

Digital Literacy and 21st-Century Success

In today's world, college/university graduates come into contact with a quickly evolving range of technologies and have access to a wealth of information. Students can be more successful after graduation if they are digitally literate—having learned how to identify and create digital solutions, adapt to new tools, and discover more effective and efficient ways of doing things in their fields. The use of technology has transformed every discipline and career, from engineers to doctors to politicians. Yet the traditional academic experience does not prepare many students for the challenges they'll face in these professions today. For instance, young campaign managers must be versed in tasks such as writing a blog and analyzing a social networking initiative, rather than just planning traditional stump speeches and campaign rallies.

This gap between employers' expectations and students' skills is demonstrated by disparities in perceptions of students' readiness to enter the workforce. In a recent study, when students were asked if they felt digitally prepared for work, 44 percent responded that they felt "well-prepared" or "very prepared." In contrast, only 18 percent of surveyed employers responded that students are prepared for entry-level

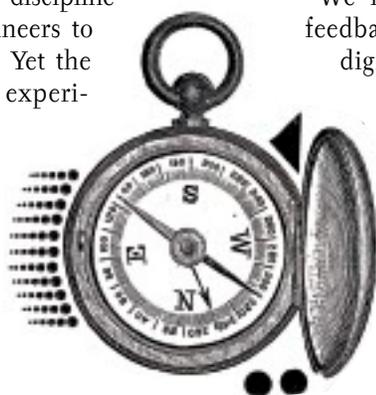
positions.¹ Additionally, employers often find digital tools more valuable than traditional tools in evaluating job applicants. In a Hart Research Associates study, employers found electronic portfolios significantly more useful than a college transcript in assessing whether students had the skills necessary to fill a position: 80 percent of employers found electronic portfolios fairly or very useful, but only 45 percent of employers found traditional college transcripts helpful.²

We have heard the same feedback about the value of digital skills to graduates directly from some major corporations. Jaime Casap, Google's Chief Educational Evangelist, told us: "Digital citizenship is the minimum requirement for the new economy. We need strong digital leaders!" Victor Montgomery, State Farm Business Analyst in charge of local recruitment in Atlanta, stated: "Digital literacy bridges the opportunity divide for students. With that in mind, we are looking for students that display initiative, innovation, and creativity while transforming the communities they live in."³

The need for students to learn digital literacy skills should not be surprising, given that this generation of students has known technology only from a consumer perspective. Whereas older tech-

nologists first experienced technology in the workplace and then found ways to merge technology into their personal lives, the current generation of students first experienced technology as a means of entertainment and social communication. Despite having grown up with access to an increasing amount of technology, students now need to learn how to use technology to solve problems in academic and professional settings. Historically, we in higher education have not readied students for this transition, even though students are increasingly asked to use technology in their learning experiences. Many students enter college having already used technology to complete academic assignments: 75 percent of high school students have accessed class information through an online portal, 52 percent have taken tests online, and 37 percent have used online textbooks.⁴

Learning to write, learning to think, and—these days—learning to form computational structures and to think digitally are requisites not only for employment but also for intellectual independence. Traditionally, the liberal arts have been about learning to think logically and to express ideas. The "liberal" in the liberal arts is about freedom. Some people have argued that widespread literacy (understood as reading at an eighth-grade level) was about making sure factory workers could read manuals well enough to keep machines running, rather than about providing for an informed citizenry. The equivalent for digital literacy would be to define it simply as being able to learn software quickly. Instead, digital literacy should be defined as knowing the effective practices suited to the dominant media. We should not teach students just the skills that will prepare them to follow instructions or quickly comprehend a user interface; instead we should aim to help students develop the expertise that will allow them to combine and create technologies to develop new and dynamic solutions. Just as traditional literacy and the liberal arts have



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been the key to independence since the advent of public schooling, digital literacy today is about intellectual freedom (see figure 1).

