Metadata of the chapter that will be visualized online

Chapter Title	Literacy and Internet Technologies	AU1
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Abstract Increasing access to and usage of Internet-networked tools around the world continue to shape and change literacy practices within social and educational contexts. It is these evolving literacies, rather than the tools themselves, that ground and motivate our discussion in this chapter. We highlight historical innovations in Internet technologies and outline major contributions foundational to understanding the changing nature of literacy: multimodality, sociality, and critical digital literacies. Next, we explore the concepts of transnational identities, literacy ecologies, and gaming as fields in progress within the increasingly mobile and interconnected world. We then turn to critical social issues, including the digital divide and the ways in which the Internet continues to drive and problematize the definitions and boundaries of education, communication, and literacy. Finally, we consider future directions for the field, including emerging implications for research, definitions of literacy, conceptions of teaching in its relation to learning, new applications/practices, statistical images of Internet access, and celebrated projects and research studies, all of which illustrate the contemporary wired literacy landscapes of the world.

AU2

1 # Literacy and Internet Technologies

2 Kevin Leander, Cassandra Scharber, and Cynthia Lewis

3

4 *"What I hope for you . . . [is] that you think of technology as a*
5 *verb, not a noun; that poetry drives you, not hardware." –*
6 *Red Burns*

7 ## Contents

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Abstract

Increasing access to and usage of Internet-networked tools around the world continue to shape and change literacy practices within social and educational contexts. It is these evolving literacies, rather than the tools themselves, that ground and motivate our discussion in this chapter. We highlight historical innovations in Internet technologies and outline major contributions foundational to understanding the changing nature of literacy: multimodality, sociality, and critical digital literacies. Next, we explore the concepts of transnational identities, literacy ecologies, and gaming as fields in progress within the increasingly mobile and interconnected world. We then turn to critical social issues, including the digital divide and the ways in which the Internet continues to drive and problematize the definitions and boundaries of education, communication, and literacy. Finally, we consider future directions for the field, including emerging implications for research, definitions of literacy, conceptions of teaching in its relation to learning, new applications/practices, statistical images of Internet access, and celebrated projects and research studies, all of which illustrate the contemporary wired literacy landscapes of the world.

AU2

Introduction

Hashtag. Digital divide. Gamification. Selfie. Unfriend. Social networking. These technology-laden words recently added to the Merriam-Webster Dictionary (2014) illustrate the increasingly online nature of our lives (http://www.merriam-webster.com/new-words/2014-update.htm). Since the previous edition of this encyclopedia, the technological world has exponentially accelerated and multiplied. For example, iPads, first released by Apple only 5 years ago in January 2010, are the dominant tablet used in K12 US schools with more than 75,000 educational apps available for teachers and students. In addition, social media platforms are used actively by large numbers of people around the world (2014) (e.g., Facebook, 1.35 billion; Instagram, 300 million; Snapchat, 300 million; Twitter, 232 million; WhatsApp, 600 million). The United Nations' International Telecommunication Union (ITU) estimates that there were almost 3 billion global Internet users and 2.3 billion mobile Internet users at the end of 2014 (ITU 2014). While these numbers help provide illustrations of the increasing access to and usage of Internet-networked tools around the world, it is the ways in which these tools are shaping and changing how we connect and interact with each other that is more significant. Due to the constantly changing technological world, our literacy practices are also evolving within social/personal and educational/professional contexts. It is these new literacies, rather than the tools themselves, that ground and motivate our interests in this discussion.

AU3

A review of research in literacy and Internet technologies, broadly speaking, reveals as much about the current theoretical and ideological paradigms operating in

