Expanding the Digital Curriculum

How colleges are embedding high-tech skills to prepare students for tomorrow's jobs

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Expanding the Digital Curriculum

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Cover photo:
Students participate in an information-literacy class at Bryn Mawr College.

AARON WINDHORST

For today's students, simply knowing how to process words on a computer, manipulate video-game controls, and load a smartphone with apps no longer qualifies as digital literacy. To find jobs and succeed at them, college and industry leaders say, students require multifaceted knowledge of how the technology they use works, as well as an understanding of the full range of what they can do with it.

Alongside advances in artificial intelligence, machine learning, and other workplace tools, colleges and universities are beginning to form programs designed to ensure that every student has a chance to become digitally fluent. They are responding to calls from employers and students themselves by finding myriad ways to embed digital-skills training into undergraduate and continuing education.

Their efforts represent an emerging trend, though hardly a monolithic one. There is as wide a variety of approaches as there are colleges. In this report, we'll examine the different efforts to position digital-skills education within a wide range of existing courses and majors, what skills are being taught, and the stumbling blocks that colleges have navigated in putting these programs into effect. While the interviews for this report were conducted before the widespread outbreak of Covid-19 in the United States, the health emergency may have sped up some of the trends that are explored here.

Defining the Skills

The first step for colleges is figuring out what are the most relevant digital skills to teach. To do this, they must balance the interests of both students and employers. They'll also need to involve faculty members as well as outside experts to decide whether the skills as defined can fit neatly into a college education.
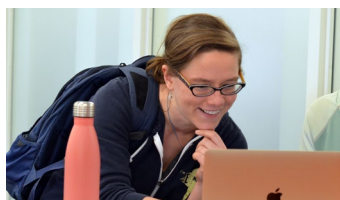
Inserting Training Into the Curriculum

Colleges have employed different strategies to impart tech skills to students. Some have decided to retrofit longstanding courses with digital elements. Others have created separate add-on credentials, while still others have focused on modules or programs that attempt to teach liberal-arts students a wide range of competencies, such as cybersecurity, data analysis, and digital research.

Emerging Challenges

As with all new ventures in higher education, programs designed to add digital elements to curricula have not always worked perfectly. Innovative efforts often need to be tested and tweaked to make sure they accomplish their goals. That is doubly so when it comes to teaching emerging technologies, which by their very nature continue to develop and change.

As colleges assess their place at the junction of education and the local and national economies, they are focusing more on how best to prepare students for jobs in a world that, by the minute, becomes increasingly driven by new technologies.

Though colleges have long thought of students as "digital natives" who glide through tech platforms like skaters across ice, many now recognize that the digital fluency of students is not deep enough for them to succeed in the workplace. To secure and prosper at jobs amid the rapid change, students must develop a richer understanding of how digital tools work, learn more about what they can do with them, and envision how those skills can be used in their chosen fields of study.

To get them there, a couple of dozen institutions around the nation have started programs that embed tech skills across majors or offer digital-training modules to every student.

Several factors drive such programs: Colleges' desire to remain relevant during a time of sweeping and continuing change, employers' needs for more digitally attuned and job-ready students, and students' worries that they may not find a good job after graduation.

The emergence of the coronavirus points up another aspect of making students more tech-savvy: Many more of them must now go through courses of study online, as most colleges have shut down their campuses.

To do what they can to help colleges make digital-skills training a focus, employers and regional business coalitions have begun to change their relationships with higher education. Employers are now seeking out long-term partnerships with higher-education institutions to train more of the skilled workers they will need. For their part, colleges are offering more opportunities for students to learn the skills that employers want.

Offering tech-centered education is good for business, some college officials say. By embracing a more holistic approach to digital learning, institutions hope not only to produce better-rounded and job-ready students but to make their degrees more valuable, therefore increasing the return on students' investment while making colleges themselves more competitive in a tough business environment.

Some college leaders have also cited a desire to maintain or enhance the crucial position many institutions hold as linchpins in their regional economies. Others have cited the need to educate students about the perils of the online world, including identity theft and a loss of privacy.

