

What Do They Know? Digital Literacy Competencies of First-Year College Students

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Abstract

Many people assume today's college students, as digital natives, are digitally literate and prepared for the rigors of academic coursework, with no need for a basic "computers 101" college course. Many post-secondary faculty have experienced that this is not always true. Undertaken at a small New England institution considered a "business school" but also offering liberal arts degrees, this study sought to determine whether first-year college students are as digitally literate as many people assume they are by examining which digital skills and competencies students acquire before entering college, and if those skills are adequate to achieve academic success in college. To explore this, the following research questions were employed: RQ1) What digital devices are students using and with what frequency? RQ2) What digital literacy competencies (DLCs) do incoming first-year students possess? RQ3) How do first-year students self-rank their DLCs, and how does that compare to individual task self-ranking? RQ4) What DLCs do incoming first-year students perceive as the most important to know, and do they have those skills? Results showed that most K-12 students are learning on Macs or Chromebooks, using the Google Suite of applications. They may need to switch to Windows machines and/or Microsoft Office products upon entering college. Almost 16% reported taking no high school courses covering computer topics. On arrival at college, only 34% consider themselves "tech savvy" and most rank themselves at the beginner or intermediate level on DLCs. They believe the three most important skills to know are spreadsheets, programming, and word processing.

Keywords: Digital Literacy, Information Technology Literacy, Competencies, Digital Skills, First-Year College Students

1. INTRODUCTION

Most students entering 4-year colleges as first-year students are considered Generation Z, born from 1997 onward (Dimock, 2019). Technology has been ubiquitous in their lives - there has always been an Internet, a World Wide Web, smartphones, and WiFi. They have always had access to social media, on-demand entertainment, and virtual reality. They are

constantly connected via mobile technology, desire instant gratification, and expect immediate response time. According to the Pew Research Center (Dimock, 2019), 95% of teens have access to a smartphone, and 45% say they are online "almost constantly." Gen Z are also the first of the digital natives.

The term "digital natives" (Prensky, 2001) refers to "native speakers" of the digital language of

technology who have been surrounded by and immersed in technology since birth. This immersion infers that Gen Z are fluent in digital skills across a wide range of technologies and are proficient in creating and using digital content (Smith, Kahalke, & Judd, 2020). It is easy to assume that these digital natives “possess knowledge and skills that allow them to handle information and communication technologies (ICT) tools in a ‘natural’ way” (Sorgo, Bartol, Dolnicar and Podgornik, 2016). Yet access to these tools and technologies does not guarantee digital literacy.

Digital Literacy can be defined as “the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills” (Digital Literacy Task Force, 2013). It encompasses various competencies including basic computer skills, network literacy, digital problem solving, information literacy, and media literacy (Vanek, 2020).

Many people assume that because today’s college students are digital natives, they are digitally literate and perfectly prepared for the technological rigors of academic coursework; this implies that they do not need a basic “computers 101” course in college. Many post-secondary faculty have experienced that this is not always true. This study sought to determine whether first-year college students are as digitally literate as everyone assumes they are by examining which digital skills and competencies students have acquired before entering college, and if those skills are adequate to achieve academic success in college.

The following sections present a review of relevant literature, describe the methodology used, report the results, and discuss the implications of the findings. A review of the literature explores four main topics: digital native stereotypes; effects of the digital divide; digital literacy skills needed by college students to be academically successful (especially during a pandemic), and digital literacy vs. information technology literacy.

2. DIGITAL NATIVE STEREOTYPES

Much of the literature regarding digital natives references the highly-cited paper by Prensky (2001). He states that “the single biggest problem facing education today is that our Digital Immigrant instructors, who speak an outdated language (that of the pre-digital age), are struggling to teach a population that speaks an

entirely new language” (Prensky, 2001). He instigated a “digital native debate” as some educators and institutions panicked over revisiting curricula and increasing technology assets and resources while others advocated more investigation. Bennett, Maton, & Kervin argued that the debate was a form of “moral panic,” not “empirically and theoretically informed” (2008). Prensky’s paper is not research-based and includes no data or evidence to support his claims. Several studies have refuted Prensky’s claims (Evans & Robertson, 2020; Judd, 2018; Smith et al., 2020).

A quantitative study of Chinese teenagers (Li & Ranieri, 2010) shows that while the majority of the participants had personal computers and Internet access at home, their overall performance on an Instant Digital Competence Assessment was “pass”, not “good” or “excellent”. Results showed large disparities in participant digital competence. Another 2010 study (Kennedy, Judd, Dalgarno, & Waycott, 2010) showed that digital natives are not a homogenous group when it comes to digital competencies; through cluster analysis the researchers identified four distinct groups: power users, ordinary users, irregular users, and basic users.

In a 2016 study of Slovenian university students, Sorgo, Bartol, Dolnicar & Podgornik found that being a digital native did not predict information literacy (Sorgo et al., 2016). A 2018 literature review study revealed various definitions of digital natives “with no specific clarification or research-based rationale” and “little connection between a student’s age and digital skills and increased learning”. In addition, “much of the research suggests that students’ digital competence may be much lower” than that of their professors (Creighton, 2018). In addition, the concept of a “digital native” does not consider the many students of Gen Z age who lack the same technology knowledge and resources as their peers due to the digital divide.