61 any time period as it does about technology's relationship to literacy. Thus, prior to
62 the beginning of our discussion, it seems important to bracket our own concerns and
63 investments about literacy and Internet technologies. First, our treatment of technol-
64 ogy is particularly invested in interactive and networked computing media, in
65 contrast to stand-alone and noninteractive media. Second, we are chiefly concerned
66 with literacy learning as not merely involving encoding and decoding, but rather
67 participating in particular sociocultural practices and discourses leading to one's
68 competent handling of texts. Third, our understanding of relations between literacy
69 and Internet technologies destabilizes conventional understandings of literacy as
70 fundamentally concerned with alphabetic print. While print remains important to
71 practices involving literacy and Internet technologies, print functions increasingly
72 along with other semiotic modalities in order to make meaning, including sound,
73 icons, graphics, and video.
74   In addition to bracketing literacy–technology relations as networked, as socio-
75 cultural, and as multimodal, our discussion is focused on how networked technol-
76 ogies fundamentally change the relationships of literacy to social relations, including
77 one's relations to one's own identity. For example, while purpose and audience have
78 very long histories in rhetoric, assumptions and configurations of purpose and
79 audience are transformed through dynamic use of Internet communication, and
80 purpose and audience may be continuously remixed through chains of distribution
81 and exchange (Kress and Van Leeuwen 2001). Moreover, social relations, through
82 texts that may have worldwide distribution, are articulated through the local and
83 global in new ways. We describe how such formations are beginning to be practiced
84 and researched within literacy studies, in and out of school contexts, and future
85 directions that such work might take.

Early Developments

87 The prehistory of the Internet is disputed and multifaceted, as it mirrors the relation-
88 ship of the Internet's prehistory to literacy practices. For instance, if we decide to
89 focus on the development of graphical World Wide Web browsers (e.g., NCSA
90 Mosaic in 1993), which led to the rapid public explosion of Internet activity, then we
91 would bracket out earlier literacy environments opened up by local area networks
92 (LANs), modems, and the like. Yet, the picture is still more complicated than the
93 technological story permits. For instance, an important date noted in the history of
94 multiuser dungeons (MUDs) is the writing of Tolkien's Lord of the Rings (1937), a
95 fantasy world that "formed the basis for most early gaming systems" (Burka 1995).
96 Over 40 years later (1978), the first MUD was developed at Essex University, where
97 the acronym was associated with "Multiple Undergraduate Destroyer" due to its
98 popularity among college students (http://en.wikipedia.org/wiki/MUD) Thus, a
99 decade and a half before the early web browsers, gamers were engaging in a text-
100 driven world that combined elements of role-playing games with social interaction.
101 An extended history of literacy and Internet technologies, as they are related to

102 education, would certainly include early practices in these pre-Internet
103 environments.
104   Additionally, Minitel was launched in France in 1982 and quickly became a
105 highly successful online service on which customers could make purchases, chat,
106 check stock prices, make train reservations, access databases, and participate in other
107 information and communication practices. As early as 1986, widespread access to
108 Minitel (or Teletel) terminals resulted in several forms of educational practice in
109 homes, schools, and university settings, including homework help lines, databases
110 with model answers to national examination questions, and online registration for
111 university courses (Guihot 1989).
112   In the USA, Seymour Papert, a renowned MIT mathematician and education
113 scholar, published the book, *Mindstorms: Children, Computers, and Powerful Ideas*
114 (1980) launching the movement of using computers in tandem with constructionist
115 and constructivist approaches for learning. Papert encouraged and researched using
116 Logo, a computer programming language, as a way to nurture mathematical con-
117 cepts and problem-solving in children. In addition, an early paper, "Microcomputer
118 Communication Networks for Education" (Laboratory of Comparative Human
119 Cognition 1982), describes the use of "non-real-time" messaging, in which teachers
120 and students could write messages on microcomputers during the day and then send
121 them overnight by telephone lines, saving the high cost and scheduling problems
122 associated with real-time messaging. This group of developers described a pilot
123 network connecting a classroom in San Diego with a classroom in rural Alaska,
124 using Apple II computers. Early research interests included studying the complexity
125 of discourse structures of multiple threads in online communication. They also
126 initiated what is likely to be one of the earliest teacher education courses on literacy
127 and information and communications technology (ICT), "Interactive Media for
128 Education," offered at the University of California, San Diego, in 1982.
129   Two other areas of early work most relevant to literacy and Internet technologies
130 include studies of reading hypertext and multimedia. Much of this work reflects the
131 cognitive traditions that informed it in the 1980s to early 1990s. Today, online
132 reading (its practices, definitions, forms, texts, and assessments) continues to
133 intrigue and challenge educators as well as researchers (Coiro 2012; Leu et al. 2013).