Above all, educators say, students need to prepare for an ever-changing future by learning how digital tools work.

> ## The digital fluency of students is not deep enough for them to succeed in the workplace.

"The notion of digital literacy isn't just about navigating platforms or building a web page," says Elizabeth Dillon, a professor of English at Northeastern University and co-director of its NULab for Texts, Maps, and Networks. "It's learning how a computer saves information, how we can crunch data and make visualizations of it. It's learning about the under-the-hood effects algorithms have on larger societal issues, such as bias and inequality."

Bryn Mawr students use a software program in a lab session for a multivariable calculus class.

Defining the Skills

As colleges think about forming digital-training programs, they must keep in mind the need to balance the desires of students and employers. They'll need to establish the role that faculty members and outside experts might play in developing courses, modules, or lessons. They must figure out a way to pay for course development. And they'll have to explore the best ways to measure whether students are learning the right skills.

Often determining the most relevant cyberskills to teach represents a program's first step.

Bryn Mawr College, a 1,700-student private institution in Pennsylvania, rolled out a new program four years ago in part to close the digital divide it saw among its students. At the time, many of them demonstrated a lack of basic digital proficiency, such as in how to use spreadsheet programs. Some students, including ones from other countries, lacked overall familiarity with digital devices. Recent graduates reported where their knowledge fell short once they had taken jobs.

The college has since focused on infusing intro-level general-education courses with digital material, with an eye toward updating how students conduct research in the liberal arts. To make sure all students, whether humanities majors or math majors, attain the fluency to work across a wide variety of digital platforms and programs, Bryn Mawr identified five key areas of focus, which range from data analysis and presentation to digital-survival skills to design.

"Amid all that, we bake in project man-

> "It's important for students to learn how they can go from having an idea to developing digital-design thinking to mobilizing a team, so they can realize their goal."

agement," says Gina Siesing, chief information officer and director of libraries. "It's important for students to learn how they can go from having an idea to developing digital-design thinking to mobilizing a team, so they can realize their goal."

All students are introduced to these concepts during a mandatory first-year course designed to help them thrive in college. As they progress through the curriculum, faculty members direct students to competencies they should focus on, based on their majors. For example, students in a physical-chemistry class write computer code to learn the amount of energy of certain molecules and which ones are most stable. In a quantum-mechanics class, students learn how to plug data into computer programs and then create meaningful visualizations of it.

The digital emphasis isn't limited to the classroom. Career and civic-engagement teams on campus find ways for students to practice their digital skills, including via internships at jobs on and off the campus. A library internship helps about 100 students per year learn how to do some computer programming and work digitally in groups.

Bryn Mawr's model has helped inspire several other liberal-arts colleges, including

> **Career and civic-engagement teams on campus find ways for students to practice their digital skills.**

Carleton and Davidson, to explore ways to improve their students' digital abilities.

Unlike colleges that have taken it upon themselves to develop ways to fold digital

Three Ways to Jump-Start Your Tech Curriculum

Colleges have taken a variety of approaches to embedding technology training and digital literacy in their academic programs. Here are three examples.

Embedding Skills Throughout

Four years ago, Bryn Mawr College began weaving digital training into its intro-level general education courses. The goal was twofold: give students instruction in how to work in a variety of platforms and programs, while showing them new ways to conduct research in the liberal arts.

The program has allowed Bryn Mawr to reach all 1,700 of its students. What's more, the initiative has branched out to include work outside the classroom, offering students several civic-engagement opportunities.

Linking Digital Studies With Majors

Some institutions have made a strong effort to apply digital learning to a student's course of study. Northeastern University offers an advanced digital-humanities course for students in its College of Social Sciences and Humanities, with the aim of giving liberal-arts majors fresh ideas on how to use computers to research their subjects.

In addition to offering all of its students opportunities to learn basic digital literacy, Keuka College focuses on offering experiences that students can apply to their majors. The result, faculty members say, are better-rounded students who are more ready for the job world.