3. DIGITAL DIVIDE

Developing digital literacy skills requires access to technological resources. Without appropriate technology, students cannot acquire the skills they need. The digital divide is not just the gap between those with and without Internet access. In addition to availability, other network inequities include quality of service, affordability, and skills necessary to obtain information (Parker, Santos, & Dancy, 2021). Hardware inequalities include aging and broken equipment

as well as limited access to computers and peripherals. Software inequity includes operating system chosen, versions of software used, and the ability to keep software up to date.

Many institutions put substantial resources into providing and upgrading technology, but not necessarily training students in how to best use that technology effectively. "The 'have nots' who, either by choice or circumstance, lack the skills and critical thinking needed to sort through the vast array of information, are excluded from fully participating in their education" (Andreae & Anderson 2012, p. 77) In fact, students who would fall under the digital native moniker "could be 'strangers' in the digital world as a result of disinterest, illiteracy, economic constraints, poor network connectivity, lack of electric power and inadequate practical accessibility" (Adjin-Tettey, 2020, p. 11).

A 2018 study of students at a minority-serving institution showed that they do not arrive at college with the technological skills required for academic success. Courses in computer applications showed efficacy at building those technical skills and were a positive experience for students, who believed the courses were "a necessary part of the college experience that benefits them academically and professionally" (Buzzetto-Hollywood, Wang, Elobeid, and Elobaid, 2018, p. 78).

Another 2018 study at a large Midwestern University in the US found that even with most students owning laptops and smartphones, a digital divide was experienced regarding consistent access to reliable technology. Approximately 20% of respondents experienced issues in accessing technology such as connectivity problems, unreliable hardware, data limits, etc. "Students of lower socioeconomic status and students of color disproportionately experienced hardships, and reliance on poorly functioning laptops was associated with lower grade point averages" (Gonzales, McCorry Calarco, & Lynch, 2020, p. 750).

Reliable computers and Internet connections are integral to accessing colleges' learning management systems. Yet a 2021 study showed that "trouble accessing the internet and connecting to coursework, reliance on tablets or mobile phones, and the need to share devices with others are all more common among students from low-income households and those who are Black or Latinx" (Parker et al., 2021, p. 9). The COVID-19 pandemic and the shift to emergency remote teaching made the digital divide more

obvious and the need for digital literacy skills more critical. A study by the Midwestern Education Compact (Jaggars Motz, Rivera, Heckler, Quick, Hance, and Karwisch, Jaggars et al., 2021) showed that inadequate technology resulted in students struggling with the switch to remote learning. Between 16% and 19% of college students reported barriers to online learning including inadequate hardware or Internet connections. The inequities of the digital divide impact low income, first-generation, and minority learners disproportionately, and are a "hindrance to student success" (Buzzetto-Hollywood et al., 2018, p. 77). Colleges must also address the needs of students with varying levels of digital literacy.

4. DIGITAL LITERACY AND INFORMATION TECHNOLOGY LITERACY

Digital Literacy

Digital literacy includes the knowledge and skill necessary to create, access, evaluate, use, and share digital information. It is not determined by age, because being able to use a particular technology does not guarantee the "critical thinking or other skills to understand the social implications or risks associated with its use" (Johnson, 2018).

While Gen Z regularly use social media applications (YouTube, Instagram, SnapChat, TikTok, etc.) for personal and recreational purposes, "research shows that young people are not as critically or technically skilled as they need to be in order to be effective digital citizens" (Talib, 2018, p. 56). The JISC (Joint Information Systems Committee) defines digital literacies as "those capabilities which fit an individual for living, learning and working in a digital society". Living, learning, and working in a digital society also involves applying digital literacy skills and using technology tools to solve problems and create solutions. In addition to digital literacy, the current economy requires students to have Information Technology (IT) literacy.

IT Literacy

Information Technology literacy goes beyond merely using tools and devices, but also requires the ability to do so effectively. Students must have a basic understanding of how their tools and devices work, and how they work together to build solutions.

IT literacy requires "an understanding of the tools technology provides ... and an understanding of the legal, social, economic and public policy issues that shape the development of the

infrastructure and the applications and use of the technologies” (Lynch, 1998). As digital tools are constantly evolving, students need a solid understanding of IT concepts to adapt to an ever-changing toolset. This understanding of fundamental technology concepts enables the transfer of skills from one context to another. For example, the student who knows how to write a formula in Google Sheets or format a document using Google Docs must be able to apply their conceptual knowledge when using Microsoft Excel or Microsoft Word. A student who is proficient in using a computer running macOS needs to be able to translate those skills to navigate a computer running Windows. Understanding fundamental technology concepts enables students to solve more complex problems with technology, to select the appropriate tools with which to build their solutions, and to be able to explain their choices and results to others.

Students must be creative thinkers, able to research information and apply their knowledge to new settings. Yet studies show that college students underestimate the importance of critical and computational thinking (Wing, 2006), demonstrating a deficiency when analyzing or navigating information (Andreae & Anderson, 2012). Students must learn and practice how to work together in teams using technologies and tools that they will encounter in the workplace and learn to use them responsibly.

