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ECAR Study of Undergraduate Students and Information Technology, 2016

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Contents

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Citation

D. Christopher Brooks. *ECAR Study of Undergraduate Students and Information Technology, 2016*. Research report. Louisville, CO: ECAR, October 2016.

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Introduction

The EDUCAUSE Center for Analysis and Research (ECAR) has conducted research on undergraduate students and information technology since 2004. Given that undergraduate students are higher education IT organizations' largest and arguably most important group of end users, understanding what they think about technology and how they use it is mission critical. Beyond IT organizations, instructors would be well served to better understand student experiences and expectations for using digital technologies for their academic work.

This installment of the ECAR study of undergraduate students and information technology is organized in a manner that makes the case for putting the student at the center of technology projects, policies, and pedagogies. We begin the report with a consideration of **the importance of technology to students,** whereby we explore students' orientation toward technology, the number and types of devices students own, and the extent to which they use their digital devices in their academic work, as well as the importance of that use. We then explore **the technology experiences of students** by considering their overall technology background, their ratings of campus wireless networks, and their impressions of faculty technology use. Next, we analyze **the technology preferences of students,** including learning environments and how they relate to technology in college. We conclude the report by exploring **the effects of technology on students** in terms of three types of engagement—student-faculty, student-student, and student-content—discussing ways in which technology enriches their learning experiences, affects their levels of academic efficacy, and distracts them during class.

In the 13th year of this research, 71,641 respondents from 183 institutions in 12 countries and 37 U.S. states participated in the research (see figure 1). The overall response rate was 7% of the population surveyed, a rate comparable to that of similar online surveys. The quantitative findings in this report were developed using a representative sample of 10,000 survey respondents from students at U.S. institutions. The large number of survey respondents yielded a 1% margin of error and allows us to make generalized statements about the findings.

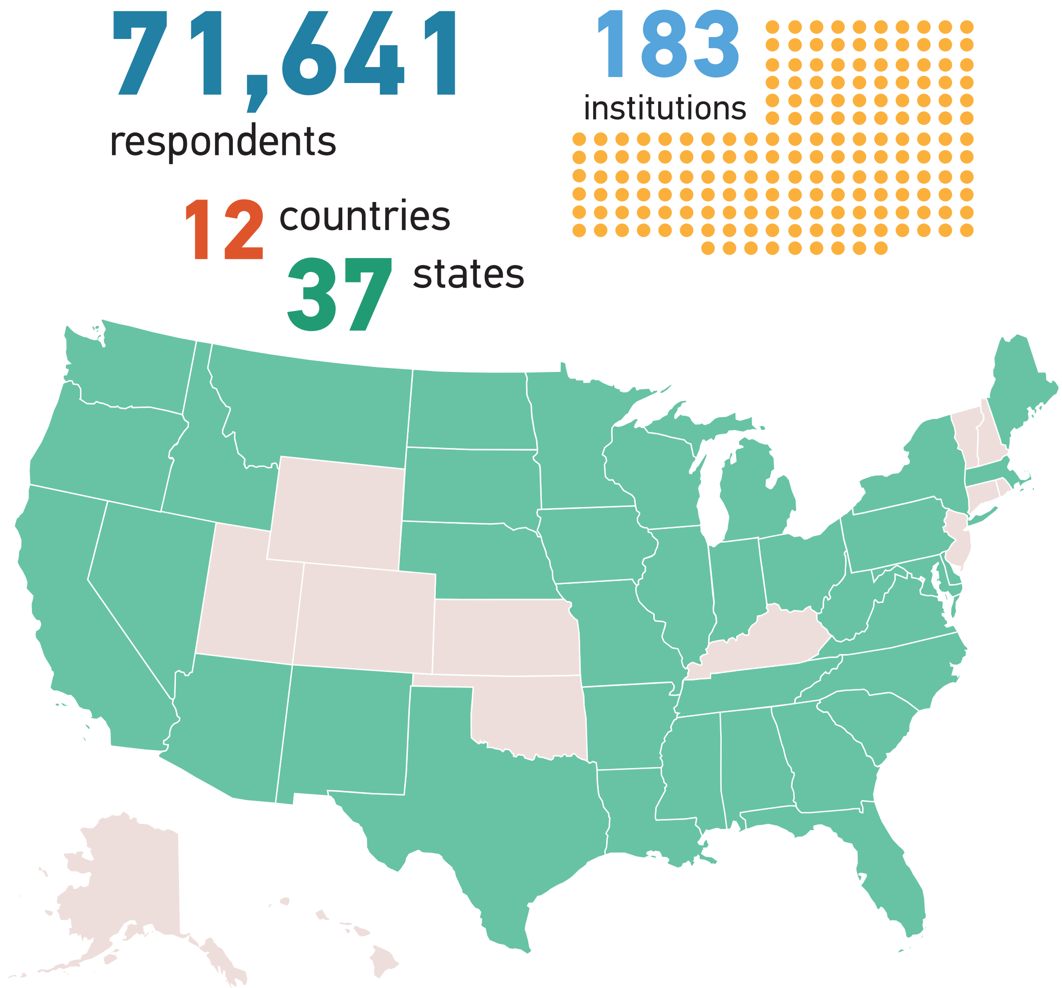

Figure 1. Student study participation overview

Key Findings

The Importance of Technology to Students

- **Students have strong positive orientations toward technology and own a lot of digital devices.** Student scores on our measures of technology disposition, attitude, and usage were the highest since we began collecting these data in 2014. Almost all students own a laptop or a smartphone; virtually no students own only a tablet.
- **Student ownership of digital devices continues to grow despite approaching market saturation for laptops and smartphones.** From 2015 to 2016, smartphone ownership increased from 92% to 96% and laptop ownership rose from 91% to 93%. Tablet ownership continues to level off, but wearable technology ownership more than doubled in the past year.
- **Device ownership is greater among students than the general public.** Over half of students own a laptop, a tablet, and a smartphone, compared with only a third of the American public. Only 1% of students do not own any devices, while 16% of U.S. adults report having no digital devices.
- **Students use their devices extensively and view them as important to their academic success.** Laptops continue to be the academic workhorse for students. Academic usage of smartphones by students increased by 9 percentage points since 2015, but tablet usage continues to decline.

The Technology Experiences of Students

- **A majority of students reported favorable experiences with campus wireless networks.** Two-thirds or more rated the reliability of access to Wi-Fi in campus libraries and classroom/instructional spaces—as well as the ease of logging in to Wi-Fi networks—as good to excellent. Network performance and the reliability of access to Wi-Fi in student housing and dormitories have the greatest opportunity for improved connectivity experiences.
- **Students believe that a majority of their instructors have technology skills adequate for course instruction, use technology in basic ways to connect to learning materials, and encourage the use of online collaborative tools.** About half of students said a majority of their instructors are using technology for more complicated student outcomes such as stimulating critical and creative thinking or maintaining student attention.

- **Students' technology experiences are a function of their encounters with campus infrastructure and their beliefs and attitudes about technology's use.** In addition to infrastructural considerations (i.e., reliability of Wi-Fi, network performance), students' technology experiences are shaped by their perceptions of the adequacy of their instructors' technology skills, their attitudes toward technology, and their belief that technology used in class will benefit them in their chosen careers.

The Technology Preferences of Students

- **Students' choices for the type of learning environment in which they claim to learn the most have remained remarkably stable over the past several years.** An absolute majority of students said they prefer courses that have some blended aspect to their design. Only 10% of students prefer entirely face-to-face courses, and 7% prefer fully online.
- **Students' current preferences for different types of learning environments tend to be shaped, in part, by the types of courses they have taken.** Those who have taken courses with more online components prefer courses with more online components; those who have taken courses with more face-to-face components prefer that modality in which to learn.
- **Students see many benefits of technology but are wary of the threats to their privacy.** Students view technology 1) as something that enables them to engage content in less traditional ways, 2) as a set of skills or literacies they are expected to possess in order to succeed, 3) as something that excites or empowers them to learn, and 4) ambivalently as a potential threat to their privacy.