Calling Out Existing Efforts

At the behest of regional employers, some institutions have begun to offer digital programs that aim to fill a technical-skills gap among graduates.

Sixteen institutions in the mid-Atlantic have signed on to create an undergraduate "digital credential" program developed with a group of corporations. The partnership, called the Capital CoLab, has worked to create a menu of digital offerings that students can take in order to show employers they have attained the digital knowledge employees need. Though the effort is young, employers and educators hope that students will be better positioned to take some of the 200,000 tech-related jobs that go unfilled in the region each year.

elements into their curricula, other institutions have counted on more direct guidance from employers. Several now offer add-on digital courses and programs.

Sixteen institutions have signed on to an undergraduate digital-credentialing program started by the Greater Washington Partnership, an economic-development group comprising around two dozen mid-Atlantic employers. The partnership has sought ways to bridge a skills gap that keeps 200,000 jobs — ones that include digital tasks — unfilled in the area each year. It started a working group called the Capital CoLab two years ago that includes college leaders in the region, from Baltimore to Richmond.

Six colleges have already unveiled their versions of a so-called generalist credential, aimed at non-STEM students, based on Capital CoLab's list of digital knowledge, skills, and abilities that future employees will need to exhibit upon graduation.

Even as they have consulted with regional companies, colleges have worked to maintain their independence as they devise digital-ed programs. "If we had given them a canned curriculum, they would have thrown it in the trash," says Jeanne Contardo, managing director of Capital CoLab. "Not to mention we'd lose out on the diversity and creativity in approaches that we're seeing."

Those approaches include offering microcredentials for learning specific digital tasks (such as at the University of Maryland at Baltimore County) to embedding a wide range of digital skills in a minor (Georgetown University) to expanding digital education within courses that already offer some of it (American University). All are open to students in any major. Students who take part can take advantage of some experiential-learning opportunities — job shadowing, mentoring, priority internships — offered by 11 of the partnership's employers to those who work toward the credential.

One of the partners, George Mason University, put together a five-course digital technology credential. The program includes two classes in statistics, and one each in cybersecurity, data analytics, and data visualization.

"We decided that, rather than creating a new curriculum, we'd map the skills to what industry says it wants," says Marc Austin, executive director of professional education and academic ventures. "We don't often get a chance to collaborate with industry like this. The guidelines are hugely important."

Marc Austin, executive director of professional education and academic ventures at George Mason U., helped work with industry partners to identify digital skills.

It's too early to add up how much digital learning is taking place. But some institutions have seen signs that students are getting something out of the new emphasis on integrating digital tech with liberal-arts programs. At Bryn Mawr, 73 percent of recent graduates said they had learned via digital experiences. A decade ago, only 15 percent did.

While much of the focus has been on job readiness, some educators say colleges keep in mind that honing digital talent can also lead to better research skills for students.

"We tend to think of digital literacy being solely in computer science. But to understand the world today, and to do research, even in the humanities, you need to understand the technology," says Elizabeth Dillon, at Northeastern. "What do humanities professors and students do when they research? They sit at their computers."

"To understand the world today, and to do research, even in the humanities, you need to understand the technology," says Elizabeth Dillon, an English professor at Northeastern U. who helps lead its NULab for Texts, Maps, and Networks.

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Inserting Digital Training Into the Curriculum

For more than a century, Northeastern University has worked with governments and industries in New England through its co-op program, which links students with experiential workplace opportunities in their chosen fields.

Last year the university's College of Social Sciences and Humanities decided to do more to prepare students for the digital age of work. Members of the Digital Integration Teaching Initiative (DITI) searched for ways to help faculty members integrate digital skills into their courses. Instead of creating new requirements or separate digital assignments, they work within the guidelines of existing courses to enhance them with digital content.

The initiative took three factors to heart:

the rapidly changing world of work, a reported deficit among surveyed recent grads regarding their tech skills, and a recognition among younger students that they need more digital acumen.

Instead of asking busy faculty members to create digital modules or to convert traditional assignments into ones based in tech, DITI hired three graduate assistants to reshape old lessons with new tools.