5. METHODOLOGY

This descriptive research study sought to determine which digital skills and competencies first-year students acquire before entering college, and if those skills are adequate to achieve academic success in college. To explore this, the following research questions were employed:

- RQ1: What digital devices are incoming first-year students using and with what frequency?
- RQ2: What digital literacy competencies (DLCs) do incoming first-years possess?
- RQ3: How do incoming first-year students self-rank their DLCs, and how does that compare to individual task self-ranking?
- RQ4: What DLCs do incoming first-years perceive as the most important to know, and do they have those skills?

Participant Characteristics

Participating students completed this survey during the first three weeks of the Fall 2020 semester, as part of an “introduction to information technology” course. Demographic information collected from respondents is

summarized in Appendix A, Table 1 which includes the summary demographics for the sample (n=440) compared to those of the population (n=936) as provided by the University Factbook compiled by the Institutional Research department. The sample population is fairly descriptive of the actual population based on all categories.

Data Collection

To answer the research questions, the following information was sought:

- Demographics including age, gender, ethnicity, first-generation status, location of high school
- Hardware information including college and high school computers used, how often devices are used, which devices are used for which tasks
- High school information including IT topics learned as part of a course, programming languages studied
- Self-ranking of whether they consider themselves “tech-savvy”
- Self-ranking of DLC application tasks (word processing, spreadsheets, presentation software, databases, email, operating system, cloud storage, web browser, digital media, other tasks)
- The three most important tech skills that students feel they need for success in college and career

To obtain the required data, the authors created an online survey to send to first-year students.

Instrument

The survey (see Appendix B) was built in Qualtrics and was easy for respondents to use via computer or smartphone. Question types included multiple choice, multiple answer, open-ended, and scaled responses using Likert-type scales.

Non-demographic questions were reviewed by several IT professors and authors of IT textbooks to affirm the researcher’s beliefs of beginner, intermediate, and expert tasks were accurate. Digital Literacy Competency questions were created after reviewing the literature and standards created by JISC (2014), (IEEE 2021), and information literacy value rubrics by AACU (2013).

Sampling Procedures

After IRB approval, online surveys were distributed to all students enrolled in a required introductory IT course at Bentley University, a

small 4-year business university in New England in the Fall semester of 2020 (n = 608) during the first semester of fully online instruction due to COVID-19. Students self-selected into the survey by agreeing to participate (n = 565, 92.93%). Respondents received no remuneration for participation.

Researchers excluded 168 records: the 43 non-participants, 60 non-completed surveys, 43 of respondents less than 18 years of age (excluded due to IRB requirements), 4 non-first-year students, and 18 transfer students who took an IT course at a previous college (3 records fell in multiple excluded groups). The analysis proceeded with 440 records (47% of population).

Sample Size, Power, and Precision

With a population of 936, sample size calculations show that 273 or more completed surveys were required for a confidence level of 95% that the real value is within $\pm 5\%$ of the surveyed value. This study's sample size of 440 meant that there is a 95% chance that the real value is within $\pm 3.33\%$ of the surveyed value (*Sample Size Calculator*, n.d.).

Data Analysis

Data were downloaded in Excel format, uploaded into SPSS for analysis, and re-coded from text to numeric values as necessary. Measures included demographics; high school computer and course information; devices and apps used and frequency of use; self-rankings of various IT tasks; agree/disagree statements; beginner, intermediate, and expert tasks for each of nine applications (word processing, spreadsheets, presentations, databases, email, operating system, cloud storage, web browser, and digital media); and technology skills beliefs.

6. RESULTS

Demographic Data

Demographic variables were tested using Pearson's correlations against the "tech savvy" variable and students' self-ranking on eleven digital literacies. There were no significant correlations found.

RQ1: What digital devices are incoming first-year students using and with what frequency?

Most students (n=424, 96.36%) planned to use a laptop to attend online classes. They expected to log in to classes from their dorm room (n=327, 74.32%) or off-campus home (n=101, 22.95%), using wireless connections (n=396, 90.0%). The

majority (n=272, 61.81%) used a Windows computer, followed by those using a Mac (n=166, 37.72%).

In high school, the majority of students used a Mac (n=179, 40.68%), followed by a Chromebook (n=122, 27.73%), and a Windows machine (n=104, 23.64%). Most students used a home computer to complete homework (n=416, 95.55%), 18 (4.09%) used a computer in a lab at school, and 4 (0.90%) used a computer at a public library.

In college, Windows machines became the most used (n=269, 61.14%), followed by Mac (n=167, 37.95%). At college, the majority of students (n=203, 46.14%) purchased a computer on their own, followed by those who purchased through the school (n=166, 37.73%). Seventy students (15.90%) used a computer that they already had at home.

Many students (n=409, 92.95%) use an iPhone daily; 29 students (6.59%) use an Android or other smartphone daily. A majority of students use a laptop (n=420, 95.45%) daily. More than half rarely or never use other devices including smart watches (n=266, 60.45%), tablets (n=258, 58.64%), Raspberry Pis (n= 373, 84.77%), VR Headsets (n=365, 82.95%), or smart speakers (n=251, 57.05%).

