
Establishing Twenty-First- Century Information Fluency

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Technology cannot be separated from its social context; rather, they are mutually occurring phenomena, intertwined with what is often distinguished as the sociocultural, political, economic, or scientific milieu.¹

In today's tech-driven environment, students often appear more focused on Facebook and texting than engaged in their learning environments. Institutions of higher education bear responsibility for changing their learning structures to accommodate the new digital environment.² The 2012 Horizon Report lists effective integration of technologies into higher education as a major challenge facing today's students and educators. Additionally, the report highlights student proficiency with digital information and tools as vital for "every discipline and profession," but there is little consensus among educators regarding what skills and competencies are most critical.³ In an effort to infuse information fluency into programming and curriculum, consideration of the learning environment and methods for integrating technology is essential.

Increased access to computers, mobile devices, and utilization of the Internet, particularly social networking platforms and text messaging, have influenced educators' classroom teaching and curriculum development, particularly out of concern for engaging members of the Millennial generation in learning.⁴ Students today demonstrate "a deep-seated need to communicate and collaborate, to access information at any time of the day or night, and to have the tools they need to synthesize, evaluate, and create information."⁵ Use of current and future technologies will continue to influence how students connect, and ultimately learn, in and out of the classroom. Given that students want to connect and collaborate, educators need to innovate pedagogically to help students develop a high level of aptitude to interact fluently with both information and technology. Methodologies developed for today's students will also inform and guide faculty and librarians for future generations.

Student search strategies are key indicators of their information fluency abilities. Perpetual commentary on the tech-savviness of today's students creates a misperception that they also possess high information fluency competencies to function in today's information environment. Students' dominant use of free search engines has led to information-seeking habits comprised of only using natural language search strings, selection of top hits, and lack of intentional critical analysis in the selection process.⁶ Typically, students' search skills reflect their goal for the search. One such example is they often have proficient searching skills for finding digital media to remix

for personal purposes. The typical college student searches in a three-part process that involves “grazing, a ‘deep dive,’ and a feedback loop.” Many create information as remixes and mashups, which provide them the ability to connect in unique ways within and outside their peer group. This form of information production is about socially connecting and collaborating.⁷ The first two components (grazing and “deep dive”) are what instructors and librarians would label as background research and higher-level research. Often what is missing within the classroom or course structure is the feedback loop.

When faced with conducting research within academic search engines and databases, students struggle because their established search habits do not transfer effectively. The four predominant challenges they encounter are getting started, defining a topic, narrowing the topic, and then weeding out non-relevant sources.⁸ This suggests that students rarely go beyond the “grazing” stage when it comes to scholarly research. Reliance on free search engines and deficiencies in knowledge and application of advanced search strategies negatively affect their ability to find information sources within the deep or hidden web, which are considered appropriate information sources within higher education. To better prepare students to succeed requires faculty and librarians to shift their focus from lower-order skills to higher-order competencies that involve interpreting, synthesizing, and constructing new concepts.

While there is significant discussion about traditional undergraduate students, there is less about non-traditional students; also called adult or returning students. These students are identified as being 25 years or older, but previous college enrollment is typically not integrated into the definition of this group. Additional characteristics for these students are the following:

- delays enrollment (does not enter postsecondary education in the same calendar year that he or she finished high school)
- attends part time for at least part of the academic year
- works full time (35 hours or more per week) while enrolled
- is considered financially independent for purposes of determining eligibility for financial aid
- has dependents other than a spouse (usually children, but sometimes others)
- is a single parent (either not married or married but separated and has dependents)
- does not have a high school diploma (completed high school with a GED or other high school completion certificate or did not finish high school)⁹