Many early digital literacy efforts in higher education focused on providing a single class that covered base-level skills, such as creating a PowerPoint presentation or spreadsheet. But what is truly needed in higher education today is integration of digital literacy throughout the curriculum, so that students are able to do the following:

1. *Find and vet information online.* In the digital world, being able to not only find information online but also determine its quality and validity is crucial.
2. *See problems from digital perspectives.* Students need to be able to analyze a problem and determine how to use digital tools to solve it. For example, can a problem be solved more quickly by creating a spreadsheet or by working the problem manually?
3. *Become self-directed learners.* The Internet has put all of the world's knowledge at our fingertips. Students should know how to take advantage of that availability of information to become lifelong learners.
4. *Obtain digital solutions.* Technology is constantly changing. Students must learn how to evaluate and buy the right digital tools to solve the problem at hand, rather than just relying on the tools they have used in the past.
5. *Learn software quickly.* Software is also always changing and improving, so students need to be able to quickly teach themselves new tools. For example, whereas being an expert in spreadsheets was an important quantitative skillset in the past, now it is increasingly important to be an expert in visualization tools such as Tableau.
6. *Design and create digital solutions.* Ultimately students should build a skillset that allows them to develop or customize their own digital tools.

FIGURE 1. Traditional Literacy vs. Digital Literacy

Traditional Literacy	Digital Literacy
Finding information	Vetting information
Reading (emersion)	Skimming (searching for solutions)
Note-taking	Curating
• transcribing	• linking
Prose composition	Multimodal composition
	• information design
	• data visualization
	• dynamic storytelling (video)
	• coding/programming
Static artifacts	Dynamic assets (multiple, diverse, reusable)
Learns from teachers	Teaches self
Permanence	Change

This does not necessarily mean that students need to be able to write their own applications from scratch. Rather, they should be comfortable customizing and combining tools to create a complete solution—for example, creating a web-form to automate the collection of customer evaluations and then outputting the results to a spreadsheet for analysis.



To understand the fundamental impact that digital literacy can have, we can look to history. Whenever the dominant medium of communication changes, controversy follows. When oral communication was replaced by written

literacy as the main means of recording and transferring knowledge—a transformation that took place over decades and at different rates in different places—Socrates was recorded to have complained: “No written discourse, whether in meter or in prose, deserves to be treated very seriously.”⁵ Socrates was concerned that transitioning from oral communication to written literacy would degrade people's intellect. If people learned by reading books, rather than by debating with their elders, they would replace a real education with a superficial likeness of one. They would have the appearance of learning because they could talk about all the things they had read, but they would be unable to think for themselves or even know they needed to, having become accustomed to simply looking things up in books and accepting what they read.

From today's perspective, Socrates' rejection of literacy seems irrational, yet echoes of the same argument are raised about information being found by searching the Internet rather than by combing through printed source materials. As we transition again, this time from written literacy to digital literacy, the fears that Socrates voiced are

resurfacing. We know the transition will be profound and we can't yet anticipate the consequences, so it's reasonable to be concerned. Resistance, however, is as futile now as it was in Socrates' day.

Designing Courses to Encourage Intellectual Independence

To address the value of digital experiences in providing a strong foundation for success, Georgia State University has launched a Digital Literacy Initiative.⁶ In the first phase of this initiative, we are incorporating digital literacy skills into our 2015–2016 Honors College freshman curriculum. This pilot program has worked with faculty who teach core courses, ranging from composition to calculus, to build digital literacy skills into their classes. In addition, the pilot provides students with a set of personalized learning tools that include lightweight personal computing devices, online portfolio-development tools, open-source electronic texts, and learning materials that interactively adapt to meet the learning needs of individual students.

An example of what can be done if we embrace digital literacy is how we have rethought and redesigned the Honors English Composition course. The course

examines how learning the art of rhetoric can introduce students to writing for the digital age. The course curriculum asks students to consider “the full stack”—not just the surface but also how the back end works. We are adding coding to reading and writing. The goal is to teach students how to think in digital ways in order to make informed technological decisions and even, in some cases, to develop their own technology as they gain intellectual independence.

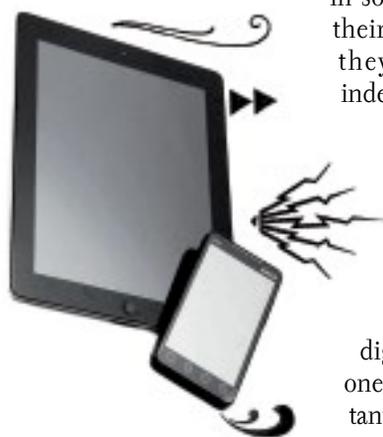
What do we mean by *intellectual independence* in this context?