Students overwhelmingly use mobile phones to send text messages (n=432, 98.18%), listen to music (n=423, 96.14%), take (n=430, 97.73%) and edit (n= 370, 84.09%) photos, and post to social media (n=420, 95.45%).

Laptop/Desktop computers are the device of choice for sending email (n=415, 94.32%), visiting websites (n=409, 92.95%), using a search engine (n=406, 92.27%), editing a document (n=430, 97.73%), and making online purchases (n=395, 89.77%). Students use both laptops/desktops (n=339, 77.04%) and mobile phones (n=330, 75.0%) to watch videos.

RQ2: What digital literacy competencies (DLCs) do incoming first-years possess?

To answer RQ2 students were asked which DLC topics were covered in courses they attended in high school. The results are shown in Table 1.

Sixty-nine students (15.68%) reported no computer topics learned in high school courses. For the 55 students who took programming, the top three languages were Java (n=30, 54.55%), JavaScript (n=21, 38.18%), and Python (n=14, 25.45%).

Topics Covered in High School Courses	<i>n</i>	%
Email	253	57.5
Using the WWW	169	38.41
Social Media	166	37.73
Spreadsheets	151	34.32
Presentation Software	135	30.68
Database Software	96	21.82
Digital Photography	90	20.45
Word Processing	74	16.82
Programming	55	12.5
Digital Video Production	50	11.36
Digital Audio Production	18	4.09

Table 1. Topics covered in high school courses taken

For social media apps, a majority of students use Instagram (n=282, 64.09%), Snapchat (n=309, 70.23%), and YouTube (n=141, 32.05%) multiple times a day. Fewer than 40% use Twitter (n=166, 37.73%). Most students never use LinkedIn (n=329, 74.77%) or Reddit (n=291, 66.14%). There was a fairly even split between students who never use TikTok (n=135, 30.68%) and those who use it multiple times a day (n=154, 35.00%).

RQ3: How do incoming first-year students self-rank their DLCs, and how does that compare to individual task self-ranking?

When asked to what extent they agree with the statement "I consider myself to be tech-savvy," 150 students (34.09%) agreed/strongly agreed; 165 were neutral (37.50%), and 115 disagreed/strongly disagreed (26.14%).

As shown in Table 2, most students ranked themselves as Beginner or Intermediate on all digital tasks before coming to college; web browsing was the only task where beginners, not experts, were the minority.

With most students self-ranking as Beginners or Intermediates, the knowledge of students in those categories was explored further. For six specific skills in each of the first nine digital literacy task categories, students ranked their knowledge of the skill as "don't know what it is", "heard of it, don't know how to do it", or "know how to do it". The skills list is provided in Appendix A, Table 2.

Combining the first two response options allowed comparison of how many students could not perform a task versus how many could. To answer the research question, the self-ranking (Beginner or Intermediate) for each of the nine digital literacy task categories was compared to the self-ranking of the two same-level tasks in the category to determine whether self-ranked beginners could complete the beginner level tasks and self-ranked intermediates could complete the intermediate level tasks.

For self-ranked Beginners, the majority could complete both beginner-level digital media editing tasks and one of the beginner-level database tasks as seen in Table 3.

For self-ranked Intermediates, the majority could complete all intermediate-level tasks in 4 of 6 categories, and only one intermediate-level task in Word Processing and Web Browsing as seen in Table 4.

Skill	Beginner		Intermediate		Expert		Total
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Word Processing	201	46.2	205	47.13	29	6.67	435
Spreadsheet Software	222	51.2	206	47.58	5	1.15	433
Presentation Software	177	40.88	226	52.19	30	6.93	433
Database Software	327	76.4	99	23.13	2	0.47	428
Email Software	112	25.75	251	57.70	72	16.5	435
Operating Systems	162	37.33	217	50.0	55	12.6	434
Cloud Storage	149	34.33	228	52.53	57	13.1	434
Web Browsers	90	20.79	225	51.96	11	27.2	433
Digital Media Editing	216	49.7	174	40.09	44	10.1	434
Online Collaboration	168	38.80	199	45.96	66	15.2	433
Online Calendar	204	46.9	183	42.07	48	11.0	435

Table 2. Self-ranking skills as beginner, intermediate, or expert.

Skill	Task	Beginners		Can		Cannot	
		<i>n</i>	<i>n</i>	%	<i>n</i>	%	
Spreadsheets	Create Chart	220	102	46.36	118	53.64	
	Sum a Range	221	46	20.81	175	79.19	
Databases	Create Table	324	158	48.77	166	51.23	
	Add Data to Table	323	191	59.13	132	40.87	
Digital Media Editing	Crop Photo	213	194	91.08	19	8.92	
	Flip Image	213	195	91.55	18	8.45	

Table 3. Self-ranked beginner knowledge of beginner tasks.