The reasons these students are now attending college vary greatly but are often related to a change in career focus, desire to be mobile in the current employment market, or to enter a career that might be designated as a “hot” career. In a recent report for the US Department of Education, Hussar

and Bailey predict that enrollment for adult students will increase significantly. By the year 2020, students aged 25–29 will increase 14 percent, for the 30–34 age range an increase of 21 percent, and individuals 35 and older are expected to increase by 13 percent.¹⁰ Currently, most adult students have a significant technology gap compared to more traditional students and may often require added exposure to various technologies.¹¹ Fortunately, there are various learning theories developed over the last few decades that address the specific needs of adult learners, which can help the transition into the college environment.¹² No one would argue that today’s learning environments are significantly impacted by the changes in our information-rich society. How, as educators, we allow it to influence our teaching and programming should depend on established learning outcomes and specific information fluency competencies.

CONSIDERATIONS FOR TECHNOLOGY INTEGRATION TO IMPROVE INFORMATION FLUENCY

When addressing information fluency, there are several components that need to be considered to ensure effective integration of technology into a course or curriculum. These include the student audience, teaching methodologies, and types of technologies available. Information fluency is often used as a synonym for information literacy. However, the concept of information fluency incorporates much more than just find, use, and evaluate. First introduced by the Associated Colleges of the South (ACS) in the mid-1990s, their model identified an information fluent individual as one who could function with ease in a changing environment of information and technologies.¹³ In subsequent years, several others offered an interpretation or definition of information fluency.¹⁴ The commonality among all of them is recognizing that information and technology are no longer separate entities but are inextricably connected. While trends and survey data provide one of several tools for understanding students, caution is required to avoid generalizations that overlook individual differences.¹⁵ Students who are immersed in the use of cell phones, video games, and Internet surfing do not always have the necessary technological skill set or knowledge of higher-level applications to be successful in their academic endeavors. When introduced to new and more difficult applications, student anxiety increases.¹⁶ Instructors should not assume all students possess digital or technological proficiencies or skills at expected levels within the higher education setting. To alleviate anxiety, frustration, and disconnection, educators can develop information fluent learners with a deliberate focus on the design, implementation, and assessment of their learning environments.

To successfully integrate technologies into courses and curricula, relevant proficiencies and appropriate technologies should be chosen as part of one’s instructional design process. Instructors should develop contextual strategies for relating the technology to instructional goals, and clearly

communicate to learners the purpose of the learning activity. When developing pedagogy, instructors should consider the rationale for using the technology and the specific activities/interactions it can support. The qualities and capabilities of the technology should support the learning outcomes, allow for varied and broad applications, and build upon common skills and practices.¹⁷ Technologies used should be recognized as tools to support an outcome or activity, including creativity, quick distribution or communication of information, interaction and collaboration, or the development of multimedia projects. Finally, instructors should consider the social context of collaborative technologies and view instructional design as an ongoing process that can be revised according to needs. At its core, authentic twenty-first century learning environment design necessitates asking these key questions:

- What pedagogy, curricula, activities, and experiences foster twenty-first century learning?
- What assessments for learning . . . foster student learning of outcomes, student engagement, and self-direction?
- How can technology support pedagogy, curricula, and assessments of a twenty-first century collaborative learning environment?
- What physical learning environments (classroom, school, and real world) foster twenty-first century student learning?¹⁸

Examining these core questions within the context of a specific learning environment can pull together the key factors that contribute to a holistic learning environment—one that focuses on content, applies measurable learning outcomes, and effectively integrates technology.

INTERPRETATION OF THE FOUR KEY TWENTY-FIRST-CENTURY LEARNING ENVIRONMENT QUESTIONS

1. What pedagogy, curricula, activities, and experiences foster twenty-first-century learning?

Technology can assist in meeting instructional goals but can conversely create counterproductive distractions and fail to improve learning outcomes if not used effectively.¹⁹ Disconnections and frustration can result if students are distracted by the technology, if instructors' expectations regarding students' previous knowledge and technical skills are off-base, or if students fail to understand the relevance of such technologies to the subject matter and particular learning experience. A primary reason educators are challenged to integrate various technologies is because of a common assumption that technology can just be "added on" to existing pedagogy and vice versa.²⁰ Sound pedagogical practices and teaching methods should never be compromised to incorporate technology into the classroom.