The Effects of Technology on Students

- **Female and first-generation students are significantly more likely to have their levels of engagement, enrichment, and efficacy raised by technology.** Both groups view technology as a tool by which they might be able to improve their respective positions and overcome structural or institutional disadvantages.
- **Students who perceive technology to increase their engagement with other students and who are encouraged to use devices during class to deepen learning are significantly more likely to be distracted.** However, we do not think this means that instructors need to avoid technology-based

activities that encourage student-student interaction. Research on the importance of different modalities of engagement in digital environments suggests that the student-student interactions that are a source of distraction are also the sources of some of the most important forms of engagement for learning.

- **Students who were prepared to use basic software applications when they started college and who reported being adequately prepared to use the technologies employed in their classrooms are significantly less likely to be distracted.** Colleges and universities may be able to reduce the impact of digital distractions by providing better and/or more technology training on basic software applications; on specialized applications used on campus and/or in students' declared major(s); and on technology ethics, etiquette, and security.

The Importance of Technology to Students

American college and university students love their technology. Technology is interwoven into the fabric of modern society, and undergraduates are exceptional in their adoption of the technologies of the digital world. Those who embrace technology, by way of ownership and use, tend to own/use a lot of it. More importantly, students view it as critical to their learning experiences. In this section, we establish the importance of technology to students by offering evidence in support of these claims.

Student Technology Orientation

In its yearly survey on information technology, ECAR asked students to place themselves on a series of 100-point scales related to their technology disposition, attitude, and usage patterns (see appendix B). Students continue to consider themselves to be fairly sophisticated and engaged with technology, with the average scores of disposition (66), attitude (75), and usage (75) all significantly above the neutral position (50) on our scales (see figure 2). With the 2016 data, we also observe a modest positive trend in each of our measures of student "techie-ness."

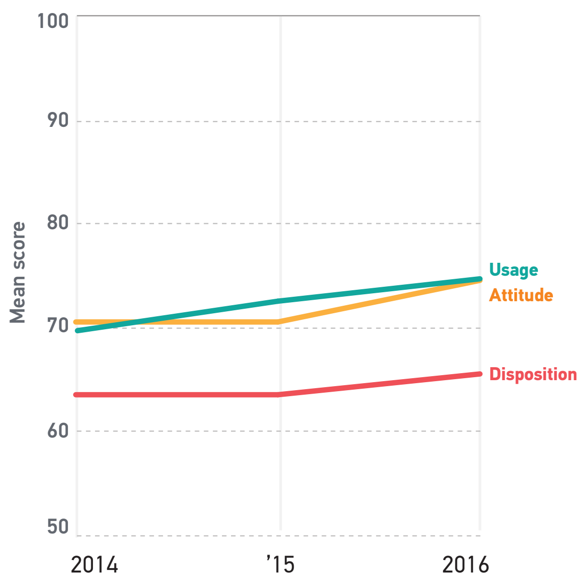

Figure 2. Mean scores of student semantic differential toward technology

Bivariate analysis of these constructs reveals some interesting patterns. First, women reported significantly lower levels of technology disposition and attitude than men and rated themselves lower on technology usage than men. Second, both black/African American and Hispanic students have significantly more positive dispositions and attitudes than whites and reported using technology more heavily than whites. We know that some minorities (blacks and Hispanics) use mobile devices more for a host of activities including the consumption of educational content[1] and may view online environments as opportunities to overcome traditional barriers of race. This may explain, in part, why they display more positive technology dispositions and attitudes than whites.[2]

Third, full-time and on-campus students reported significantly lower technology dispositions, attitudes, and usage patterns than part-time and off-campus students, respectively. Fourth, students enrolled at private BA institutions in our sample tended to rate themselves lower in terms of disposition, attitude, and usage patterns than students at a number of other institution types. Community college students tended to report more positive attitudes and more frequent use of technology than students at some other institutions.[3]

Student Device Ownership

For some technologies, student ownership is continuing to grow despite approaching complete market saturation (see figure 3). From 2015 to 2016, smartphone ownership increased from 92% to 96%; in other words, half of the students who did not own a smartphone in 2015 now do. The modest increase in laptop ownership from 91% to 93% since last year represents a one-fifth reduction in the number of students who did not own laptops last year. Although 57% of students reported owning tablets in 2016, tablet ownership appears to be growing more slowly in recent years; only 5% of students expressed an intention to purchase a tablet in the next year. Indeed, tablet sales in general have fallen off in 2016.[4] Notably, student ownership of wearable technologies (fitness devices, headsets, and smartwatches) has increased to 29%, an increase of approximately 150% since 2015.

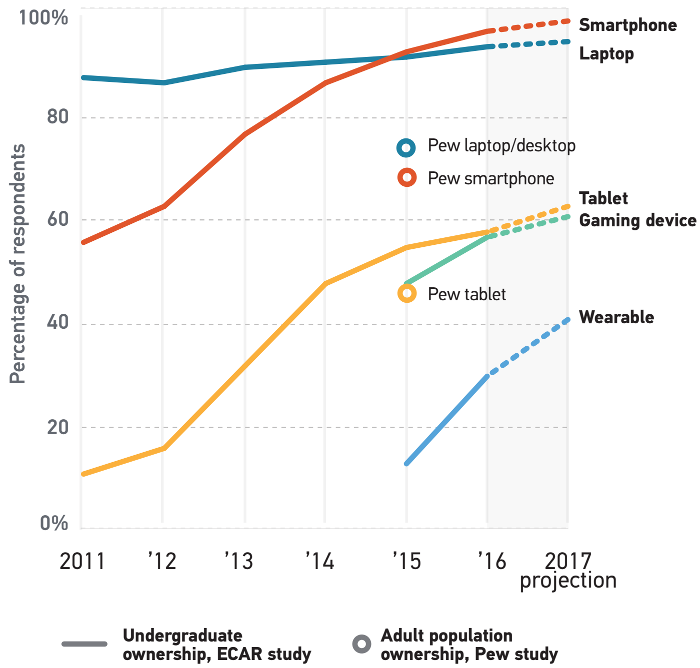

Figure 3. Device ownership history, with 2017 predictions

When we compare student device ownership with that of the general population of the United States, the importance of technology to college and university students becomes clearer. While over half of students (52%) own each of the three major technologies—a laptop, a tablet, and a smartphone—a study by the Pew Research Center found that only 36% of Americans own all three devices.[5] On the other end of the spectrum, 16% of U.S. adults own *none* of these devices, compared with just 1% of American college and university students. Similarly, 18% of Americans, compared with 5% of students, own only one of the three devices. Among students, the most popular combination of dual-device ownership is a laptop and a smartphone (38%). Put simply, students who own technology own a lot of technology (see figure 4).

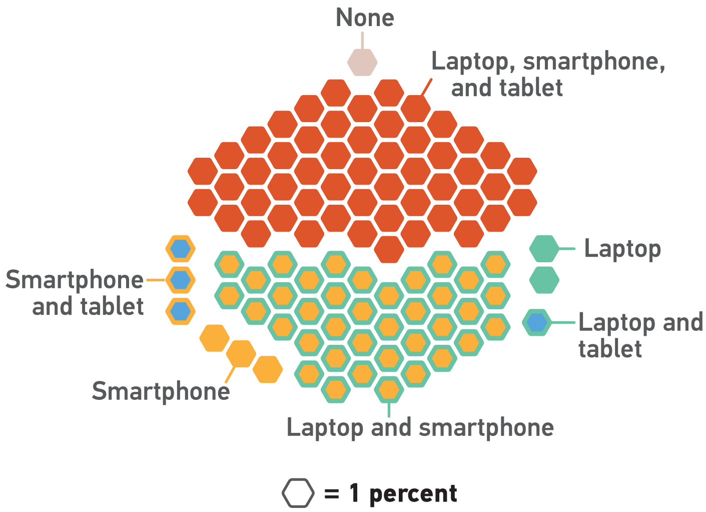

Figure 4. Student laptop, tablet, and smartphone ownership

Student Device Usage for Academics

Of the devices owned by students, laptops continue to be the academic workhorse, with 95% of students claiming to have used the device in at least one course (see figure 5). Indeed, two-thirds of students told ECAR that they use their laptops for all of their courses. Following a brief period of relative stagnation, student smartphone usage for academic purposes in at least one class increased by 9 percentage points in 2016; this means that approximately one-third of students who had previously never used a smartphone in a course began using one since 2015. Although relatively small by comparison (7%), the use of wearable technologies for coursework increased by over 100% since 2015, the first year we began tracking the use of such devices.