The program, begun last year, has become popular on campus. More than 400 students signed up last fall for 21 courses with digital content. This spring the number rose to 620 students in 32 courses. The initiative has worked with 16 academic departments or schools on campus, including economics, philosophy, and women's studies.

To engage such a wide range of students, DITI constructed what Dillon, the English

Sarah Connell is assistant director of Northeastern's NULab for Texts, Maps, and Networks, which is expanding digital education for students.

professor, calls "on ramps" to digital education — explanations of platforms and data analysis that students can get their heads around. Graduate assistants work to introduce digital material that fits each course's syllabus — and then scale up the degree of difficulty later in the course, or in higher-level courses.

"Building the scaffolding is the most important part," says Sarah Connell, assistant director of the NULab for Texts, Maps, and Networks, which leads the effort. "That includes developing assignments that allow students to learn chunks of information slowly."

The idea is to first build students' confidence. In one instance, English students were taught how to use a spreadsheet to

"These aren't huge digital challenges — they're basic literacy, but they give students a familiarity that will add up."

track all of the apps connected to their co-op experience. In another, they built a web page for their résumés.

"These aren't huge digital challenges —

they're basic literacy," says Dillon. "But they give students a familiarity that will add up."

More-advanced courses, like the digital-humanities course that Connell and Dillon co-teach, get students working on programming languages, basic code writing, and textual-analysis skills. They can digitally scan Shakespeare's works to find certain word combinations, or data-mine Twitter to detect language trends in tweets.

Key to the effort's success has been DITI's approach to faculty members, Dillon says. The program is voluntary, so faculty members have to sign off on adding digital education to their courses. "We let them know we're not trying to replace them," she says. "There's been a real appetite for this."

Other colleges have created new courses, with a goal of giving non-STEM majors experience in high-tech areas of study so that they develop job skills — communication and familiarity with how to use data — that might make them more marketable. Some institutions, including the University of Illinois at Urbana-Champaign, allow students from a wide variety of majors to take computer-programming classes.

A few institutions have allowed businesses to directly shape their digital training by offering them inroads into the curricula in exchange for the no-cost use of a particular product line. Three public universities in North Carolina — East Carolina, North Carolina at Chapel Hill, and Winston-Salem State — have signed deals to work directly with a multinational software company. Using its tools and guidance, educators teach students how to create multimedia presentations, videos, and visualizations of lab results that are relevant to their coursework.

Winston-Salem State, a historically black university, started threading digital skills throughout its courses in 2017. A year later, the state-university system agreed to the deal with the software provider. By

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adopting the company's products and then creating lessons around them in a required freshman writing course and two biology courses, Winston-Salem has been able to introduce about one-third of its 5,000 students to digital skills. The university hopes to roll out a second phase for its health-care students within the next two years.

A main benefit of the effort is that it helps close a socioeconomic gap. Many of the university's students and some faculty members lack the resources or skills to tackle digital media on their own, says Wanda White, director of the university's Center for Innovative and Transformative Instruction.

The "products are free, which is a big bonus for us," she says. "A lot of our students otherwise wouldn't have these tools."

Emerging Challenges

As with all first-time ventures, programs designed to add digital elements to courses and curricula have run into snags.

At Keuka College, a private liberal-arts institution in New York, a digital-learning program formed in 2014 offered comprehensive and high-level training. Campus officials reasoned that embedding skills within the curriculum would go farther in creating well-rounded students with job skills than opening a computer-sciences major would.

The program missed the mark. Faculty buy-in was spotty. Students came to the college with wildly varying levels of digital expertise, handicapping many of them.

The college, a pioneer in experiential learning, had started the program "to find our niche and differentiate ourselves a bit from other liberal-arts schools," says Tim Sellers, associate provost for academic innovation. "It worked to do that for a while, but we weren't filling that niche in the way we envisioned."

