143–1144.
- Thoman, E., and T. Jolls. 2008. *Literacy for the 21st Century: An Overview and Orientation Guide to Media Literacy Education*. Malibu, CA: Center for Media Literacy.
- Torrance, E. P. 1974. Interscholastic brainstorming and creative problem solving competition for the creatively gifted. *Gifted Child Quarterly* 18 (1): 3–7.
- Tzou, C., G. Scalone, and P. Bell. 2010. The role of environmental narratives and social positioning in how place gets constructed for and by youth. *Equity & Excellence in Education* 43 (1): 105–119.

- Urban Dictionary. 2013. Retrieved August 25, 2013, from <http://www.urbandictionary.com/define.php?term=jappin>.
- U.S. Census Bureau. n.d. *American Fact Finder*. Retrieved November 25, 2012, from <http://factfinder2.census.gov/>.
- Van Galen, J. A., ed. 1996. *Caring in Community: The Limitations of Compassion in Facilitating Diversity*. Albany: State University of New York Press.
- Vansteenkiste, M., and E. L. Deci. 2003. Competitively contingent rewards and intrinsic motivation: Can losers remain motivated? *Motivation and Emotion* 27: 273–299.
- Waller, W. 1932. *The Sociology of Teaching*. Chicago: University of Chicago Press.
- Walter, S. E., K. Forssell, B. Barron, and C. Martin. 2007. Continuing motivation for game design. In *CHI '07 Extended Abstracts on Human Factors in Computing Systems*. New York: Association of Computing Machinery.
- Warschauer, M. 2003. *Technology and Social Inclusion: Rethinking the Digital Divide*. Cambridge, MA: MIT Press.
- Warschauer, M. 2006. *Laptops and Literacy: Learning in the Wireless Classroom*. New York: Teachers College Press.
- Warschauer, M., and T. Matuchniak. 2010. New technology and digital worlds: Analyzing evidence of equity in access, use, and outcomes. *Review of Research in Education* 34 (1): 179–225.
- Watkins, C. 2012. Digital divide: Navigating the digital edge. *International Journal of Learning and Media* 3 (2): 1–12.
- Webb, N. M. 1989. Peer interaction and learning in small groups. *International Journal of Educational Research* 13: 21–39.
- Wenger, E. 1998. *Communities of Practice: Learning, Meaning, and Identity*. Cambridge, UK: Cambridge University Press.
- Wentzel, K. R. 1997. Student motivation in middle school: The role of perceived pedagogical caring. *Journal of Educational Psychology* 89: 411–419.
- Wertsch, J. V. 1998. *Mind as Action*. New York: Oxford University Press.
- Wiggins, G., and J. McTighe. 2005. *Understanding by Design*. Exp. 2nd ed. Alexandria, VA: Association for Supervision and Curriculum Development.
- Wing, J. M. 2006. Computational thinking. *Communications of the ACM* 49 (3): 33–35.
- Wing, J. M. 2011. Research notebook: Computational thinking—what and why? *The Link: The Magazine of the Carnegie Mellon University School of Computer Science* 6: 20–23.
- Wortham, S. 2004. From good student to outcast: The emergence of a classroom identity. *Ethos* 32 (2): 164–187.
- Zywica, J., K. A. Richards, and K. Gomez. 2011. Affordances of a scaffolded-social learning network. *Horizon* 19 (1): 33–42.