Understanding publication options in today's digital environment is one example. An important goal for academics is to publish the results of their research in journals. Academics very often offer this work free of charge in order to reach a community of peers. Academic journals are typically published by a small, overworked, and largely volunteer staff. They survive on donations and departmental and college subsidies, generally selling the rights to the results of their labor to distribution houses. The distribution houses then sell the work back to the institutions and individuals who produced the work for free to begin with. In the digital age, when journals are distributed electronically and when resources

for professional printing are no longer needed, the distribution houses add little or no value. Slowly, libraries and journals are starting to break free of this model. In November 2015, for instance, the editors and editorial board members of *Lingua*, a linguistics journal, resigned.⁷ They then established *Glossa* (<http://www.glossa-journal.org/>), a new open-source linguistics journal. Given that the prestige of a journal is determined by the rigor of its peer-review process, a value added entirely by the academics working and networking among themselves, the primary reason for remaining indentured to distribution houses is lack of technical knowledge on the part of those running the journals. If the graduate students of today learn how to select and build their own content-management systems and digital networking tools, they can control production and distribution. They will then be free to create their own value and to share (or sell) that value as they see fit.

Digital literacy isn't just about economic freedom, however. Digital literacy enables forms of thinking that are not as readily enabled by traditional literacy. Without these forms of thinking and communicating, people are at a social and economic disadvantage. They are unable to think outside of the software they have memorized or to express themselves beyond the no-longer-relevant constraints of the printed page.

This is why learning to code is invaluable. Even at a basic level, coding helps a person develop critical thinking skills. In a deterministic system, like that of a computer, a single input leads to a single output: cause leads to effect. If you don't understand how something works, you can change one element and carefully observe the result. In addition, diagnostic thinking, which is critical thinking in deterministic settings, is an iterative process of hypothesize, test, refine, repeat. Given enough iterations, patience, focus, and discipline (changing only one variable at a time), a coder can start to build a mental model that



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solves a mystery or illuminates the black box behind how a system works.

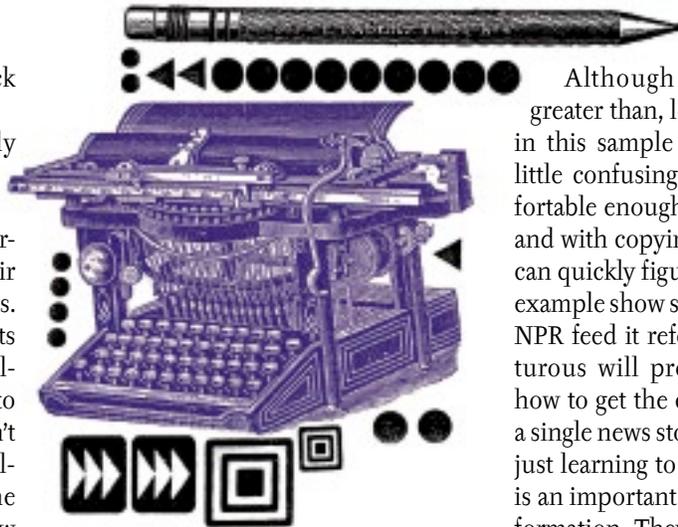
People who think diagnostically don't do the same thing over and over again while expecting different results each time. They don't jump to unwarranted opinions. They learn to test their beliefs and uncover their assumptions. In a computer coding setting, students can practice diagnostic thinking in a fail-fast way. Transference of these skills to more complex, real-world systems isn't guaranteed, of course, and most real-world problems aren't without some element of randomness. But given how common digital tools are, knowing how to diagnose and troubleshoot problems is a valuable skill on its own, and the practice offered is a great foundation for increasing a learner's digital literacy.

First Steps toward a Different Kind of Literacy

Nontechnical people tend to resist the idea of writing code, but we have found that some relatively simple pieces of code can interest people who are more excited by ideas than technicalities.

For example, many people of a certain generation are accustomed to reading the same newspaper every day. They like their news from "trusted sources." The digital, they feel, can't be trusted. But an emerging model of receiving news is through mobile apps such as Flipboard. These apps ask us what we want to see and then provide relevant stories, with results that are constantly refined and that are based on what we interact with and what we say we like. The goal of these apps is to make us happy, and their assumption is that our happiness is reflected in our "liking" what we read. So, our tool for acquiring information helps reaffirm our biases. We aren't being informed so much as we are being further convinced of our own current thinking. It's our passivity in the process, and our ignorance of code, that helps ill-inform us.