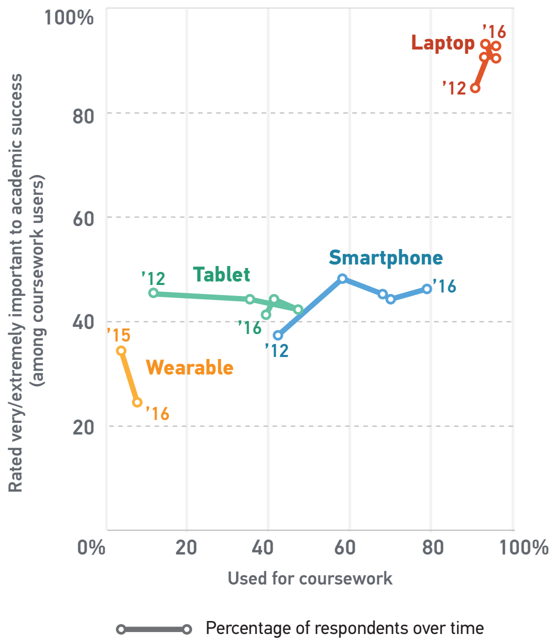

Figure 5. Relationship of device used for coursework with importance to student success

Tablet usage by students in at least one course has continued to wane, although the rate at which that is happening appears to be slowing. From 2014 to 2015, student tablet use for academic purposes dropped from 47% to 41%; in 2016, usage has fallen to 39%. One possible explanation for lower levels of usage is that the increase in smartphone usage might be siphoning student activity from tablets. However, this hypothesis is unsupported, given that students who use their smartphone for coursework are significantly more likely to use their tablet for coursework, too.[6] Another possible explanation is that the relatively low levels of tablet ownership may contribute to low usage levels: Ownership of a tablet significantly increases the probability (from 6% to 67%) of using a tablet in at least one course.[7] Although this finding is in keeping with the relatively low usage vis-à-vis ownership of devices, this finding does little to explain the overall low levels of tablet usage. Finally, the level of importance students attach to using tablets for their academic work could offer some insight, but tablet importance to student success has remained stable. The lack of evidence for these explanations suggests that the reasons for the decline in tablet usage may be related to any number of other factors for which we do not have data (e.g., lower levels of instructor usage in class) or part of a larger decline in tablet usage, especially among 18–24-year-olds.[8]

Student Device Importance

For students who use their devices for academic purposes, the importance of those devices to their academic success continues to be relatively stable (see figure 5). Laptops, presumably due to their power and flexibility, continue to be the most important device in the student arsenal of digital devices; 93% of students said that laptops are very to extremely important for their academic success. Laptops are also more than twice as important to student success as either smartphones (46%) or tablets (41%). The one exception to the stability in device importance is wearable technologies, which experienced a 10% drop this year, the second in which we asked about their importance.

Although we cannot fully explain the decrease in the importance of wearable technologies to student success,[9] we do know that importance levels for all device types are positively and significantly related to the extent to which devices are used for academic work. When students use a device in at least half of their courses, they are significantly more likely to consider it to be extremely important for their success. And, even when students deem a device to be completely unimportant to their academic success, the probability of using that device for at least one course is still practically 100%.

The Technology Experiences of Students

In this section we explore the factors that shape students' overall technology experiences on their campuses. We found that students' technology experiences are a function of their experiences with infrastructure (i.e., wireless networks), the adequacy of instructors' technology skills, students' attitudes toward technology, and students' beliefs about the importance of classroom technologies to their chosen careers.

Overall Technology Experiences

An overwhelming majority (80%) of students reported having a good to excellent experience with technology on their campuses (see figure 6). For the most part, student technology experiences are similar across the various demographic characteristics, with no substantial differences between ethnic groups or first-generation[10] and non-first-generation students. However, the overall good to excellent technology experiences of students tend to be significantly different by institution type, with private MA (84%), AA (81%), and public DR (80%) students reporting the highest levels of satisfaction and private BA (67%) students reporting the lowest levels.

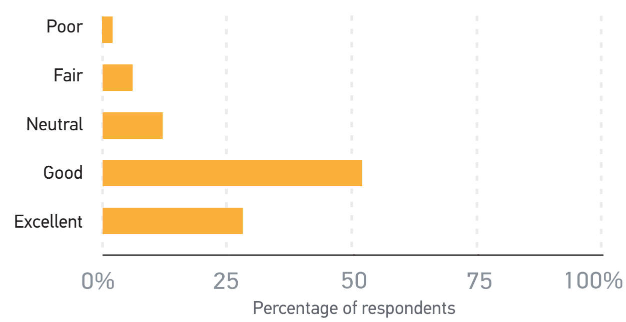

Figure 6. Students' overall technology experiences

Another noteworthy difference is evident, however: Off-campus students have a marginally better—but statistically significant—technology experience than do on-campus students.[11] This may be a function of the amount of time students spend online when on campus. The median amount of time undergraduate students spend online doing research and completing homework (3–4 hours) and engaging in social media (1–2 hours) is considerable. They also spend a few additional hours online per day watching streaming content (1–2 hours) or doing other things (less than 1 hour). However, students who live on campus spend significantly more time doing online research and homework, using social media platforms, and streaming content than do students who do not live on campus. Spending more time on campus means that students spend more time logged in to campus networks—which serve as their de facto ISPs—thereby creating more opportunities for negative experiences with campus infrastructure. Although we do not have data that can directly address the difference in the amount of time off-campus students spend doing online activities, some reasonable hypotheses might be that they are more likely to be nontraditional students with work and family obligations and/or may spend time commuting to and from campus.

Experiences with Wireless Networks

A majority of students rated their experiences with wireless networks on campus favorably (see figure 7). Two-thirds or more rated the reliability of access to Wi-Fi in campus libraries and classroom/instructional spaces and the ease of login to Wi-Fi networks as good to excellent. Network performance and the reliability of access to Wi-Fi in student housing and dormitories were the most poorly rated, with only 58% and 52% favorability, respectively; in fact, a quarter of respondents rated network performance and dormitory Wi-Fi as fair to poor. Furthermore, the difference between students who live off campus and on campus persists across each of these items, with off-campus students offering a significantly more generous evaluation of their experiences with the campus wireless network than their peers who live on campus. The greatest gaps between off- and on-campus students are their evaluations of network performance (22 percentage-points) and the reliability of student housing Wi-Fi (14 percentage-points).

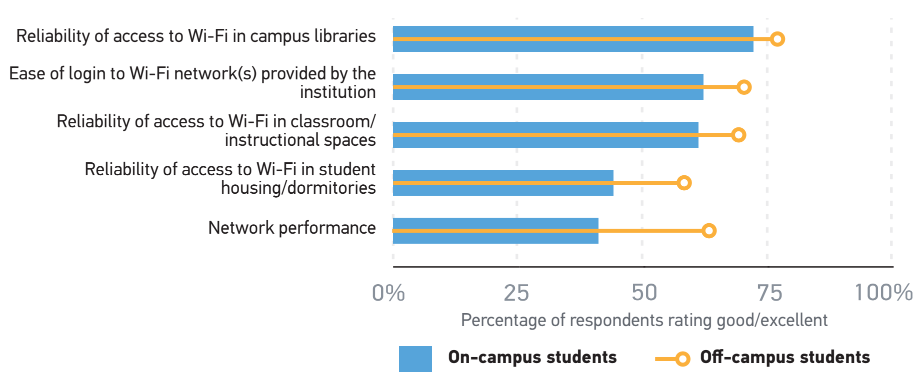

Figure 7. Student experiences with wireless networks

Dissatisfaction with network performance and Wi-Fi access reliability in student dormitories should not be surprising. A typical dormitory setting has a high concentration of students, 95% of whom own two or more Internet-capable devices and 90% of whom attempt to connect two or more of those devices to campus networks at the same time. Moreover, the dormitories are also more likely to be the spaces in which students are using devices to game and/or stream digital content. And, our data suggest that the greater the number of devices students attempt to connect to the network, the worse the students' rating of both network performance and reliability of Wi-Fi access in the dorms.