When determining how to encourage the development of the key twenty-first century competencies, all aspects of teaching and student learning should incorporate the components of active learning, critical thinking, and reflection. The instructional design process creates a framework to apply sound pedagogy and to develop quality curricula, activities, and learning experiences.²¹ Selection of technologies can then be made in the context of appropriate pedagogical principles and strategies. That pedagogy includes the development of well-defined learning outcomes, relevant learning exercises, multiple levels of reinforcement, and assessment methods to determine the level of learning.²² Student performance and learning are at their highest when the setting advances individual learning and accommodates diverse learning styles; establishes a supportive environment where students can readily seek help; provides opportunity to explore new information and build a knowledgebase; communicates individual usefulness and relevance; and creates a sustaining framework of concepts, processes, and strategies.²³ Once these elements become the focus and foundation of the student learning experience other aspects like learning outcomes can be developed.

Solid learning outcomes and competencies help guide the process of inclusion of these key elements. Well-written outcomes play a role in multiple aspects of building curriculum such as the establishment of the focus of what will be taught, the student learning experience, and a foundation for assessment. There are numerous guides and texts on how to write effective learning outcomes, but all rely on these foundational aspects: (1) goals and outcomes represent the broad picture of the instruction and (2) goals and outcomes focus on active and constructive processes, social interaction, collaborative learning, and problem solving. An effective way to develop robust and relevant outcomes is to create each in three parts:

- an action verb phrase [this describes what the learner will be doing]
- the connection phrase "in order to"
- an accomplishment/achievement phrase [this describes why the learner is engaged in the action].²⁴

The benefit of this formula is that it can be used for outcomes at the program, course, assignment, and activity levels. An example of an assignment outcome using this formula could be: Students will reflect on their interpretation of election political rhetoric in the form of a podcast or videocast to demonstrate their critical analysis and interpretation skills of contemporary commentary. Among the many steps in which program coordinators, department heads, and teaching librarians can engage to determine how to integrate twenty-first century learning into pedagogy, curricula, activities, and experiences, the key is to establish a process that addresses this type of outcome-based learning at all levels of the planning and student learning cycles.

2. What assessments for learning . . . foster student learning of outcomes, student engagement, and self-direction?

Some educators, despite increased institutional support, have a negative view of learning assessment tools and feel many are used just for the sake of assessing technology integration. Using inappropriate assessments can have a negative influence on the learning environment and ultimately may not provide rich, useful data. In the best circumstances, assessment has a positive influence on students' effort to learn content, demonstrate knowledge, and engage with their peers.²⁵ Assessment is valuable when it is: "redeemable, transparent, incremental, valid, authentic, demanding, reliable, timely, fair, efficient & manageable, equitable, and formative." Additionally, it should "motivate students to learn, promote deep learning, start as early as possible in a course or module, and enable the demonstration of the excellence."²⁶ Assessment is often categorized into three types: assessment for learning, assessment as learning, and assessment of learning; on occasion researchers and educators merge assessment as learning with assessment for learning. Assessment for learning is used to help instructors analyze the effectiveness of the various teaching and learning activities used. It helps them examine in what ways students are gaining specific knowledge and how they are applying this knowledge within the classroom. Assessment as learning puts the student in the center of the process to promote his or her metacognitive development. This type of assessment is often done by helping and guiding students through critical reflection and analysis of how and what they learn. Assessment of learning, often referred to as summative, focuses on determining what students have learned and how they demonstrate this knowledge. This also helps the instructor evaluate how students compare to each other.²⁷ It is important to remember that a combination of assessment types will ensure the most effective way to evaluate how and what students are learning.