The program's shortcomings forced Keuka to take a step back and work on developing students' baseline skills. In 2018 the college switched to offering basic digital literacy, but with an applied aspect. Social-work majors now use digital tools to help clients schedule regular appointments. Occupational-therapy students develop ways to use their smartphones to measure a patient's range of motion, as well as create mini-apps to chart their progress.

Keuka still has some headaches, includ-

> "Students are interested and understand what is valuable, but they're conscious that they have limited time. We need to show them that if they do this, they'll get the bang for their buck."

ing human bandwidth. A lack of available outside experts and of professional support for digital education and technology infrastructure remains an issue, as it does at Bryn Mawr and elsewhere. Still, Keuka's new approach is a better fit, Sellers says. "We're finding some sense in infusing our general-ed courses with digital skills so they can trickle on up the curriculum."

Many digital-program leaders acknowledge that they are newly confronted with some old problems, including money. A lack of it keeps successful programs from scaling up and fresh ones from reaching all the stakeholders they need to establish themselves.

As Bryn Mawr has worked to weave data-science skills throughout more of its humanities courses, it has been forced to move more slowly. Like many colleges, it initially used foundation grants to start its program, money that has proven hard to replace. The college is looking at alternatives to rapid growth, including tucking parts of existing bioinformatics or physics courses within liberal-arts courses.

Students who lack money present another issue. Making sure that all students have access to digital hardware and software can become a financial burden, especially at institutions that serve a large number of financially needy students.

Colleges and universities that run embedded digital-ed programs also worry about whether they will reach enough students in the long term. Some, like George Mason, have sent student program ambassadors into classrooms to spread the word.

Another concern is whether students, time-strapped by classes, jobs, and studies, can fit additional digital training into their schedules. Stanford University was forced to break off a pilot degree program that combined liberal-arts skills with digital training after students found it so time-consuming that they couldn't pursue experiential-learning opportunities as well.

"Students are interested and understand what is valuable, but they're conscious that they have limited time," says MJ Bishop, director of the University of Maryland system's Center for Academic Innovation. Colleges may have to help them adjust their schedules to accommodate digital training. "We need to show them that if they do this, they'll get the bang for their buck," she says.

Mike Fasil, a George Mason student, will be among the university's first graduates awarded a generalist digital technology credential.

But the opportunities for institutions to grow and better fulfill their missions outweigh the stumbling blocks. Maintaining strong digital-skills programs that span the disciplines can be good for business.

"It's part of our regional growth plan to keep our students working in this region," says Jill Klein, interim dean of American University's School of Professional and Extended Studies. "Over time, we believe that the Capital CoLab employer partners may look to us to do the upskilling or reskilling training for their employees, many of whom were once our students, and who once took all those unfilled jobs."

Programs in higher education that infuse a wide range of traditional courses and curricula with digital elements are on the rise. Though new and still few in number, they have arisen in part to address long-standing concerns for colleges and universities: the ability to prepare students for the working world, a desire to enhance students' educational return on investment, and a need to remain relevant economically, intellectually, and pedagogically.

Rather than settle on one model, institutions have molded campuswide digital-skills initiatives around their own missions and the needs of employers and students. What they have in common is an emphasis on reaching students whose areas of study are not in the high-tech or STEM realm. By offering education to liberal-arts students on how digital applications, platforms, and programs work, and how they can most productively use them, colleges hope to broaden their education and make them more attractive to employers.

So far these efforts have focused on developing digital skills in cybersecurity, data analysis and visualization, digital research, the use of digital spreadsheets and other business-centric programs, and the creation of multimedia presentations, including podcasts and videos.

Programs either fold digital-skills training into existing courses, feature an "add-on" digital credential that is available to all students at an institution, or enroll liberal-arts students in digital STEM courses. Some programs rely on guidance from employers or tech companies — some more than others.

Institutions face some stumbling blocks, most notably funding, program design, varying interest among faculty members, and the tight schedules of students. But given the

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Like other institutions, Bryn Mawr College has woven data-science skills throughout many of its humanities courses.

need to remain relevant and to expand their programs, many college leaders see digital-skills training as something that needs to be done to ensure their success.

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