Major Contributions

135 We have organized our discussion to focus on major contributions in three categories
136 that are foundational to understanding the changing nature of literacy in relation to
137 Internet technologies: multimodality, sociality, and critical digital literacies.

Multimodality

139 Although literacy has always been multimodal, contemporary literacy practices rely
140 on an increasingly complex range of modalities. Conceptual work on technology has

141 considered the relationship between the visual and linguistic modes, noting the shift
142 to complex images and simpler texts that contain fewer embedded clauses (Kress
143 2003). Communication technologies often blur distinctions between speech and
144 writing, depending on aural modalities in unprecedented ways.
145   Many scholars have argued that reading and writing practices change with these
146 changes in textual form and function (e.g., Knobel and Lankshear 2007; New   AU4
147 London Group 1996). They point out that Internet technologies require readers
148 and writers to make meaning laterally across modes, sampling the multimodal
149 resources available to them and interpreting an array of surface features and combi-
150 nations of texts, genres, and modes. Thus, reading practices associated with print
151 (often described as linear or deep) can be viewed as one way of reading, rather than
152 the only way to be a competent reader (Kress 2003). Moreover, as the "logic of the
153 image" replaces the "logic of writing," there will be "far-reaching effects on the
154 organization of communication, not just on the screen but also on the page, and on
155 the mode of writing" (Kress and Jewett 2003, p. 16). Despite several decades of
156 work in the area of "new" literacies, we know relatively little about how to work with
157 and produce modally complex texts. Rowsell (2013) addresses this problem with a
158 detailed focus on eight modes and their implications for meaning-making and
159 production.
160   A good example of the shifting multimodal nature of literacy is Snapchat. To date,
161 there are over 50 million users of Snapchat, typically between 13–23 years old with
162 the median age being 18 (Colao 2014). Snapchat users are estimated to share
163 between 400–700 million pictures and videos per day (http://en.wikipedia.org/
164 wiki/Snapchat). Essentially, a photo-based, and now video-based, application,
165 Snapchat, allows users to take photos (called snaps), record 15-s videos, or send a
166 24-h peek into lives (knitted together snaps from one day called stories). Users add
167 text, doodles, and filters and then send these "snaps," "stories," or videos to selected
168 recipients. The magical part about Snapchat is that the media disappears and self-
169 destructs – senders decide to give recipients between 1–10 s to view a snap before it
170 disappears forever from phones and the actual servers themselves. Videos can only
171 be viewed once – no replays. Snapchat represents another key dimension of multi-
172 modality – not only does each mode construct meaning in different ways but the
173 temporal and spatial affordances of the media shapes the meaning of the multimodal
174 experience. In this case, the media's short life adds to the excitement, creativity, and
175 intimacy of the users' experience. Snapchat is also a prime example of the increasing
176 social nature of contemporary literacy practices.

Sociality

178 New technologies shape and are shaped by social relations and practices. Since they
179 are socially mediated, particular kinds of Internet technologies afford particular types
180 of social relations. Distinctions between offline and online worlds fall away as
181 people shift seamlessly from digital to face-to-face contexts (Leander and McKim
182 2003). Once a technology becomes commonplace, people tend not to think of it as

183 technological. As Herring (2004) points out, young people with Internet access
184 naturalize particular kinds of Internet technologies, such as texting, as an ordinary
185 part of their lives. Bolter and Grusin (2000) use the term "remediate" to describe the
186 process by which new technologies incorporate elements of established technolo-
187 gies. Instant messaging (IM) incorporated elements of phone exchanges and note
188 passing, for instance, but its status as a new technology has already evolved into
189 more mobile forms of chat and texting. It is not the computer or the Internet itself that
190 is central to literacy, but the way that these tools of technology shape social relations
191 and practices.