Thoughtfully considering how assessment can enhance the student learning experience, in addition to helping gather quality data, is a core component of its use within the classroom. It is important to use learning outcomes as the foundation for the development of the assessments. Implementing a variety of ways to assess what and how students are learning provides a more robust analysis. Applying established methods for gauging the validity of the assessments ensures the gathering of quality data. Additionally, assessment is an ongoing process that should be adjusted as instructional content and teaching processes change.²⁸ Authentic assessment methods are an effective way to integrate assessment for learning and assessment as learning into a curriculum or course. This method targets the illustration of knowledge and skills in addition to application in a variety of scenarios. The characteristics of this method include six components. Quality authentic assessments: (1) have more than one correct approach; (2) are thought-provoking, not simply requiring recall of memorized facts; (3) require decision making, rather than just rote memorization; (4) develop thinking in a variety

of ways; (5) lead to other problems to be solved; and (6) raise other questions.²⁹ Examples would include problem-based learning, case studies, guided activities, or reflective journals. Classroom Assessment Techniques (CATs), such as One Minute Papers, Think/Pair/Share, or Polling, are another effective method for integration of assessment into a course.³⁰ For librarians teaching one-shot guest lectures CATs can prove to be a particularly effective way to assess student learning.

Having valid assessments is essential in determining whether or not students are learning what the established learning outcomes state they will learn. Data gathered from an invalid assessment, at the very least is wasted effort on the part of the instructor and students and, at the worst, may negatively affect students' final grades or take a course, program, or curriculum in a misguided direction. Some key steps to consider when validating an assessment are:

- clearly identify in what ways the assessment matches the content and competencies established by the learning outcomes;
- identify alternate scenarios that could influence how students demonstrate the behavior or complete the assessment, which might include taking into consideration student motivation, relevance to what is being learned, or equal access to specific tools; and
- establish what the assessment is supposed to do and what the data are expected to indicate. Then test it to ensure this is consistently the case.³¹

Developing and using valid assessment for library instruction and programming is particularly important because access to learners is often limited or short-lived. With increased pressure to show positive impact and value for efforts in the classroom, ability to provide a holistic picture of teaching efforts and student learning could be disrupted if data gathered is not valid.

3. How can technology support pedagogy, curricula, and assessments of a twenty-first-century collaborative learning environment?

Flexible technologies can enable the creation of multi-faceted learning environments that accommodate diverse learning preferences and cognitive processes. It is important to be mindful of the implications of technology use in the classroom on the ability of students to learn and process new knowledge. The abundance of learning style theories and models is recognition that individual preferences can affect how a student may function within a learning environment. While it is not prudent to state that learning styles alone should be the driver in how technologies are integrated, it is a component that needs to be considered. The basis for most learning style models is visual, auditory, and kinesthetic, with many being more intricate in how learning styles are defined and identified.³² A recent study in *Science* reported that students using technology in the classroom learn and retain

content twice as effectively as students who learned the content in lecture format alone.³³ Additionally, digital interactive tutorials often incorporate text, audio, visual, and hands-on components, making them ideal for accommodating diverse learning preferences.³⁴ Considering the cognitive process and learning styles preferences is significant because they affect how digital learning objects are designed, what technology should be used, and ways new information is presented to the learners. Regardless of the specific learning style theory or model, it is important to remember that how people learn is a driving factor in successful use and integration of any technology both in the classroom and personal life.

Even if students are immersed in technology outside the classroom, most do not expect the classroom environment to mirror their personal array of technology and many preferring moderate use of technology in their learning environments.³⁵ Instructors, therefore, must not assume the increased use of technology is necessarily better. For integrating technology, it is important to consider the function of a tool instead of merely the tool itself. For instance, instead of focusing on how to click through the interface of a specific database or search engine, concentrating on teaching the higher concepts of searching as a transferable function creates a more authentic experience. Using observation to monitor comprehension and provide point-of-need clarification is an excellent assessment for learning techniques. Another example is to teach students about effective communication techniques and methods and then use a social networking tool such as Twitter to apply or analyze use of (or lack of use) the concepts being taught.³⁶ Both of these examples align use of the tool to the concepts and theories being taught within the context of a course.