Telling nontechnical people that Really Simple Syndication (RSS) and the Extensible Markup Language (XML)



could liberate them from decisions made by their apps would likely cause their eyes to glaze over. RSS? XML? Alphabet soup. But if instead you give them a bit of code to copy-and-paste, code that requires very minimal modification to change what it displays, you may be able to push them gently toward liberation. For example:

```
<?
print "<a href='https://www.google.com/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=rss%20feeds'>Search for more rss feeds</a><br>";
$html = "";
//change url below to an rss feed of your choice.
$url = "http://www.npr.org/rss/rss.php?id=1032";
$xml = simplexml_load_file($url); for($i = 0;
$i < 1; $i++){ $title = $xml->channel->item[$i]->title; // change < 1 to 5 for 5 articles instead of 1
$link = $xml->channel->item[$i]->link;
$description = $xml->channel->item[$i]->description;
$pubDate = $xml->channel->item[$i]->pubDate;
$html .= "<a href='$link'><h3>$title</h3></a>";
$html .= "$description";
$html .= "<br />$pubDate<hr />";
}
echo $html;
?>
```

Although symbols such as the greater than, less than, and dollar sign in this sample script can at first be a little confusing, most people are comfortable enough with the idea of a URL and with copying-and-pasting that they can quickly figure out how to make this example show something other than the NPR feed it refers to. The more adventurous will pretty quickly figure out how to get the code to show more than a single news story. At this level, they are just learning to read code, but doing so is an important step in the digital transformation. They aren't afraid, and they aren't content with letting others do the work entirely for them.

Economy of Language and Code

Another example moves the new coder from reading to writing—or at least to modifying with more complexity. It also directly demonstrates that the values of digital literacy are entirely compatible with the values of traditional written literacy. New coders generally learn relatively early in the process to follow an "if, then" branching statement. If "a=value," then do the following. When they combine "if, then" statements, ever-lengthening code can allow for more complex combinations. For instance, consider the code for a slot machine. If "a=lemon" and "b=cherry" and "c=orange," then print that the user has lost because the values don't match, and so on for every possible winning and losing combination of a, b and c. Brutal. A simple "while" loop can do that same computing with much less code. A "while" loop more concisely says: continue automatically changing the values of a, b, and c until all three values match; when that happens print that the user won, otherwise print that the user lost.

The goal of understanding how to make code more efficient requires learning how to execute a loop. This might seem confusing at first for those with no programming experience, but with a bit of effort, and a few instructional hints, most people will get there

pretty quickly. The game-like emersion of hitting refresh and seeing nothing change, with the promise that when the learner gets the code right, the slot machine will spin, keeps most people focused on the task until the code works more efficiently.

This looping code can be used for more than just spinning fruit images on a slot machine. A coder could use images of food groups, for example, to create a game that randomly generates a recipe out of three lists of ingredients. Or a coder could create a list of pants, shirts, and accessories and then have the machine randomly generate outfits. With a little basic CSS and the right images, the coder could even have the machine put the outfit together as if on a person. None of this requires sophisticated coding or thinking. But it does require a kind of thinking that most humanities majors don't realize they can do because they are focused on static content—on cutting words for economy of language rather than code.

This example underscores the fact that economy of effort is a shared virtue. Whereas economy of code creates faster applications, economy of prose creates faster comprehension for the reader. If a writer can get an insight across by saying something unexpected but immediately understandable, the writer can generate delight and admiration. Most great writers, and all memorable writers, have many of these flashes of simple brilliance to offer. Consider Mark Twain's statement: "The difference between the *almost right* word and the *right* word is really a large matter—'tis the difference between the lightning-bug and the lightning."⁸

One important intellectual transformation that shifting from traditional written literacy to digital literacy requires is recognizing the difference between dynamic and static content. A key

element is automation. Something printed remains as it was forever, until it fades away. In a digital environment, by contrast, the writer can have words come and go in response to events, such as the passing of a certain date. The basic thought pattern is "if event," then print. Added to that might be a time limit: after event + X time, unprint. Some high-profile misprints of celebrity deaths have made it obvious that obituaries are written long before a celebrity dies. These days, just about the only thing that gets written on the fly is weather reports and sports scores. Everything else is written in advance and saved in a content management system for when its moment arrives. Students in our example composition course learn to understand this principle with a very simple PHP date function that allows them to release information for web publication when a certain date, such as Valentine's Day, arrives.

```
$valentines = date('m d');
if($valentines == '2 14'){
include ("origin_of_valentines_day.
php");
}
```

This may be trivial as code, but it is useful as an inducement to digital thinking and writing. What anticipated event

should trigger what message? The piece can be written over time and presented as a carefully crafted finished product when the appropriate moment triggers the machine to print it.