192   Internet technologies have been found to hold potential for the development of
193 new social linguistic identities and relationships (Lam and Warriner 2012; McClean
194 2010; Burnette and Merchant 2014). In an early study of adolescents' uses of instant
195 messaging, Lewis and Fabos (2005) found that participants manipulated the tone,
196 voice, word choice, and subject matter of their messages to fit their social commu-
197 nication needs. They designed their practice to enhance social relationships and
198 statuses across contexts, circulated texts across buddies, combated unwanted mes-
199 sages, assumed alternative identities, and overcame restrictions to their online
200 communication. These functions revealed that the technological and social
201 affordances of IM gave rise to a performative and multivoiced social subject. Digital
202 technologies can foster affinity group connections related to common interests and
203 shared norms over common class and race affiliations (Gee 2002). Others, however,
204 point to the potential for online communication to perpetuate, even exacerbate,
205 inequitable social relations and limiting social roles (Warschauer 2002).

206   New problems and issues for research on sociality, literacy, and Internet technol-
207 ogies emerge as new technologies rapidly develop, as becomes clear by considering
208 the popularity and complexities of collaborative, cloud-based spaces. An exemplary
209 example is Wikipedia, a free, multilingual, web-based encyclopedia project
210 consisting of over 34 million pages that are created and updated primarily by
211 volunteers. Born in 2001, Wikipedia's content is openly editable, which allows
212 this online encyclopedia to continually morph, grow, and update along with world's
213 changes. More importantly, more than 73,000 editor collectives make these changes   AU5
214 from around the world. Wikipedia's English Wikipedia is one of more than
215 200 Wikipedias and contains over 4.6 million articles (http://en.wikipedia.org/
216 wiki/Wikipedia). While Wikipedia has its flaws (e.g., the gender bias present in its
217 editors – only 13% female), conceptually it illustrates the global, networked, col-
218 laborative nature of information and people (with 500 million unique visitors per
219 month). Educationally, Wikipedia and wikis themselves have weathered both praise
220 and scorn, with many teachers banning Wikipedia as a credible research reference
221 and others using wikis to engage in collective knowledge building, writing, and
222 meaning-making (Chandler-Olcott and Mahar 2003). In fact, today cloud-based,   AU6
223 collective writing is fast becoming a norm with Google Drive and Dropbox making
224 documents accessible, sharable, and editable by multiple users from any Internet-
225 connected computer. Collectively accessed, sharable, and editable video-based
226 spaces (i.e., Google Hangouts and Skype) also contribute to the increasingly social
227 and multimodal nature of literacies used within education, home, and work spaces.

Critical Digital Literacies

228

229 The concepts of "digital literacies" and "critical literacies" are themselves not new,
230 but the fusion of these two concepts into a separate, distinct concept referred to as
231 "critical digital literacies" (CDL) is swiftly coming of age in education and research
232 arenas. Hallmarked by shifts in authority and power from and between teachers and
233 students, CDL is enacted through participatory learning where a co-learner/co-
234 facilitator relationship is fostered between teachers and students (Ávila and Zacher
235 Pandya 2012). This more fluid relationship is enhanced and enacted through engag-
236 ing with digital media; "we want students to be empowered to travel across both
237 formal and informal learning environments; we also want them to define themselves,
238 and be defined, as proficient and capable. Traveling with both critical and digital
239 tools can make one powerful indeed" (Ávilia and Zacher Pandya 2012, p. 2). When
240 learners are positioned as consumers, designers, and interrogators of language,
241 media, and power, learners can "identify and work within [these]
242 understandings…[and] move from awareness to action" (Hagood 2012, p. 223).
243 For example, Dixon-Román and Gomez (2012) make the argument that is only
244 through investigating the multiplicity of forms and ideologies of Cuban youth
245 cultures that the future of the country can be understood. In particular, youth
246 engaging in media-rich hop hop and reggaetón play/practices participate in critical
247 and transformative dialogue that provides windows to the country's social, cultural,
248 and economic pasts as well as to its future.

249   CDL is also expressed as "critical engagement" (Wohlwend and Lewis 2011),
250 "pedagogies of possibilities" (Jocson 2012), and "narratives of hope and critique"
251 (Berry and Cavallaro 2014), all referring to affect an agency as central components
252 of critical digital literacy. Lemke (2015) describes an "amplifying" effect when
253 students interact with media texts, wherein meanings multiply or exceed any of
254 the separate component parts of the text, such as language or image. Similarly,
255 Ellsworth (2004) finds that media texts set "representations into motion across
256 emergent contexts and into event potentials" resulting in "new alignments" and
257 "unexpected intensities" (p. 127).