How should IT units respond to the growing demand for bandwidth from on-campus students, especially in the dormitories, where satisfaction levels are marginal? One option would be to regulate the number and/or type of devices with which students can access campus networks and systems. Another option would be to increase the capacity of networks and the availability of Wi-Fi on campus, especially in the dormitories. In this scenario, the better option may be to increase the supply to meet (or even exceed) the demand, given that 1) regulating and monitoring the number and type of devices students bring to campus and use to access campus networks and systems is difficult and likely ineffective, and 2) improving the infrastructure could be viewed as an investment with an eye to transforming the digital capacity of the entire campus, preparing it for unforeseen future network and device demands. Additionally, IT organizations might consider educating students about how to conserve bandwidth, a limited resource with real costs that are passed on to students and their families.

Student Experiences with Faculty and Technology

When it comes to student experiences with their faculty using technology, we have some mixed results to report (see figure 8). First, a majority of students (69%) reported that *most or all* of their instructors demonstrate technology skills adequate for course instruction; 90% of students said that at least *some* of their instructors demonstrate adequate technology skills. Hopefully, this finding can allay faculty concerns about whether they appear competent when using technology in the classroom and can help them be confident educational technology users even when the technology does not work as planned.[12] Second, a majority of students said that most of their instructors are using technology in some basic way, such as connecting to learning materials (61%) and encouraging the use of collaborative tools (57%). Here, faculty should consider continually deepening their understanding of how to better integrate technologies into their teaching. Third, about half of students said a majority of instructors are using technology for higher-level student outcomes, such as cultivating critical and creative thinking (49%) or maintaining student attention (48%).

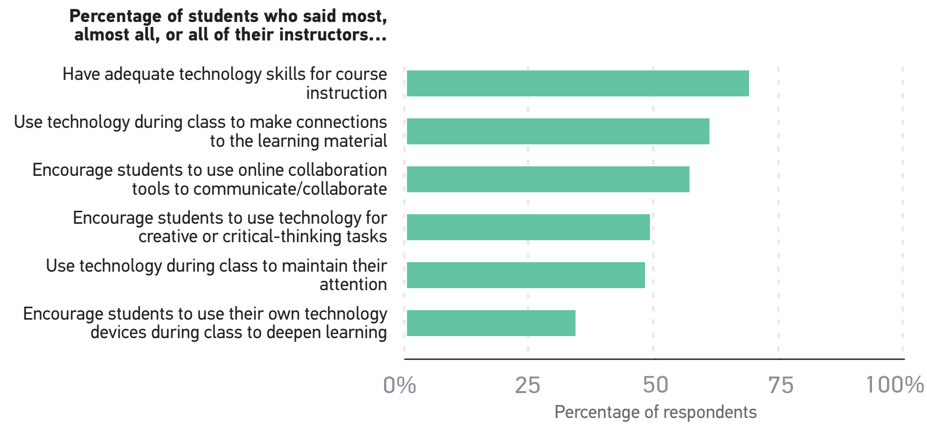

Figure 8. Faculty use of technology as a means to engage students

Only one-third of students said a majority of instructors are harnessing the computing power students have in their backpacks and pockets to deepen learning. Indeed, more students (41%) said that none or few instructors are doing this than said most instructors are (34%). As we have noted elsewhere,[13] faculty need to overcome their lack of motivation to use and/or reservations about using student technologies, especially mobile devices, for academic work in the classroom. Indeed, we argue that faculty need to

- engage in skillful, thoughtful, and effective uses of technology in the classroom that are grounded in empirical research that demonstrates benefits to students;
- seek direct assistance from instructional designers to design and/or redesign assignments and courses; and
- take advantage of technology-oriented professional development opportunities.

To isolate the factors that significantly predict students' overall technology experiences, we used a stepwise ordered logistic regression procedure that included a host of variables related to the following factors:

- Student experiences with wireless networks on campus
- The number of devices students typically try to connect to the network at the same time
- The amount of time students spend actively engaged in a variety of activities
- Student appraisals of instructor skills and uses of technology
- Student evaluations of the impact of technology on their future
- Student technology dispositions, attitudes, and usage patterns

The model retained only seven variables on four of these factors that are simultaneously highly significant predictors of students' overall technology experiences.[14] On the infrastructure side, the more positive a student's evaluation of experience with the Wi-Fi in the **dormitory** and in the **libraries**, the greater the likelihood of the student's having a good or excellent overall technology experience. Similarly, the easier it is for a student to **log in to the Wi-Fi network** and the **better the network performance**, the better the student's overall technology experience. On the human side, the more **instructors whom students perceive to be adequately skilled** with technology, the better the overall technology experience. A more **positive attitude** toward technology also predicts a more positive overall technology experience. And, finally, if students believe that the **technology they use in their courses now will prepare them adequately for their chosen careers** after college, they are more likely to rate their overall technology experiences higher.

Clearly, the quality of students' technology experiences is partially about the infrastructure and tools with which they are provided, especially in the spaces where they live and work the most. But it is also connected to how the technologies are used and who uses them. Faculty members who know how to effectively use technology for teaching and encourage their students to use relevant technologies effectively for learning are critical components in the overall technology experience of the contemporary American college student.

The Technology Preferences of Students

Students tend to prefer blended courses—those that provide some combination of face-to-face and online learning environments. We found that students' preferences for different types of learning environments are shaped by the types of courses they have taken, how students relate to technology, and a couple of demographic variables.

Preferred Learning Environments

The type of learning environments in which students claim to learn the most has remained remarkably stable over the past several years (see figure 9). An absolute majority of students prefer courses that have some blended aspect to their design. Specifically, 16% of students said they learn best in a course that is mostly but not completely online; another 58% said that learning works best for them when there are at least some online components. On the ends of the continuum, 10% of students prefer fully face-to-face courses, while 7% of students said that fully online courses work best for them. For the second year in a row, the percentage of students who expressed no preference declined.

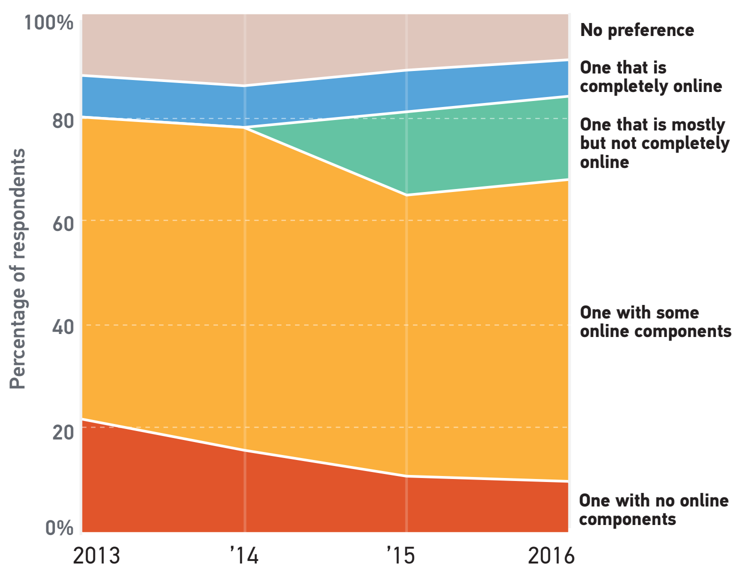

Figure 9. Students' preferred learning environments

The convergence of students' preferences toward blended learning environments may prove beneficial to student learning outcomes. In 2010, Barbara Means and her colleagues reviewed a host of online learning studies and found that fully online courses produced learning gains that are indistinguishable from those produced in fully face-to-face environments.[15] In other words, they found that "instruction conducted entirely online is as effective as classroom instruction but no better."[16]

Surprisingly, they also found that "[b]lends of online and face-to-face instruction, on average, had stronger learning outcomes than did face-to-face instruction alone."[17] The authors were careful to note that the benefits of the blended environment were more a product of increased time on task under those conditions than any specific attribute of the environment. Regardless, the indications that blended environments have the capacity to improve student learning by increasing time on task and that American college and university students are embracing those environments should be cause for some cautious optimism.