4. What physical learning environments (classroom, school, and real world) foster twenty-first-century student learning?

There is an increased discussion about what the modern or contemporary classroom should include to enhance the learning experience and to promote twenty-first century competencies. Many see the design of the space as a way to promote specific learning environments. For instance to promote individualized, focused learning, group work, and interactive projects, the learning space needs to include computer workstations, group discussion areas, and larger worktables or workbenches.³⁷ In a time when space is at a premium, a good design would create areas that are multifunctional and flexible. It is important to note that just because a learning space has high-end equipment and tools, it should not be assumed that students are actually acquiring twenty-first century competencies.³⁸ The structure and design of the programming and curriculum guide learning much more than the space or tools alone.

How the learning environment is designed to enhance information fluency can be based on several different learning theories such as constructivism, connectivism, situated learning, or full immersion. All of these theories are based

on the concept of learning by doing and experiencing, which resonates with today's learners who want to interact and connect with their professors, classmates, and learning environment.³⁹ While distance and online learning initiatives are expanding within traditional higher education institutions and are the preferred method of for-profit universities, they are only a small percentage of the overall number of learning environments, even though this is the environment where various technologies are expected to be utilized. Most faculty still teach in traditional classrooms. Even though this may still be the case, this does not preclude or prevent the use of technologies. Several faculty teach hybrid or blended learning courses that incorporate elements of both traditional and online learning. These environments are often "defined as the appropriate mix and use of face-to-face instructional methods and various learning technologies to support planned learning and foster subsequent learning outcomes."⁴⁰ A key component of having a successful hybrid learning environment is to consider what technologies are available within the institution as well as freely available on the web and then to identify how their core purpose or functionality matches the learning outcomes, integrates into activities or projects, and complements the type of assessments to be conducted. Being well aware of support structures such as a community of practice, campus IT workshops, webinars, and the like can aid in a smoother integration and implementation.

CONCLUSION

The impact on society of the Internet, wireless communication, and related technologies is immense; the level of integration into daily life appears to increase as rapidly as the development of new tools, mobile device apps, services, and platforms. Despite this trend, research continues to demonstrate that daily use of technology, including the Internet, does not guarantee advanced technological competency, or, more importantly, the critical analysis skills necessary to synthesize new information. The proliferation of digital information makes it increasingly important for every citizen to possess competencies for managing, integrating, creating, and communicating information, in addition to finding, using, and evaluating it. Higher education is poised to lead in this arena and extend its mission of lifelong learning into the digital twenty-first century.

Looking to the future, our focus needs to be on shaping students so they can adjust and integrate new technology into their lives while being cognizant of the primary or essential purpose.⁴¹ One way to achieve this is to shift from focusing on highly definable concrete skill sets and, instead, utilize techniques and methodologies that give students a high level of aptitude to interact fluently with both information and technology. Authentic twenty-first-century learning environment design can serve as a framework to support educators who seek to integrate technologies into their courses and curricula in effective, meaningful, and contextual ways. By considering

the particular functions of technology and relating those to specific learning outcomes, pedagogy, and assessment, educators can successfully create sound learning environments and activities to engage learners and support diverse learning styles and cognitive processes.