Skill	Task	Intermediates		Can		Cannot	
		<i>n</i>	<i>n</i>	%	<i>n</i>	%	
Word Processing	Add Page Numbers	205	184	89.8	21	10.24	
	Use Format Painter	205	47	22.9	158	77.07	
Presentation SW	Use a Theme	221	208	94.1	13	5.88	
	Change Layout	221	177	80.1	44	19.91	
Email	Add an Attachment	250	240	96.0	10	4.00	
	Reply All	250	201	80.4	49	19.60	
Operating System	Install/Uninstall	213	161	75.6	52	24.41	
	Backup Data	213	110	51.6	103	48.36	
Cloud Storage	Share Link	222	145	65.3	77	34.68	
	Collaboratively Edit	223	141	63.2	82	36.77	
Web Browser	Accept Cookies	222	155	69.8	67	30.18	
	View HTML Source	222	70	31.5	152	68.47	

Table 4. Self-ranked intermediate knowledge of intermediate tasks.

RQ4: What DLCs do incoming first-years perceive as the most important to know, and do they have those skills?

In an open-ended question, respondents were asked what three technology skills they thought were the most important to help prepare them for their college education and their future careers. Responses were loaded into a text analyzer (<https://www.online-utility.org/text/analyzer.jsp>) which provided a word count of each individual word (n=880). Words occurring less than 5 times were eliminated, as were extraneous words (articles, pronouns, adverbs, etc.) that did not reflect a digital literacy. The remaining 90 words were reviewed for similar meanings (e.g., "spreadsheet", "spreadsheets", "Excel") and combined where appropriate. The 10 highest word counts were: spreadsheets (n=291), programming (n=128), word processing (n=110), computer (n=103), security/privacy (n=96), email (n=87), presentations (n=81),

Microsoft/Windows (n=64), data/database (n=40), and web/websites (n=29).

7. DISCUSSION

We theorized that while the students surveyed fell into the age range of digital natives, not all arrived at college with the digital literacy skills necessary to succeed. This section provides further discussion of the research questions, suggests implications of these results for practice, and recognizes limitations of this study.

RQ1: What digital devices are incoming first-year students using and with what frequency?

As reported, the majority of students (n=272, 61.81%) are using a Windows computer in college, followed by those using a Mac (n=166, 37.72%). In high school, the majority of students used a Mac (n=179, 40.68%), followed by a Chromebook (n=122, 27.73%), and then Windows machines (n=104, 23.64%). So, three-

quarters of incoming first-year students used a non-Windows machine before college. The number of Mac users remained relatively the same between high school and college, which means Chromebook users switched to Windows machines for college. The digital divide is evident for any student switching to a machine running a different operating system than they are used to using. Chromebook users will not have experience with Windows OS and Office software. At this school, Macs need to access a remote server to run Windows versions of apps, forcing students to use different versions of software. In addition, many students used the Google suite of applications software in high school and are now expected to learn the Microsoft office "equivalents" for completing coursework.

Almost 90% of students planned to use wireless connections for online classes, which would prove to be an issue with Zoom when being required to turn cameras and mics on during classes. Where they got their computer could also have ramifications. The 70 (15.90%) students using a computer that they already had at home could have issues with up-to-date software, virus protection, slow speed, not enough RAM, etc. and in addition may need to share the computer with others in the household.

RQ2: What DLCs do incoming first-years possess?

Nearly 16% of students reported taking no computer-topic courses in high school. Various reasons could include courses not being offered, students not having room on their schedules, or schools not offering topics in which students are interested. High school students must research and write papers, prepare and give presentations, and email classmates and teachers. Many DLCs may be picked up in a "learn by doing" fashion without formal training, leaving gaps in knowledge and skills.

A majority of students report using Instagram (n=282, 64.09%), Snapchat (n=309, 70.23%), and YouTube (n=141, 32.05%) multiple times a day, which Pew Research Center (2018) reported as the most popular social media apps. Students' near-constant use of smart phones and social media requires "a knowledge of online social networks, how to learn from them and through them, and how to use them to access and disseminate information" (Vanek, n.d.). They are communicating and collaborating, but other DLCs will make a bigger contribution to academic success.

RQ3: How do incoming first-year students self-rank their DLCs, and how does that compare to individual task self-ranking?

The majority of students ranked themselves as Beginner or Intermediates in knowledge of the nine DLCs, corroborating findings of Kennedy et al. that students are not a homogenous group when it comes to digital literacies. Comparing the self-ranking with the same-level tasks in each category showed that in general, students were ranking themselves accurately. For the Beginner-level tasks, a slight majority (51.23%) could not accomplish the database task of creating a table. Only 21.82% covered databases in a high school course, and they may have been given completed tables to work with since the majority (59.13%) knew how to add data to an existing table. The majority of self-ranked beginners could not accomplish either of the spreadsheet tasks. This may also be due to limited exposure since only 151 (34.32%) of students took a high school course that covered spreadsheets. It is notable that both of these categories were listed in the top ten "most important things to know" results, spreadsheet at #1, and databases at #9. Corroborating Li & Ranieri, we found wide disparity in knowledge for some DLCs.

RQ4: What DLCs do incoming first-years perceive as the most important to know, and do they have those skills?

Of the 10 "most important to know" skills that students identified, 5 are pre-college digital literacy skills - spreadsheets (#1), word processing (#3), email (#6), presentations (#7), and databases (#9) - for which the majority of students ranked themselves as beginners or intermediates. Therefore, these are digital literacy skills in which they know they could become more proficient.