Relations to Technology

Students appear to relate to technology in one of four basic ways (see figure 10). **First**, students see it as something that enables them to **engage materials in less traditional ways**. Three in 10 students claimed that they are more likely to skip classes when streamed or recorded lectures (31%) or materials presented in class (28%) are available online. Younger students (18–24) are almost twice as likely as older students (25+) to skip when lectures (36% versus 19%) or materials (33% versus 17%) are available online. Perhaps a function of perceived anonymity, students at larger institutions are also more likely to skip class than students at smaller institutions. For instructors teaching face-to-face courses and who are reluctant to stream lectures or post recordings and materials to the Internet, this finding may confirm their fears of students' skipping out on valuable class time. This finding might also serve as an indictment of the lack of value students place on classroom time with each other and the instructor as a meaningful learning experience.

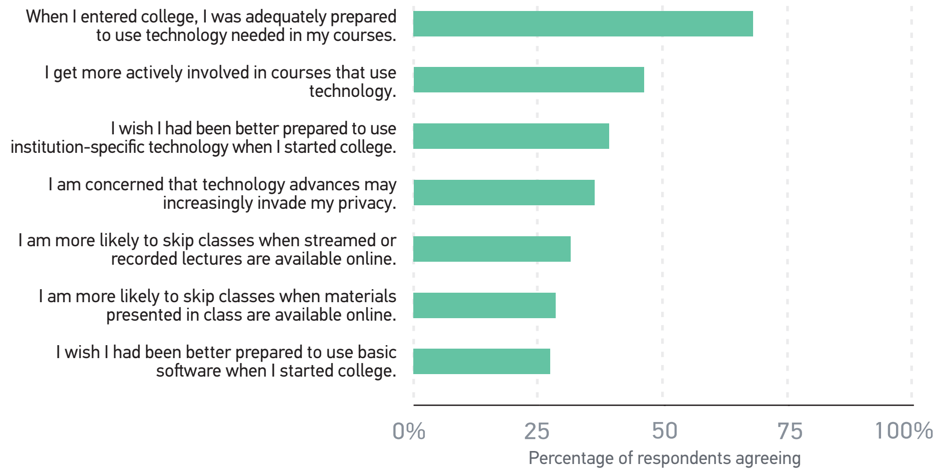

Figure 10. How students relate to technology in college

Conversely, about half of students disagreed or strongly disagreed that they would skip if lectures were streamed/posted (49%) or when materials are made available (53%) online, suggesting that—for some students—an online repository presents an opportunity to enhance, not replace, the classroom experience. Moreover, online resources might allow some flexibility for students who have complex schedules and obligations. Indeed, online content may provide a safety net to students who are struggling with or need quick reviews of material. Faculty can breathe a sigh of relief as there are, of course, any number of policies and procedures that can be employed to incentivize attending their face-to-face classes even while content is available online.

Second, students relate to technology as **a set of skills or literacies they are expected to possess**. In fact, a majority (68%) agreed or strongly agreed that they were adequately prepared to use technologies needed in their courses when they entered college. Still, 4 in 10 (39%) wish they had been better prepared for institution-specific technology (e.g., the course registration system, the learning management system, the library search system), and 3 in 10 (27%) wish they had been better prepared to use basic software (e.g., MS Office, Google Apps, etc.) when they started college.

Third, a plurality of students perceives technology as **something that excites or empowers them**. About 47% of students agreed or strongly agreed that they get more actively involved in courses that use technology; only 18% claimed that technology does not get them more actively involved.

Fourth, students are ambivalent about whether **technology increases the possibility of getting burned by invasions of their privacy**. About one-third of students expressed concern that technology advances may increasingly invade their privacy, while another third were unconcerned about potential threats to their privacy, an attitude that has been corroborated elsewhere.[18]

Determinants of Learning Environment Preferences

What factors shape student preferences for their learning environments? To answer this question we drew upon a number of theoretical and control variables that we thought might influence student reports about what learning environment they perceive is best suited for learning. Using a stepwise ordered logistic regression modeling technique, we explored the possible impact of the following factors on students' learning environment preference:

- The number of courses students reported to have taken in different learning environments in the previous year
- Items (discussed above) about how students relate to technology
- Demographics
- The type of institution at which students are enrolled (i.e., a modified Carnegie classification)
- Student appraisals of instructor skills and uses of technology

Only 9 of the 31 variables included in the model were retained as significant predictors of student learning environment preferences (see table 1).[19]

Table 1. Determinants of student learning environment preferences

Preferred Learning Environment	Predictors
Completely or mostly online	Taken more completely online courses in previous year Taken more mostly online courses in previous year Get more actively involved in courses that use technology Instructors encourage use of technology devices during class to deepen learning Women More positive disposition toward technology More positive attitude toward technology
Completely or mostly face-to-face	Taken more completely face-to-face courses in previous year Taken more mostly face-to-face courses in the previous year

Students' current preferences for different types of learning environments tend to be shaped by the types of courses they have taken previously. On the one hand, students who have taken more **fully online** and **mostly online** courses in the previous year are considerably more likely to prefer courses with mostly to completely online content. On the other hand, students who have taken more courses in **fully face-to-face** or **mostly face-to-face** environments are significantly more likely to think they learn best in courses with more face-to-face components. That the more courses students took in a **balanced blended** environment fails to predict preferences significantly suggests that many students are already comfortable with well-blended environments and/or students on the ends of the continuum prefer to study with the demons they know than with the ones they do not. It is also plausible that many students—by virtue of where they live, the type of institution in which they are enrolled, or other life circumstances—do not have many, if any, choices about with which demons they get to study.

In the vein of how students relate to technology, three of the items we included help us understand student learning environment preferences. First, **students who claim to get more actively involved in courses that use technology** are significantly more likely to prefer courses with more online components. Second, **students who have more instructors who encourage them to use their own technology devices during class** to deepen learning by searching online for related concepts, examples, or demonstrations are more likely to prefer learning environments with more online components. It is also worth noting here that all of the variables related to levels of self-reported student preparedness for technology use failed to contribute to our understanding of what learning environments students prefer. Third, students with more positive **dispositions** and **attitudes** toward technology express preferences for learning environments that are mostly or completely online.

Only one demographic variable is associated with learning environment preferences: Women reported that they learn better in environments with more online components. Although we do not have data from this survey to explain why these demographics are significantly correlated to learning environment preferences, we can offer some speculation. First, in addition to overcoming the aforementioned constraints of work and family,[20] women may prefer an online environment where they do not have to compete to share their thoughts and ideas in a classroom with men, who tend to exhibit more assertive behavior and dominate classroom discussion.[21] Furthermore, there is secondary research evidence that supports the notion that men may not perform as well as women in online learning environments, thereby shaping their preferences for face-to-face environments.[22]

Finally, it is worth noting that institution types were cast into the ashes of the stepwise model employed here; none of the institution types emerged as a significant predictor for student learning environment preferences in the presence of the other factors.

The Effects of Technology on Students

Students think that technology contributes to their engagement with instructors, with other students, and with course content; enriches their learning experiences; and empowers them to be better students. Technological classroom distractions appear to have largely supplanted traditional, analog distractions. Although a number of factors may exacerbate digital distractions, faculty can mitigate the effects of digital distractions without banning the devices from their classrooms.

Student Engagement

For the 2016 ECAR student study, we developed a battery of items to measure the three basic modalities of student engagement: student-faculty engagement; student-student engagement; and student-content engagement. Our results suggest that students see technology as a positive force in helping them engage in all three of these ways.

Student-Faculty Engagement

The interactions between students and faculty are believed to be one of the most important contributors to student learning. From the student perspective, technology appears to be a critical component of changing the manner in which students communicate with and relate to their instructors (see figure 11). In terms of one-way communication, 79% of students claimed that technology makes it easier for them to ask their instructors questions, and 75% agreed that technology helps them get feedback from instructors in a timely manner. For two-way communications, three-fifths (63%) of students also agreed that technology plays a role in helping them discuss course topics with their instructors. Technology also plays a role in changing the relationships between students and faculty. A majority of students agreed or strongly agreed that technology helps them understand their instructors' expectations (69%) and view their instructors as approachable (61%). When it comes to developing personal relationships with instructors, students are a bit more ambivalent about technology's role, with only 37% expressing a positive contribution and 28% expressing a negative one.