Works in Progress

258

259 In the following consideration of works in progress, we feature research that is
260 addressed toward understanding literacy and Internet technologies as related to an
261 increasingly mobile and interconnected world.

Transnational Identities

262

263 Scholars are increasingly combining research related to immigrant youth with
264 research on global media and transnational movements (e.g., Dahlberg and Bagga-

265 Gupta 2014). Lam (2014) has found that Chinese immigrant youth use social media
266 to mobilize transnational identities across geopolitical borders within economies of
267 exchange related to theories of social and cultural capital. Digital communication
268 also can create cosmopolitan connections across widely diverse cultures that
269 "upholds local commitments and takes into consideration larger arenas of concern"
270 (Hull and Stornaiuolo 2010, p. 331). In Space2Cre8, a social network space,
271 adolescents from different hemispheres with vastly different daily lives shared
272 their values, realities, and concerns through digital arts-based artifacts. On the
273 other hand, newer work is beginning to look at how the social practices of diverse
274 ethnic groups create digital networks that are distinct and cannot be grouped into an
275 imagined single vision of connected learning (de Haan et al. 2014). As these scholars
276 demonstrate, digital literacy merges the producer and consumer roles, situating
277 youth as agents who create, critique, rearticulate, and juxtapose as they consume
278 popular forms of transmediated global culture.

Literacy Ecologies

280 Whereas the digital revolution and resulting divide were initially about access to
281 these technological tools above all else (Warschauer and Matuchniak 2010), the
282 current revolution is one of the *participations*, where youth must have access to both
283 the technology and the literacies (technical and cultural) to create, evaluate, and
284 contribute to society (Jenkins 2009). This type of participatory culture is viewed as
285 the basis for contemporary learning, civic engagement, and communication (Kafai
286 and Peppler 2011; Soep 2014). Low-income youth often lag behind more well-
287 resourced youth who regularly create digital content to participate in local and global
288 meaning-making and communication; however, there are many programs that nav-
289 igate this participation gap, including the celebrated media production company
290 called Youth Radio (https://youthradio.org) that trains youth in news, radio, and
291 video production (Soep and Chávez 2010).
292   Connected learning (Ito et al. 2013) focuses on learning "pathways" that move
293 across formal and informal settings to transform the very nature of learning (and by
294 extension, literacy) – what it means, how it occurs, and where it takes place (Peppler
295 2013). Such learning has been described as interactive, improvisational, participa-
296 tory, and social (Jenkins 2009), reflecting new epistemologies and pedagogies for
297 learning that occur in a wide array of settings. The Digital Youth Network (http://
298 digitalyouthnetwork.org) is an example of a Chicago-based connected learning
299 network consisting of over 22 learning spaces (Barron et al. 2014).
300   Institutions that support engaged learning must build bridges as well as cross
301 institutional knowledge so they can collectively better support youth (Ito et al. 2013;
302 Sefton-Green 2012; Shernoff 2013). These robust literacy ecologies will anchor and
303 extend learning for the foreseeable future. Importantly, Ito et al. (2013) caution that
304 without "a proactive reform agenda that begins with questions of equity, leverages
305 both in-school and out-of-school learning, and embraces the opportunities new

306 media offer for learning, we risk a growth in educational alienation by our most
307 vulnerable populations" (p. 7).
308   One broad national initiative grounded in the concept of connected learning is the
309 Learning Labs in Museums and Libraries program that is financially supported by
310 the Institute of Museum and Library Services and the MacArthur Foundation http://
311 www.imls.gov/about/learning_labs.aspx. In 2011, 24 lab sites were supported by
312 grant dollars to plan and design labs within library and museum spaces (not schools),
313 including one unique site in Minnesota that is a joint partnership between a city's
314 public library and its parks and recreation program (i.e., Createch Studio: http://
315 www.urbanlibraries.org/createch-studio-pages-313.php). All labs honor the learning
316 that occurs in these youth-centered, digitally infused lab spaces, commonly referred
317 to as *Hanging Out, Messing Around, Geeking Out* (HOMAGO) (Ito et al. 2010).
318 Even the design of these new learning labs is emerging as a form of new literacy
319 practice involving multiple modalities and embodied learning (Leander and Hollett
320 2013).