Programming and creating websites were ranked #2 and #10 respectively. As previously reported, only 12.5% of students have prior programming experience and only 14.1% have created a website. So, most students do not have these skills but recognize them as important to know.

Assuming that "computers/Mac/laptop" and "Microsoft/Windows" refer to learning more about their college computer, and perhaps a new operating system, this tracks with more than a third of students (n=162, 36.82%) self-ranking as beginners regarding their computer's operating system. Regarding security/privacy, 64% of students (n=282) agreed/strongly agreed that they were concerned about online privacy, and less than half (n=197, 44.77%) agreed/strongly agreed that they could explain

different ways to protect their systems and information from unethical users. The lack of/desire for knowledge of first-years in these DLCs has implications for colleges and their IT course offerings.

Limitations

The study occurred at one four-year institution which may affect the generalization of findings to a larger population and therefore the external validity. Since the institution is considered a "business school", it may attract significantly different students than would be found at a non-business-focused institution. Students self-selected to participate in the survey via a link in their course management system, after being informed about the survey by their instructor. The respondents could have been influenced by thinking the study was part of the course or required by the instructor. In addition, there is always a chance that self-reported answers are inaccurate or incomplete.

Conclusion

This study has shown that students may need to learn new hardware, software, and operating system skills when transitioning to college. With almost 16% of students reporting taking no high school courses covering computer topics, colleges cannot make assumptions about student digital literacy. Far from being technology experts, only 34% consider themselves "tech savvy" and most rank themselves at the beginner or intermediate level on DLCs. The digital native stereotype is harmful to students who due to various circumstances, including the digital divide, do not arrive at college with the digital literacy competencies needed to succeed academically. Many will need the scaffolding of a basic IT literacy course to ensure they are introduced to the skills and knowledge they will need to succeed in higher-level courses and persist to graduation. Institutions should capitalize on the fact that students believe spreadsheets, programming, and word processing skills are important to know for their college and professional success and ensure that these skills are offered formally via courses and supported with labs, tutoring, and other resources.

A near-term goal for future research is to replicate this study at different types of institutions (community colleges, large research institutions, etc.) to determine whether similar results are found. For example, unlike results from Buzzetto-Hollywood et al., this study

showed no significant correlation between demographic factors and DLCs; other researchers may find a link.

In conclusion, the DLCs students learn before college may not be the skills they need in college. They need IT courses to help them develop the digital literacies they are lacking and strengthen and improve the ones that they have. The goal should be to develop IT literacy – applying their DLCs to solve problems and create solutions.

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Appendix A. Tables

Demographic	Population	Sample
Number		
	936	440 (47.00%)
Age		
18-20	905 (96.69%)	432 (98.18%)
21 or over	1 (0.11%)	8 (01.82%)
Gender		
Female	368 (39.32%)	166 (37.72%)
Male	568 (60.68%)	273 (62.04%)
Prefer not to answer	n/a	1 (00.23%)
First generation?		
Yes	172 (18.38%)	49 (11.14%)
No	764 (81.62%)	391 (88.86%)

Demographic	Population	Sample
Ethnicity		
Nonresident Alien	104 (11.11%)	n/a
Black	39 (4.17%)	14 (3.18%)
Hispanic	101 (10.79%)	29 (6.59%)
Native American	3 (0.32%)	1 (0.25%)
Asian	84 (8.97%)	54 (12.27%)
White	563 (60.15%)	295 (67.05%)
Middle Eastern/North African	0	9 (2.05%)
Multiracial	35 (3.74%)	35 (7.95%)
Unknown	7 (0.75%)	3 (0.68%)
High School Location		
New England	557 (52.96%)	279 (63.41%)
Outside New England	258 (31.35%)	113 (25.68%)
Outside the U.S.	104 (14.72%)	47 (10.68%)
Unknown	17 (1.82%)	1 (00.23%)

Table 1. Population Demographics vs. Survey Respondent Demographics

DLC	Beginner	Intermediate	Expert
Word Processing	Format text using bold, underline, or different fonts and sizes to change the appearance of a document	Add a picture to a document	Perform a mail merge
	Add page numbers to a document	Use the format painter	Use the references feature to create a bibliography
Spreadsheet	Write a formula to calculate the sum of two numbers if they are equal, and calculate their product if not equal	Create a basic pie, line, or bar chart	Create a pivot table
	Write a formula to calculate the sum of a range of cells	Write formulas in excel using references such as \$A\$1	Write formulas to look up values in a table
Presentation Software	Use fonts and styles to change the appearance of a document	Modify a slide's background	Apply slide transitions and animations
	Insert shapes or images	Modify a slide's layout pattern	Apply a theme to your presentation
Database	Create a table to store data	Create a report	Relate information in two different tables
	Add data to a table	Add a primary key	Find records that match a specific condition (such as all employees from Connecticut)
Email	Send a message	Send a message with an attachment	Send a message encrypted for security
	Delete messages from your inbox	Reply to everyone who received a message	Organize messages in folders
Operating Systems	Create a new folder	See how much free storage remains on your hard drive	Zip or compress a file
	Copy a file from one folder to another	Install or uninstall a program	Back up files on your computer
Cloud Storage	Access your files in the cloud from your computer or mobile device	Upload your files to the cloud from your computer or mobile device	Share a link to a document stored in the cloud with someone else
	Edit a document stored in the cloud collaboratively at the same time as someone else	Specify folders on your computer to store on the cloud	Synchronize your files stored in the cloud across multiple devices
Web Browser	Bookmark a website	Accept cookies	View the HTML source code of a website
	Get directions using an online mapping service	Build a search query to limit search results using modifiers	Clear your browser's cache
Digital Media	Crop or resize a photo	Cut a section from a video clip	Publish a video to YouTube
	Flip or rotate an image	Add a title or credits to a video	Make a podcast