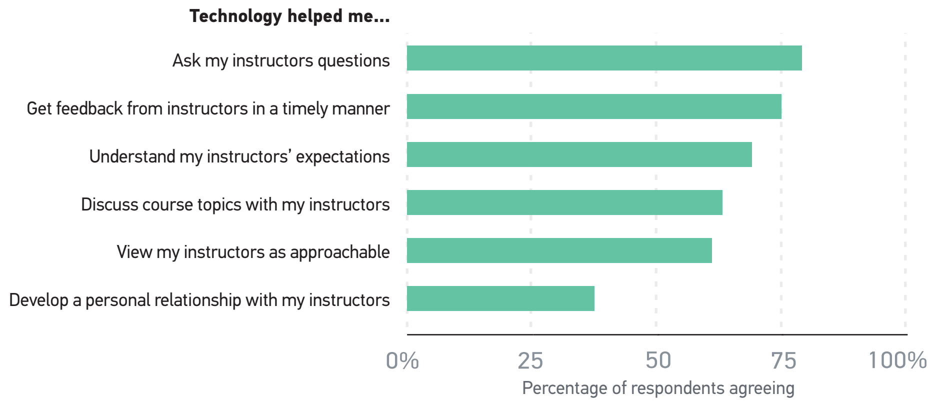

Figure 11. Student-faculty technology engagement

Changing the relationship between faculty and students with technology by reducing the temporal, physical, and psychological space between them is a double-edged sword. On the one side, technology helps shatter the stereotype of faculty as unapproachable gods who guard braziers of knowledge from Promethean thieves—students who are not afraid of their instructors are more likely to reach out to them for help with their academic work. On the other side, if the distance between student and faculty is reduced too much, faculty might end up saying goodbye to civil and respectful conversation as students' digital messages take on the tones and styles of peer communication or display rude technology behaviors. Here we think there are lessons to be learned for both students and instructors.

Student-Student Engagement

A majority of students agreed or strongly agreed that technology helps them engage with other students on a number of different tasks (see figure 12):

- Working with other students on class projects
- Communicating with other students (e.g., participating in groups, asking questions, discussing course topics, getting feedback)
- Teaching and learning from other students

As with student-faculty engagement issues, technology does not appear to be as comparatively strong in terms of helping change personal relationships with students as it is at helping change professional ones. That is, only a plurality of students agreed or strongly agreed that technology also helps them see other students as approachable (46%) or develop personal relationships with other students (38%).

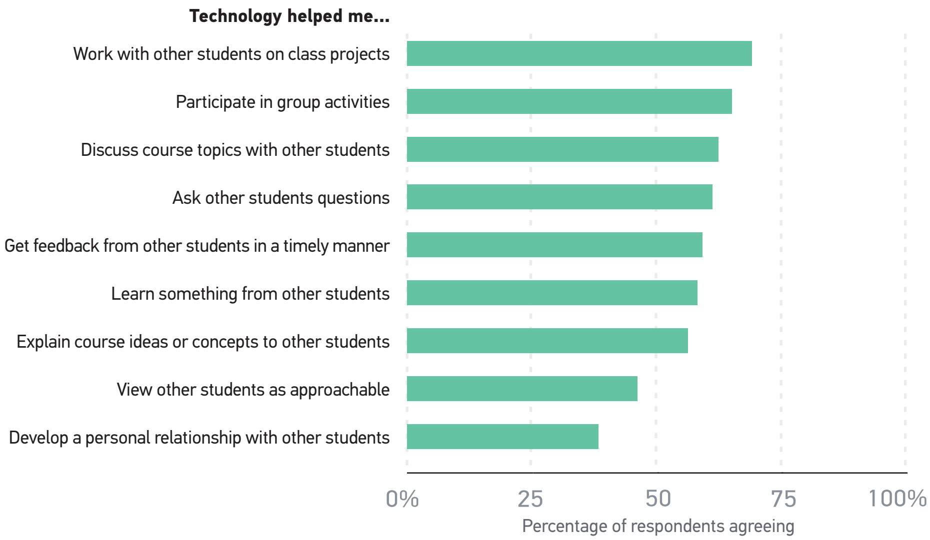

Figure 12. Student-student technology engagement

Student-Content Engagement

When it comes to student engagement with course content—perhaps the most important academic relationship of the three explored here—a supermajority of students agreed or strongly agreed that technology helps them (see figure 13). Over 80% of students said that technology helps them conduct research for class assignments, keep track of course news or announcements, and document their class work or projects. Over 70% of students extol the benefits of technology to help investigate topics outside class time, reflect on source materials, and analyze data.

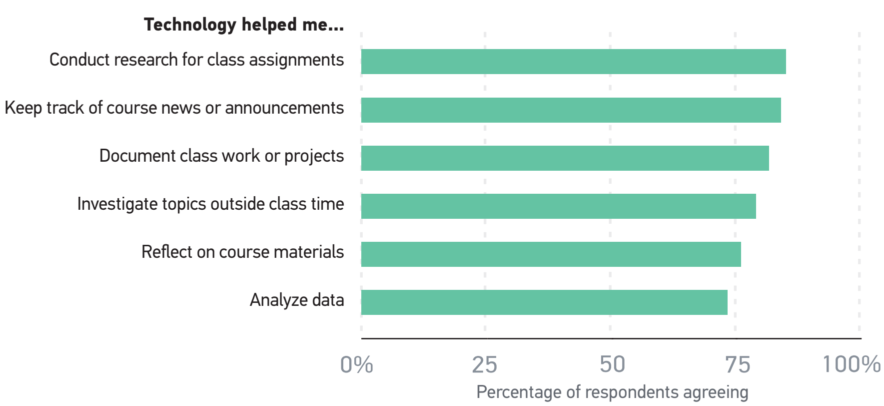

Figure 13. Student-content technology engagement

To understand the factors that lead students to attribute increased levels of overall engagement, we created a stepwise generalized linear model using a number of demographic and theoretical variables. As it turns out, women and first-generation college students are significantly more likely to perceive technology as helpful with engagement than are men or students who are not the first in their families to attend college. Students' attitudes and technology usage patterns are the most influential characteristics of students who see technology as a tool that helps them engage faculty, each other, and course materials. Students with high disposition, attitude, and usage scores tend to see technology as facilitating engagement more than students with lower levels of those measures.

For nearly two decades, student engagement has been an object of interest and an area of investment in higher education. Institutions have participated in large-scale surveys that purport to measure levels of student engagement with a plethora of academic and extracurricular activities.[23] Educational researchers have written volumes on how to measure various types of engagement and link those measurements with observable improvements in student learning outcomes. And, many instructors give considerable thought to how their approaches to teaching and learning engage (or do not engage) students in their classes.

What our data show is that most students see technology as a powerful mechanism for increasing their levels of engagement in their academic work. As such, instructors should take seriously students' perceptions of technology and think carefully about how to use technology in the classroom effectively. In this regard, our data offer some very practical suggestions that instructors might employ to engage students more directly (e.g., opening lines of communication, information exchange, and feedback), to engage students with each other (e.g., collaborative or group assignments, frameworks for discussion or debate, opportunities to teach each other), and to engage students with the course material (e.g., conducting research and investigating topics, reflecting on course materials, analyzing data).

Student Enrichment

Students also claim that technology enriches their academic experiences (see figure 14). Indeed, over two-thirds of students agreed or strongly agreed with almost every enrichment statement about which they were asked. At the upper end of the scale, students claimed that technology used in their courses

- contributed to the successful completion of their courses (78%),
- was appropriate to the content being delivered (77%),
- enriched their learning experiences (75%), and
- was relevant to their achievement of course learning objectives (74%).