Gaming

322 Gaming remains an area of continued interest for educators and researchers alike due
323 to the potential of games to increase engagement, creativity, and authentic learning
324 (NMC Horizon Report 2014). Video games are fast becoming a pastime of choice
325 among many youth across the globe, involving multimediated experiences in which
326 participants take on new identities, fight battles, go on collaborative virtual missions,
327 take on new textual and visual identities, built art objects, and create new forms of
328 sociality. One of the world's most popular video games with 100+ million players is
329 Minecraft, a multiplatform game whose hallmark is its open-ended gameplay – there
330 are no specific goals or challenges, so players can choose how they want to engage in
331 the game. Minecraft's graphics are old school – its allure to players is the nature of
332 the game itself; there are no instructions about how to play, so exploration, creativity,
333 and experimentation are the keys to playing (learning). This learning also extends
334 outside of the game itself, through collaboration with other gamers via the Minecraft
335 wiki (http://minecraft.gamepedia.com) and forum (http://www.minecraftforum.net).
336 Educators and researchers continue to have interest in understanding and harnessing
337 the power of gameplay for educational arenas. Gee (2003, 2005) has authored a
338 widely read and provocative early work on video games as venues of learning and
339 literacy, drawing on a wide swath of current learning theories to develop 36 learning
340 principles informing video gameplay as learning activity. Unlike much of contem-
341 porary schooling, with its division of knowledge into isolated bits, Gee argues that
342 video games are semiotic domains that one slowly learns and can master.
343 Steinkuehler et al. (2012) recently published an edited book on games and learning
344 containing contributions from a wide array of worlds including academic, design,
345 education, and industry.
346   New and ongoing work in game development demonstrates an important inter-
347 section between changing literacy ecologies and game design, in particular as games

348 begin to blend online and offline, physical and digital tools and forms of mediation.
349 Location-based technologies are increasingly being used to create interactive envi-
350 ronments in (and out of) classrooms, especially through augmented reality environ-
351 ments. Klopfer and Squire (2008) designed "Environmental Detectives," "a
352 multiplayer, handheld augmented reality simulation game designed to support learn-
353 ing" in science. As an augmented reality game, students used personal digital
354 assistants that would augment the physical world by providing a virtual layer of
355 data accessed through the device: the data on the handheld was connected to the
356 physical location. Similarly, Dunleavy and colleagues' "Alien Contact!" (2009)
357 established an augmented world for students to explore as they interviewed virtual
358 characters, collected digital items, and solved a variety of math, language, arts, and
359 science puzzles. Such an environment allowed the researchers to investigate the
360 ways in which teachers and students described their learning and teaching experi-
361 ences in an augmented reality space.

Problems and Difficulties

363 In the mid-1990s, the Internet began its foray into schools, and in the digital decades
364 that have followed, the Internet continues to drive, and at times problematize, the
365 definitions and boundaries of education and communication, and therefore, what
366 counts as literacy. While standardized testing in the USA tends to support and assess
367 traditional reading and writing skills, there are other standards that outline best
368 practices for K12 teaching, learning, and leading with technology in education.
369 The International Society for Technology in Education's (ISTE) standards (http://
370 www.iste.org/standards) are available for students, teachers, administrators, technol-
371 ogy coaches, and computer science educators. Collectively, these standards articu-
372 late the literate practices demanded in the world today through providing direction
373 for educational practices that better reflect the digital world. The *National Standards*
374 *for English Language Arts* (2012) (http://www.ncte.org/standards/ncte-ira) are broad
375 enough that they do not limit definitions of text to print only, thereby leaving room
376 for expanded notions of reading and writing so that teachers and students can
377 embrace, analyze, and construct digital texts. Taking things one step further, the
378 current English curriculum in Australia is specifically designed so that students must
379 be competent in digital multimodal literacy. Unsworth and Thomas (Eds., 2014) urge   AU7
380 primary and secondary teachers and scholars to embrace new forms of narrative
381 entwined with media through sharing practical as well as theoretical examples/ideas
382 for the construction, sharing, and critique of multimedia narratives including *Inan-*
383 *imate Alice* and *Macbeth*.
384   Teaching strategies for intertextual reading in online environments is important,
385 yet teachers often feel that they lack the knowledge to do so (Coiro and Castek
386 2010). Literacy that incorporates Internet technologies is generally left up to teachers
387 who themselves have not been trained to read across genres and modes. Moreover,
388 Internet technologies present the additional challenge of interactivity as part of the
389 reading process. Although all reading involves readers interacting with texts,

390 interactive reading is intensified online as a material feature of the reading process.
391 Readers make decisions about text construction and organization through selection
392 of links and modes, among other elements of website design. In so doing, readers can
393 be viewed as participants in the critical processes of production and analysis.