Table 2. Digital Competency Skills List

Appendix B. Survey Instrument

Willingness to Participate

You are invited to participate in a research study on the use of technology as it relates to IT education. You were selected as a possible participant because you are enrolled in IT 101. Please read this form and ask any questions you may have before agreeing to be in the study.

This study asks about your experiences learning about and using technology from high school to the present. If you agree to be in this study, you will be asked to answer several questions about your technology experiences. Your responses will be recorded and downloaded for analysis. The survey should take approximately 15 minutes to complete.

Click YES to participate. Click NO to withdraw from this survey.

- Yes I will participate
- No I will not participate

Skip To: End of Survey If Click YES to participate.

Demographics

In which section of IT 101 are you enrolled?

▼ Select Your Section and Instructor (drop-down list of sections and instructors)

From where do you plan to attend this class?

- my dorm room on campus
- my home or apartment off campus
- another location on campus

Which device do you plan to use most often to connect to your online classes?

- mobile phone
- laptop computer
- tablet
- desktop computer
- other (please specify) _____

Which best describes the Internet connection you plan to use most often to connect to your classes when joining them online?

- wireless
- wired connection
- cellular / mobile phone carrier
- I don't know
- other (please specify) _____

How old are you?

- Under 18
- 18-20
- 21 or over

Skip To: End of Survey If How old are you? = Under 18

With which gender identity do you most identify?

- female
- male
- transgender female
- transgender male
- gender variant/non-conforming
- other (please specify) _____
- prefer not to answer

What is your race or ethnicity (please select all that apply):

- White
- Hispanic, Latino, or Spanish origin
- Black or African American
- Asian or Asian Indian
- Native American or Alaska Native
- Middle Eastern or North African
- Native Hawaiian or Other Pacific Islander
- Another race, ethnicity or origin

Are you a:

- First-Year Student
- Second, Third, or Fourth-Year Student
- Transfer Student

Display This Question:

If Are you a: = Transfer Student

Did you take a technology class at your previous college?

- Yes
- No

Display This Question:

If Did you take a technology class at your previous college? = Yes

Did [college] accept credit for your technology course at a previous college?

- Yes
- No

The computer that you currently use for school is a:

- Mac
- Windows Computer
- Chromebook
- Other _____

The computer that you currently use here at college was:

- Purchased through college's program
- Purchased on my own
- One you had at home and/or used in High School

Where did you attend High School?

- New England (MA, NH, CT, RI, VT, ME)
- Elsewhere in the US
- Outside of the US

Are you the first person in your family to go to college?

- Yes
- No

High School Experience

Where would you most often use a computer when completing homework assignments in high school?

- A computer in a lab at school
- A computer at the public library
- A computer at home

Which of these topics, if any, did you learn as part of a course in high school?

- Programming
- Web Design / Making Websites
- Digital Photography
- Digital Video Production
- Digital audio production
- Computer Science
- Word Processing
- Spreadsheets
- Presentation Software
- Email
- Databases
- How to use the World Wide Web
- Social Media

Display This Question:

If Which of these topics, if any, did you learn as part of a course in high school? = Programming

Which programming languages or environments did you learn in high school? (Check all that apply)

- Alice
- Scratch
- Java
- JavaScript
- C or C#
- Python
- HTML
- Visual Basic
- Other _____

Which computer or device did you use most in high school?

- Google Chromebook (Desktop or Laptop)
- Windows Computer (Desktop or Laptop)
- Mac Computer (Desktop or Laptop)
- Linux Computer (Desktop or Laptop)
- iPad
- Android Tablet
- Other _____

Did you take an AP Computer Science Test?

- Yes
- No

Did you work or volunteer as a help desk, computer lab assistant, or technology tutor while in high school?

- Yes
- No

Your Current Use of Computers and Devices

How often do you use these devices?

	Rarely/Never	Weekly	Daily
Iphone	0	0	0
Android phone	0	0	0
Other mobile phone	0	0	0
Smart Watch	0	0	0
Ipad or Tablet	0	0	0
Raspberry Pi	0	0	0
Laptop	0	0	0
Gaming Device	0	0	0
VR Headset	0	0	0
Smart Speaker (Alexa/Google Home)	0	0	0

Which device(s) do you use to perform the following tasks?

	Laptop/Desktop	Tablet	Mobile Phone
Watch a video	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Send email	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Send a text message	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Visit websites	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use a search engine	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Edit a document	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Make an online purchase	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Listen to music	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Take a photo	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Edit a photo	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Post a photo to social media	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How often do you currently use the following social media apps?