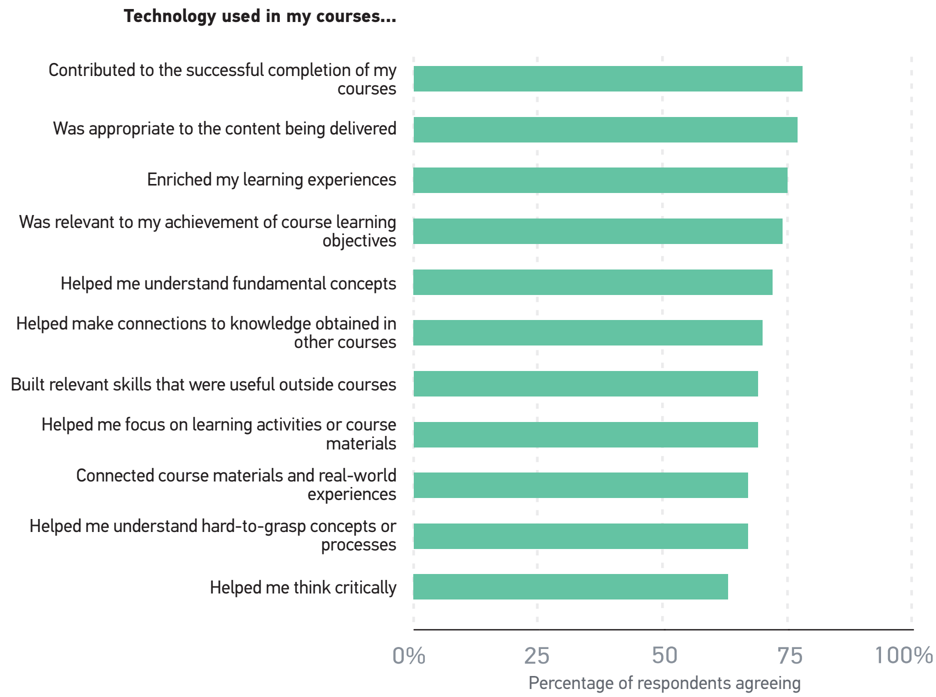

Figure 14. Student technology enrichment

Given these numbers, technology appears to have become an established part of enriching the academic lives of American college and university students.

We ran another multivariate analysis to better understand which kinds of students see technology as enriching their academic experiences. Again, women and first-generation college students are significantly more likely to think that technology used in courses enriches their learning. And, students who possess more positive attitudes about technology and use technology more are significantly more likely to see technology as enriching.

Student Efficacy

Students also see technology as a tool that empowers them to seize control of their learning experiences (see figure 15). The top 3 ways in which technology improves students' levels of efficacy are utilitarian. Large majorities of students agreed that technology enables them to

- communicate basic messages (78%),
- use technical or academic terminology correctly (69%), and
- receive feedback from others right away (66%).

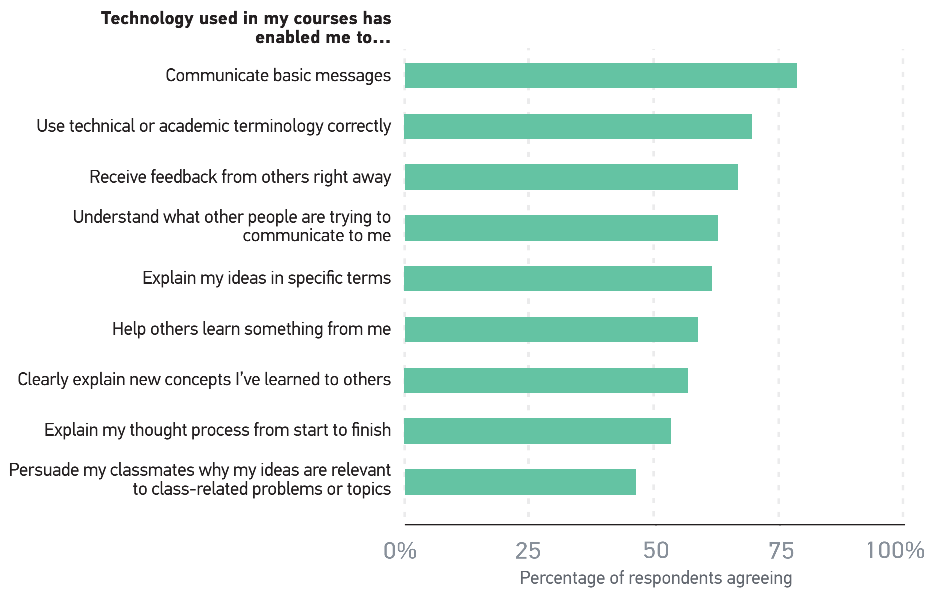

Figure 15. Student technology efficacy

A majority of students also agreed that technology enables them to perform the role of student-as-teacher. Specifically, the efficacious power of technology extends beyond general communication, and technology helps them to

- explain their ideas in specific terms (61%),
- help others learn something from them (58%),
- clearly explain new concepts they've learned to others (56%), and
- explain their thought processes from start to finish to others (53%).

Overall, a majority of American college and university students agreed or strongly agreed that technology empowers them in nearly all of the ways we asked about. The exception to this is their ability to persuade their classmates about the relevance of their ideas to class-related problems or topics (46%), serving as a reminder that, irrespective of the mode of transmission, the message must ultimately be convincing.

Once again, women, first-generation college students, students with highly positive dispositions and attitudes toward technology, and students who use technology frequently are significantly more likely to claim that technology increases their efficacy levels. This time, however, ethnicity joins sex and first-generation status as a significant demographic predictor of high levels of efficacy derived from technology. Specifically, nonwhite students, significantly more than their white classmates, view technology as a tool that empowers them to communicate, teach, and learn in the classroom. Again, this may have something to do with the ability of technology to remove race from the equation during student interaction, placing the focus on the substance of what is being said rather than who is saying it.

We need to also keep in mind that these data are self-reported effects of technology on students' own experiences. That is, students may not know for sure whether technologies actually improved their levels of engagement, enrichment, and efficacy, and we did not measure improvements in those areas in this study. However, perceptions are extremely important and may, to a certain extent, be reality.

Digital Distractions

In 2015, faculty expressed considerable concern about classroom distractions caused by student use of mobile devices. Forty-nine percent of faculty agreed that the in-class use of mobile devices was distracting for themselves, and 60% said that the use of such devices was distracting for others. These opinions are not without consequence: Faculty who agreed that in-class use of technology is distracting are significantly more likely to ban or discourage the use of technology in the classroom. Given how much students see technology as important to their higher education experiences, it would behoove us to understand how much they are distracted and what might be done—short of tearing their devices from their hands—to mitigate those distractions.

We asked students to tell us whether they agreed that they get distracted during class by any of several digital activities (e.g., texting, reading e-mail, using social media, surfing the web, reading websites not related to class) and analog activities (e.g., talking to neighbors; reading books, magazines, or other printed materials not related to class; reading a newspaper; passing notes) (see figure 16). Between 33% and 39% of students agreed or strongly agreed that they do, in fact, get digitally distracted in class. Texting is the most frequently cited culprit (39%), followed closely by using social media (37%) and surfing the web (35%). This relative distribution parallels closely the findings from a recent *Journal of Media Education* study.[24] Comparatively, students claim that they participate in the analog distractions we might traditionally expect of students significantly less than the contemporary digital ones. Only a quarter of students get distracted by talking to neighbors; 1 in 5 are distracted by reading nonclass materials; and only 1 of every 10 students is distracted by reading a newspaper or passing notes in class.