394 Writing instruction also needs to change in the wake of Internet technologies. In a
395 recent PEW survey, the majority of surveyed teachers appreciate the value in
396 utilizing digital technologies as means to facilitate writing, often "encouraging
397 teens to write more often in more formats than may have been the case in prior
398 generations" (Purcell et al. 2013, p. 2). The multimodality and sociality of the
399 technology landscape have resulted in ongoing changes in writing processes and
400 identity representations. The writing process for many digital writers does not occur
401 as a set of stages – even recursive ones. Nonetheless, most schools and teacher
402 education programs remain wedded to the stages of the writing process as they were
403 established for pen and paper. Voice is another writing concept that is in flux as
404 researchers and educators begin to understand how it functions in online writing
405 environments. Often presented in schools as something unitary and authentic, voice
406 in digital writing can be purposefully unstable, shifting moment to moment for many
407 different audiences. Students would benefit from learning strategies to negotiate the
408 performance of self in writing online for multiple audiences. Audiences in online
409 writing are rarely the remote academic audiences of school assignments. Commu-
410 nicating and collaborating more often across space in real time mean that "remote"
411 audiences become more immediate in online writing. Students need to be prepared to
412 make effective rhetorical choices given such changes.

413 Finally, another ever-persistent problem in the field of education and literacy is
414 the digital divide. This problem originally described the differences in *access* to
415 technology between low-, middle-, and high-income people. Today, this problem is
416 not just technological, but it is also concerned with and complicated by social and
417 contextual factors – geographic, economic, racial, ethnic, educational, and gender
418 demographics (Warschauer and Matuchniak 2010). For example, in 2012, while
419 almost all of American adults had some form of Internet access (fixed or mobile),
420 almost one-third of American homes did not have a broadband Internet connection;
421 only 60% of rural communities had broadband connection; and 68% of White people
422 had home broadband compared to 45% of Hispanic people (NTIA 2014). Globally,
423 while over 80% of people in Germany, France, the UK, the USA, and Canada had
424 Internet connection in 2014, only 19% of people in India and 2% of people in
425 Ethiopia had connection (http://www.internetlivestats.com). To obscure the divide
426 further, it is the ways in which Internet-connected media are *used* within educational
427 settings as well as within daily lives that continue to complicate the digital divide as
428 well as shape contemporary definitions of literacy. Today, honing the differential
429 abilities to use new media to critically evaluate information, analyze and interpret
430 data, attack complex problems, test innovative solutions, manage multifaceted pro-
431 jects, collaborate with others in knowledge production, and communicate effectively
432 to diverse audiences – in essence, to carry out the kinds of expert thinking and
433 complex communication that are at the heart of the new economy (Levy and

434   Murnane 2004) – is the most critical pedagogical and social challenge for literacy
435   educators and researchers.