	Once a day	Several times a day	One or a few times/week	One or a few times/month	I never use it
Facebook	0	0	0	0	0
Instagram	0	0	0	0	0
LinkedIn	0	0	0	0	0
Reddit	0	0	0	0	0
Snapchat	0	0	0	0	0
TikTok	0	0	0	0	0
Twitter	0	0	0	0	0
YouTube	0	0	0	0	0

Your Tech Skills

Keep up the good work! You're about half-way there! This section has 11 questions related to tasks you might know how to complete with various software applications.

Rate your ability to use each of these applications before you came to college.

	Beginner	Intermediate	Expert
Word Processing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Spreadsheets	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Presentation Software	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Database Software	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Email Software	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your computer's operating system (Windows or Mac OS)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cloud Storage (Google Drive, Dropbox, OneDrive, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Web Browsers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Digital Media Editing (photos, videos, music)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Online and Social Collaboration	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Online calendar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your ability to perform these word processing tasks before you came to college.

	Don't know what this is	Heard of it, but don't know how to do it	Know how to do it
Format text using bold, underline, or different fonts and sizes to change the appearance of a document	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Add page numbers to a document	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Perform a mail merge	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Use the references feature to create a bibliography	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Add a picture to a document	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Use the format painter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your ability to perform these spreadsheet tasks before you came to college.

	Don't know what this is	Heard of it, but don't know how to do it	Know how to do it
Create a basic pie, line, or bar chart	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Write formulas in excel using references such as \$A\$1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Create a pivot table	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Write formulas to look up values in a table	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Write a formula to calculate the sum of two numbers if they are equal, and calculate their product if not equal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Write a formula to calculate the sum of a range of cells	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your ability to perform these presentation software tasks before you came to college.

	Don't know what this is	Heard of it, but don't know how to do it	Know how to do it
Use fonts and styles to change the appearance of a slide	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Modify a slide's background	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Apply slide transitions and animations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Apply a theme to your presentation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Insert shapes or images	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Modify a slide's layout pattern	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your ability to perform these database tasks before you came to college.

	Don't know what this is	Heard of it, but don't know how to do it	Know how to do it
Create a table to store data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Add data to a table	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Create a report	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Add a primary key	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Relate information in two different tables	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Find records that match a specific condition (such as all employees from Connecticut)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your ability to perform these e-mail tasks before you came to college.

	Don't know what this is	Heard of it, but don't know how to do it	Know how to do it
Send a message	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Send a message with an attachment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Send a message encrypted for security	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Organize messages in folders	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reply to everyone who received a message	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Delete messages from your inbox	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your ability to perform these operating system tasks before you came to college.

	Don't know what this is	Heard of it, but don't know how to do it	Know how to do it
Create a new folder	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Zip or compress a file	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
See how much free storage remains on your hard drive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Install or uninstall a program	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Copy a file from one folder to another	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Back up files on your computer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Rate your ability to perform these cloud storage service (such as OneDrive, Google Drive, or Dropbox) tasks before you came to college.

	Don't know what this is	Heard of it, but don't know how to do it	Know how to do it
Upload your files to the cloud from your computer or mobile device	0	0	0
Access your files in the cloud from your computer or mobile device	0	0	0
Share a link to a document stored in the cloud with someone else	0	0	0
Synchronize your files stored in the cloud across multiple devices	0	0	0
Edit a document stored in the cloud collaboratively at the same time as someone else	0	0	0
Specify folders on your computer to store on the cloud	0	0	0

Rate your ability to perform these web browser tasks before you came to college.

	Don't know what this is	Heard of it, but don't know how to do it	Know how to do it
Accept cookies	0	0	0
Bookmark a website	0	0	0
View HTML source code of a website	0	0	0
Clear your browser's cache	0	0	0
Build a search query to limit search results using modifiers	0	0	0
Get directions using an online mapping service	0	0	0

Rate your ability to perform these digital media tasks before you came to college.

	Don't know what this is	Heard of it, but don't know how to do it	Know how to do it
Crop or resize a photo	0	0	0
Cut a section from a video clip	0	0	0
Flip or rotate an image	0	0	0
Add a title or credits to a video	0	0	0
Publish a video to YouTube	0	0	0
Make a podcast	0	0	0

Rate your ability to perform these social media tasks before you came to college.

	Don't know what this is	Heard of it, but don't know how to do it	Know how to do it
Write a post to a blog or social media site	0	0	0
Set up a blog or website using a content management tool	0	0	0
Write a comment on a blog or social media post	0	0	0
Make a video call or participate in a video conference	0	0	0
Create an appointment on an online calendar	0	0	0
Specify which friends or groups of friends can see your posts to Facebook	0	0	0

Important to Know

Two more questions to go!

To what extent do you agree with each of these statements?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Coding is a valuable skill to have.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am concerned about my privacy online.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would like to build mobile apps.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I consider myself to be tech-savvy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I understand how technology works and know how to use it responsibly.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can explain good practices for selecting a strong password for my accounts online.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can explain different ways to protect my technology systems and information from unethical users.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can explain basic practices that contribute to a website's accessibility to people with disabilities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What three technology skills do you think are the most important that will help prepare you for your college education then into your future career?