References and Notes

1. Jenifer S. Winter, "Fostering Information and Communication Technology Literacy: Insights from Telecommunications Services," *Journal on Excellence in College Teaching* 18, no. 1 (2007), 101.
2. Morley Winograd and Michael D. Hais, *Millennial Momentum: How a New Generation Is Remaking America* (New Brunswick, NJ: Rutgers University Press, 2011).
3. Larry Johnson, Samantha Adams, and Michele Cummins, *The Nmc Horizon Report: 2012 Higher Education Edition* (Austin, TX: The New Media Consortium, 2012).
4. Shannon D. Smith and Judith Borreson Carusco, "Key Findings: The ECAR Study of Undergraduate Students and Information Technology, 2010" (Boulder, CO: EDUCAUSE Center for Applied Research, 2010), accessed March 15, 2011, <http://net.educause.edu/ir/library/pdf/EKF/EKF1006.pdf>.
5. Douglas Fisher and Nancy Frey, "Preparing Students for Mastery of 21st Century Skills," in *21st Century Skills: Rethinking How Students Learn*, ed. James Bellanca and Ron Brandt (Bloomington, IN: Solution Tree, 2010), 225.
6. Ian Rowlands et al., "The Google Generation: The Information Behaviour of the Researcher of the Future," *Aslib Proceedings* 60, no. 4 (2008): 290; The British Library and JISC are currently conducting a three-year study on Generation Y doctoral students in attempt to better understand research behavior and challenge the assumptions about the tech-savviness of Generation Y students that have perpetuated within the literature. More information is available at www.researchersoftomorrow.net.
7. John Palfrey and Urs Gasser, *Born Digital: Understanding the First Generation of Digital Natives* (New York: Basic Books, 2008); The documentary film RIP: A Remix Manifesto provides a unique look at mashups, creative use of information, and the fine line between fair use and copyright infringement. More information about the film is at <http://ripremix.com>; the full movie is available via Hulu and iTunes.
8. Alison J. Head and Michael B. Eisenberg, *Truth Be Told: How College Students Evaluate and Use Information in the Digital Age*, progress report of Project Information Literacy (Seattle, WA: The University of Washington Information School, 2010).
9. Susan Choy, *Nontraditional Undergraduates* (Washington, DC: US Department of Education, National Center for Education Statistics, NCES 2002-012, 2002).
10. William J. Hussar and Tabitha M. Bailey, *Projections of Education Statistics to 2020* (Washington, DC: US Government Printing Office, NCES 2011-026, 2011).
11. Andrew S. Rash et al., "Non Traditional Students: Needs and Challenges," *The College Student Experience*, Paper 6 (2008), accessed September 27, 2011, <http://digitalcommons.wku.edu/cns/6>.
12. Jovita M. Ross-Gordon, "Research on Adult Learners: Supporting the Needs of a Student Population that Is No Longer Nontraditional," *Peer Review* 13, no. 1 (Winter 2011): 26–29.
13. "Information Fluency Definition," Associated Colleges of the South, accessed August 25, 2004, www.colleges.org/techcenter/if/if_definition.html.