Future Directions

437   In a recent Pew survey (Rainie et al. 2014), over 1000 experts shared ideas about
438   future "Internet activities and applications that might emerge in the age of gigabit
439   connectivity." Three themes emerged as directly connected to the future/synergies
440   between literacy and education. First, online collaboration will become more
441   "vivid," more immersive, and much easier. Next, education sectors were named as
442   being greatly impacted by new Internet applications. One scientist believes that "the
443   school day will disaggregate into a number of learning sessions, some at home, some
444   in the neighborhood, some in pairs, and some in larger groups, with different kinds
445   of facilitators." Finally, the digital divides (old and new) will continue to persist and
446   could be magnified. Considered together, these ideas about future Internet-related
447   activities due to high-speed Internet connectivity will impact the types and natures of
448   literacies used within educational contexts as well as the ways in which these
449   literacies are honored and honed.
450   Coding is the latest literacy to begin weaving itself into common educational
451   practices. Computer coding programs and research projects are just launching, both
452   within and outside the USA (e.g., ScratchJr project @ MIT Media Lab; www.code.
453   org; the Hour of Code initiative; www.girlswhocode.com). There is also a movement
454   to include computer science and coding opportunities within the US K12 schools;
455   seventeen states currently count computer science classes as math or science (not
456   elective) credits toward graduation. Grounding the coding literacy movement is the
457   belief that students need to learn how things work, not simply specific software or
458   hardware. Tensions about what counts as literacy and learning in contemporary and
459   future educational contexts will continue to challenge educators as well as
460   researchers.
461   Another enduring need for ongoing research involves the development of peda-
462   gogical, theoretical, and methodological frames that will enable us to understand
463   changing relations of power, changing constructions of identity, and changing uses
464   of literacy. If the meaning of literacy is deictic or regularly redefined with respect to
465   new technologies (Leu 2000), then part of what follows from this insight is that
466   studies of individual tools and practices (e.g., iPads, VoiceThread, chatting), how-
467   ever helpful, must also avoid parochialism and provide theoretical and pedagogical
468   conceptions that contribute to a broader and deeper picture of literacy/ICT
469   co-productions. An example of a theoretical insight that might traverse specific
470   tools is the manner in which new literacy practices are reshaping the experience of
471   time and space. While schooling may often construct literate activity as monochro-
472   mic (temporally linear, tangible, and divisible), youth often use Internet technologies
473   in ways that treat it as polychromic (fluid, layered, and simultaneous) (Jones 2005).
474   This difference has implications for research as well, challenging researchers'
475   assumptions about a single dominant temporal frame or spatial situation of literate

activity. Researchers will need to continue to refine and translate, if necessary, methods and skills to conducting studies within digital environments. For example, researchers continue to discuss the methodological implications of conducting ethnographies in online spaces. Some scholars believe that online ethnography is a distinct form of ethnography often referred to as "netnography" (Kozinets 2009), "virtual ethnography" (Hine 2000), and "expanded ethnography" (Beneito-Montagut 2011). These scholars are interested in (re)constructing and (re)defining the concepts of presence, field observations, time, and place/boundaries. Similarly, Landri (2013) advocates for an emerging form of educational ethnography that shifts its centrality away from people to the network(s) of relationships. Other scholars discuss nuances in ethnographic methods but maintain that making distinctions between offline, blended, and online social worlds is not necessary (Baker 2013; Hammersley and Atkinson 2007). Stornaiuolo and Hall (2014) point to challenges when exploring digital learning spaces including tracing cross contextual meaning-making and managing data multiplicity in the mobile, multi-sited, on-and-off screen work that literacy studies now typically entails. Collectively, these scholars take up the blurriness of our contemporary lives that is lived across virtual and material spaces and communities.

Educational fads appear and disappear frequently and with great abandon. Increasingly, these fads are related to technological tools or Internet-based environments (e.g., flipped classrooms, iPads, MOOCS) and boast fixes for education's perceived woes. Spence's (2001) metaphor of technology itself being "an internal combustion engine on the back of a horse and buggy" captures the essence of the underlying issue with technological fads in education – many times these technologies (i.e., the engine) simply encourage the same approaches to teaching and learning (i.e., the horse and buggy) that have been used for centuries rather than facilitate a re-imagination of contemporary and future teaching, learning, and literacy practices. Scharber (2014) advocates for an updated teaching and learning metaphor that may be complementary for the engines of technology – the 1981 DeLorean featured in the film, *Back to the Future* (1985). This car is actually a time machine that can travel easily between past, present, and future. Like the car as time machine, modern schooling often requires teachers and students to move between contemporary and traditional educational practices, sometimes even in the space of one class session. As with the DeLorean, constant maneuvering is necessary with educational practices due to constantly updated engines and fluctuating expectations. While our DeLorean time machine will enable teachers and students to move back and forth in time, we must keep our visions for education future oriented. As Doc says to Marty in the final scene of the film before they head off to the future, "Roads? Where we're going, we don't need roads."

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