These few lines of readable code are enough to encourage writers to see code as adaptable, learnable, and even kind of interesting—or at least a fun challenge.⁹ Having come that far, students will soon start thinking about what things code can do that words on paper cannot.

Learning Digitally

Beyond the basic utility of knowing a bit about digital ways of thinking and communicating, learning to code provides students with another critically important learning opportunity. Because coding languages evolve and because there are many ways to do more or less the same thing, students have to learn how to learn online and how to teach themselves to become at least minimally capable with code. This means finding tutorials, breaking down complex problems into parts, seeking alternatives, and engaging with a community of like-minded learners. Being able to teach yourself is far more important than being learned because what we need to know changes constantly, what we know today may be useless five years from now, and what we know now



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may even get in the way of learning if we aren't flexible.

The days of specialization among professionals and businesspeople are long gone. If you can't do a great many different things, and a few of them at once, you will be unable to compete successfully. If you wanted to drive a taxi five years ago, you secured a class E license, and someone else took care of the car maintenance and insurance. All you had to do was drive. Today the "gig economy," which empowers workers to shift jobs throughout their career, has changed

all that. Now you are on the hook for all aspects of the business. You are the business, if not the profit center. *The specialist is dead. Long live the entrepreneur.* As a result, the entire definition of what it takes to be literate has changed.

Technology allows educators and students to more easily reach audiences outside of the college or university, to employ a variety of media in communication, to create simulations, and to access a host of other tools that would not have been as available before the rise of computing. The Digital Literacy Initiative that we are undertaking at Georgia State University challenges faculty members across core disciplines—including English, history, math, science, and art—to ask: "What is digital literacy?" They are considering this question within their own subject areas and creating assignments that allow their students to apply these skills to real-life situations so that the students can demonstrate to future employers an ability to solve problems using the full range of available tools.

Students constantly ask how to discover their best career options. Our answer? Focus on developing skills such as computational thinking, team building, adaptive communication skills, and algorithmic design—all key elements of digital literacy. Both the 21st-century economy and the careers needed to fuel it are changing at an unprecedented rate. Constant business process disruptions, powered by technology, are challenging companies to find employees with the skills needed to navigate the future. Students must be prepared for nonlinear careers, pivoting to match the ever-changing work landscape. At the end of the day, digital literacy is about solving the problems facing today's world. By incorporating digital literacy across core subjects, colleges and universities will prepare their students to live at the intersection of humanity and technology. ■

Notes

1. Internships.com, "New Skills Gap Survey Reveals Increasing Student Demand for Digital Skills, Employer Appetite for Tech Savvy Hires,"

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2. Hart Research Associates, *Falling Short? College Learning and Career Success* (Washington, DC: Association of American Colleges and Universities, 2015), p. 13, https://www.aacu.org/sites/default/files/files/LEAP/2015_employerstudentsurvey.pdf.
3. Jaime Casap, personal communication with the authors, October 8, 2015; Victor Montgomery, personal communication with the authors, October 2, 2015.
4. Project Tomorrow and Speak Up, "The New Digital Learning Playbook: Understanding the Spectrum of Students' Activities and Aspirations, 2014," p. 3, <http://www.tomorrow.org/speakup/pdfs/SU13StudentsReport.pdf>.
5. Plato, *Phaedrus*, 277c.
6. For more information, see the Honors Digital Literacy Initiative webpage: <http://technology.gsu.edu/technology-services/services-for-you/honors-digital-literacy-initiative>. We will be rolling the initiative out to additional colleges beginning in the fall of 2016.
7. Scott Jaschik, "Language of Protest," *Inside Higher Ed*, November 2, 2015, <https://www.insidehighered.com/news/2015/11/02/editors-and-editorial-board-quit-top-linguistics-journal-protest-subscription-fees>.
8. Mark Twain, letter to George Bainton, October 15, 1888, in George Bainton, *The Art of Authorship: Literary Reminiscences, Methods of Work, and Advice to Young Beginners, Personally Contributed by Leading Authors of the Day* (New York: D. Appleton and Company, 1890), 87–88.
9. For more code examples, see George Pullman, *Writing Online: Rhetoric for the Digital Age* (Indianapolis: Hackett Press, 2016).

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