14. For other more information about information fluency consult these resources: Beth Bloom, "IF=CCC: Information Fluency Is Now a Core Proficiency on Campus," *Climbing to New Heights* (Denver, CO: Special Libraries Association, 2007), accessed October 15, 2011, www.sla.org/pdfs/sla2007/bloominformation-fluency.pdf; University of Central Florida, "UCF Information Fluency Initiative," accessed October 15, 2011, <http://if.ucf.edu>; Susan Hagen, "Stages of Information Fluency from IF? To OK!" (ACS Information Fluency Symposium, Atlanta, GA, 2002), accessed August 25, 2004, www.colleges.org/techcenter/if/presentations/hagen_powerpt02.html; Michael Howser, "Improving the Quality of Student Research through Information Fluency" (AAC&U Student as Scholar Conference, Long Beach, CA, 2007), accessed October 15, 2011, www.aacu.org/meetings/undergraduate_research/documents/Miami.pdf; "Information Fluency Definition," Illinois State University Milner Library, accessed January 10, 2011, <http://library.illinoisstate.edu/library-information/about/departments/information-use-and-fluency/standards.php#IFdefine>; George Lorenzo, *Catalysts for Change: Information Fluency, Web 2.0, Library 2.0, and the New Education Culture* (Clarence Center, NY: Lorenzo Associates, 2007), accessed October 15, 2011, <http://edpath.com/images/IFReport2.pdf>; Jeffery Overholtzer, "Promoting Information Fluency," *EDUCAUSE Quarterly* no. 1 (2003), August 25, 2004, <http://net.educause.edu/ir/library/pdf/EQM0319.pdf>.
15. Maureen E. Wilson, "Teaching, Learning, and Millennial Students," *New Directions for Student Services* no. 106 (2004): 59–71; Chris Dede, "Planning for Neomillennial Learning Styles," *EDUCAUSE Quarterly* 28, no. 1 (2005): 7–12; Michael D. Coomes and Robert DeBard, "A Generational Approach to Understanding Students," *New Directions for Student Services* 2004, no. 106 (2004): 5–16.
16. Maureen E. Wilson, *Teaching, Learning, and Millennial Students*; Melinda Messineo and Ione Y. DeOllos, "Are We Assuming Too Much? Exploring Students' Perceptions of Their Computer Competence," *College Teaching* 53, no. 2 (2005); Mary Ann Bell, "Native Knowledge: Knowing What They Know-and Learning How to Teach Them the Rest," in *Dancing with Digital Natives: Staying in Step with the Generation That's Transforming the Way Business Is Done*, ed. Michelle Manafy and Heidi Gautschi (Medford, NJ: CyberAge Books, 2011), 351–72.
17. Qiyun Wang and Huay Lit Woo, "Systematic Planning for Ict Integration in Topic Learning," *Educational Technology & Society* 10, no. 1 (2007): 148–56.
18. Bob Pearlman, "Designing New Learning Environments to Support 21st Century Skills," in *21st Century Skills: Rethinking How Students Learn*, ed. James Bellanca and Ron Brandt (Bloomington, IN: Solution Tree, 2010), 122–23.
19. Shiang-Kwei Wang and Hui-Yin Hsu, "Using the Addie Model to Design Second Life Activities for Online Learners," *TechTrends* 53, no. 6 (2009).
20. Cameron Richards, "Towards an Integrated Framework for Designing Effective Ict-Supported Learning Environments: The Challenge to Better Link Technology and Pedagogy," *Technology, Pedagogy and Education* 15, no. 2 (2006): 239–55.
21. Several instructional design models have been created to specifically incorporate technology. Among these are the ASSURE model, ICARE model, eTIPS, and Wang and Woo. The foundation of all instructional design models is ADDIE, which provides a simple and straightforward framework for any type of curriculum development.
22. Kent L. Gustafson and Robert M. Branch. "What Is Instructional Design?" in *Trends and Issues in Instructional Design and Technology*, ed. R. A. Reiser and J. Dempsey (Columbus, OH: Merrill Prentice Hall, 2002), 17–25.
23. Joel Foreman, "Next-Generation: Educational Technology Versus the Lecture," *EDUCAUSE Review* (July/August 2003), accessed October 5, 2010, www.educause.edu/ir/library/pdf/ERM0340.pdf.
24. Deb Gilchrist is credited with developing this learning outcome formula for the Association of College and Research Libraries

- Information Literacy Immersion Program.
25. Filip Dochy et al., "Assessment Engineering: Breaking Down Barriers between Teaching and Learning, and Assessment," in *Rethinking Assessment in Higher Education: Learning for the Longer Term*, ed. David Boud and Nancy Falchikov (London: Routledge, 2007), 90–1.
 26. Phil Race, Sally Brown, and Brenda Smith, *500 Tips on Assessment* (London: RoutledgeFalmer, 2005), 2–4.
 27. "Rethinking Classroom Assessment with Purpose in Mind: Assessment for Learning, Assessment as Learning, Assessment of Learning" (Winnipeg, Manitoba Canada: Minister of Education, Citizenship and Youth, 2006), accessed January 13, 2012, www.edu.gov.mb.ca/ks4/assess/index.html.
 28. Linda Suskie, "Using Assessment Results to Inform Teaching Practice and Promote Lasting Learning," in *Assessment, Learning and Judgement in Higher Education*, ed. Gordon Joughin (Dordrecht, The Netherlands: Springer, 2009), 133–52.
 29. Robert Heinich et al., *Instructional Media and Technologies for Learning*, 7th ed. (Upper Saddle River, NJ: Merrill, 2002), 76.
 30. Carolyn J. Radcliff, *A Practical Guide to Information Literacy Assessment for Academic Librarians* (Westport, CT: Libraries Unlimited, 2007).
 31. Filip Dochy, "The Edumetric Quality of New Modes of Assessment: Some Issues and Projspects," in *Assessment, Learning and Judgement in Higher Education*, ed. Gordon Joughin (Dordrecht, The Netherlands: Springer, 2009), 85–114.
 32. For an excellent review of some of the most common learning style theories and models consult: Frank Coffield, et al., *Learning Styles and Pedagogy in Post-16 Learning: A Systematic and Critical Review* (London: Learning and Skills Research Centre, 2004), accessed August 22, 2013, <http://lenenlernen.nu/bronnen/Learning%20styles%20by%20Coffield%20e.a..pdf>.
 33. Louis Deslauriers, Ellen Schelew, and Carl Wieman, "Improved Learning in a Large-Enrollment Physics Class," *Science* 332, no. 6031 (2011): 862–64.
 34. Doris U. Bolliger and Supawan Supanakorn, "Learning Styles and Student Perceptions of the Use of Interactive Online Tutorials," *British Journal of Educational Technology* 42, no. 3 (2011): 470–81.
 35. Charles H. Becker, "Student Values and Research: Are Millennials Really Changing the Future of Reference and Research?" *Journal of Library Administration* 49, no. 4 (2009): 341–64; Robert B. Kvakik, "Convenience, Communications, and Control: How Students Use Technology," in *Educating the Net Generation*, ed. Diana G. Oblinger and James L. Oblinger (2005), accessed May 27, 2006, www.educause.edu/ir/library/pdf/pub7101g.pdf; Gregory R. Roberts et al., "Technology and Learning Expectations of the Net Generation," in *Educating the Net Generation*, ed. Diana G. Oblinger and James L. Oblinger (2005), accessed May 27, 2006, www.educause.edu/ir/library/pdf/pub7101c.pdf; Shannon D. Smith, Gail Salaway, and Judith Borreson Carusco, "The ECAR Study of Undergraduate Students and Information Technology," (Boulder, CO: EDUCAUSE Center for Applied Research, 2009), accessed September 23, 2011, <http://net.educause.edu/ir/library/pdf/ers0906/rs/ERS0906w.pdf>.
 36. Douglas Fisher and Nancy Frey, *Preparing Students for Mastery of 21st Century Skills*.
 37. Randall Fielding, "The Death of the Classroom Learning Cycles and Roger Schank," accessed October 5, 2011, www.designshare.com/index.php/articles/death-of-the-classroom.
 38. Ken Kay, "21st Century Skills: Why They Matter, What They Are, and How We Get There," in *21st Century Skills: Rethinking How Students Learn*, ed. James Bellanca and Ron Brandt (Bloomington, IN: Solution Tree Press, 2010).
 39. Roger McHaney, *The New Digital Shoreline: How Web 2.0 and Millennials Are Revolutionizing Higher Education* (Sterling, VA: Stylus, 2011); Dede, *Immersive Interfaces for Engagement and Learning*.
 40. Doo Hun Lim and Michael Lane Morris, "Learner and Instructional Factors Influencing Learning Outcomes within a Blended Learning Environment," *Educational Technology & Society* 12, no. 4 (2009): 282–93.
 41. Douglas Fisher and Nancy Frey, *Preparing Students for Mastery of 21st Century Skills*, 223.