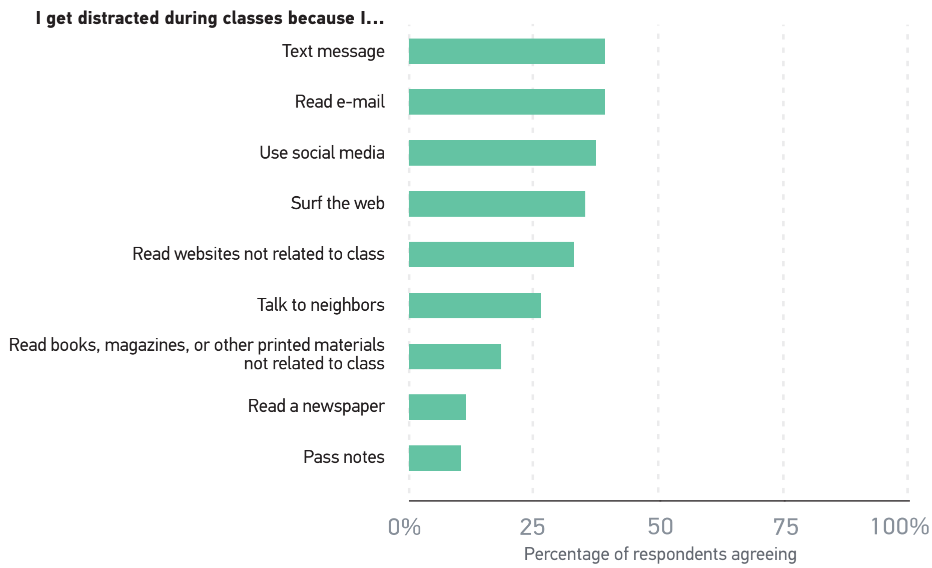

Figure 16. Student technology (and analog) distractions

Although digital distractions are probably not as ubiquitous as some faculty think (40–50% of students claim that they are not distracted by any of the digital activities about which we asked), neither can we claim that such distractions are not an issue. Moreover, it is possible that students believe they are engaging in the discredited activity of multitasking[25] and are, therefore, underestimating or underreporting their distraction levels. Indeed, the confidence displayed by the 30% of students who claim that they can use devices without distraction should give us pause.[26]

One response to student digital distractions has been for faculty to ban or discourage the use of devices during their classes. The prayers of faculty hostile to technology in the classroom were answered when Clay Shirky, citing recent empirical research showing that multitasking on laptops is a distraction for both the user and surrounding students,[27] famously asked his "students to put their laptops away."[28] Ignoring screams of "Confirmation bias!" from the educational technology community, some faculty have moved to follow Shirky's lead and ban or discourage laptops from their classrooms; 16% of faculty in 2015 claimed to ban or discourage laptop use in their classrooms, up 10% from 2014.[29]

Instead of fueling the flames of a scorched-earth approach to addressing the problem of digital distractions in the classroom, faculty might instead consider leveraging student devices to the advantage of teaching and learning. As we have discussed, students claim that technology is a boon to their academic lives—engaging them with one another, with instructors, and with content; enriching their learning experiences; and empowering them. If this is true, we might reasonably expect that the more students use technology purposefully, the less likely they will be distracted. Controlling for a host of factors (age, sex, ethnicity, part-/full-time status, on-/off-campus residency, being a first-generation college student, disposition, attitude, and usage), we found that the story is more complicated.

Using a stepwise generalized linear modeling technique, we isolated some factors that contribute to digital distractions, mitigate or undermine digital distractions, and identify the characteristics of those students who are more or less likely to be distracted by digital devices in the classroom. First, we found that students who perceive that technology engages them with *other students* more and are encouraged to use devices during class to *deepen learning* are significantly more likely to be distracted. Second, in terms of student characteristics, we found the following:

- Students who are more likely to skip class when lectures or course materials from class are offered online are significantly more likely to be distracted.
- Students who are underprepared to use basic software and applications before coming to college are significantly more likely to be distracted.
- Conversely, students who are adequately prepared to use technology needed in their courses are significantly less likely to be distracted.
- The more time students spend actively engaged in social media, the greater the likelihood of their being distracted.
- Younger students are significantly more likely to be distracted than older students.

Certainly there appears to be some trade-off here when digital devices are used in the classroom, even with purpose. That is, instructors risk students' becoming distracted when they design educational technology assignments and activities that require students to interact with one another. However, research on the importance of different modalities of engagement in digital environments suggests that the student-student interactions that are a source of distraction are also the source of some of the most important forms of engagement for learning.[30]

We cannot reasonably expect to eliminate all distractions from the classroom, digital or otherwise. We can, however, conceive of ways to channel the potential for distraction into possible learning enhancements. Students do not seem to care for circumstances in which technology is used for its own sake or when technology is used frivolously. But technology-enhanced instruction that engages students with content, each other, and their instructors can improve student learning. Active learning approaches, which are superior to passive learning ones (e.g., lecture) for student learning[31] and engagement,[32] are student focused and meet students where they are. When coupled with digital technologies, active learning pedagogies have the potential to produce significant and meaningful gains. Given that 63% of students who use devices during class claim that they do so to fight boredom,[33] it may be time for instructors to consider making some changes to how they teach and finding ways in which technology might help engage students more.

For those instructors who need help taking the first or next steps in thinking about integrating technology into their courses, opportunities for professional and faculty development abound. According to the 2015 EDUCAUSE Core Data Service (CDS), a majority of institutions provide an extensive array of training, professional development, and support services for faculty and students (see table 2). According to David Wicks, chair of Seattle Pacific University's digital education leadership program, individual and programmatic opportunities can help faculty "take responsibility for adding technological elements to their courses that are specifically designed to take advantage of what devices can do to promote learning."[34] Moreover, they can help instructors develop progressive classroom technology policies and approaches that avoid banning student device usage while helping students learn the boundaries of appropriate device behavior.

Table 2. Educational technology services provided by institutions in the United States

Service	Percentage of Institutions
Learning (course) management support for faculty	99%
Learning (course) management training for faculty	99%
Faculty individual training in use of educational technology	99%
Faculty group training in use of educational technology	98%
Online learning technology support for faculty	96%
Online learning technology support for students	95%
Instructional technologists to assist faculty and instructional designers with integration of IT into teaching and learning	95%
Instructional designers to help faculty develop courses and course materials	89%
Designated instructional technology center available to all faculty	82%
Faculty teaching/excellence center that provides expertise on IT	79%
Faculty training on incorporating students' use of mobile devices during class	74%

Source: 2015 EDUCAUSE Core Data Service (CDS)

For students, it appears as if explicit technology training and advice about the appropriate use of technology in the classroom may also reduce classroom distractions. Students who were prepared to use basic software applications when they started college and reported being adequately prepared to use the technology employed in their classrooms are significantly less likely to be distracted. Such a finding is clearly actionable: As students matriculate and are oriented to campus during their first year, provide them with meaningful technology training on both basic software applications and specialized ones used on campus and/or in their declared major(s). Coupling the technical training with some basic guidelines about the appropriate, secure, and civil use of technology in and out of the classroom—especially as it relates to social media—could go a long way toward reducing the levels of student distraction in the classroom. Although blocking social media services from campus networks might seem to be an easy and inexpensive solution to the problem of classroom distractions, such an approach is rarely effective for the long term, undermines academic freedom, and puts IT organizations in the undesirable position of being in loco parentis.

Conclusions

Our data demonstrate clearly that American college and university students have a strong and positive orientation toward digital technologies. They use these technologies extensively and see them as critical to their academic success. Students' campus experiences are shaped by the degree to which the campus IT infrastructure facilitates or constrains their access and by the ways in which technology is selected and employed by their instructors. Students are strongly and increasingly oriented toward blended learning environments, a modality that holds promise for increasing student learning gains. Students see technology as something that engages them in the learning process with their instructors, other students, and course content; enriches their learning experiences; and empowers them to take charge of their learning and to become better students.

However, digital devices can also distract students from the learning process during class. This is a problem, but it does not justify policies that ban digital devices from the classroom or discourage their use in the classroom. Meeting students where they are with digital technologies and attempting to leverage the tools they carry in their pockets and backpacks seems to be a much better approach to solving the problem of digital distractions in the classroom. At the same time, students could benefit from learning how to better use technologies effectively, understand privacy and security policies, and practice some basic rules about device etiquette. We think that college and university IT organizations are in a position to help both students and faculty, and we offer the following recommendations as a way to start that conversation.

Recommendations

- IT organizations should consider (re)investing in Wi-Fi infrastructure, especially in student housing, to improve the overall technology experience of students. In addition to increasing bandwidth, IT organizations might consider educating students about how to conserve communal technology resources.
- IT organizations should make their regular training and development offerings highly visible and identify any gaps in their current repertoire. These efforts could help instructors take the first or next steps in thinking about integrating technology into their courses, such as seeking out professional development opportunities or training workshops, courses, or seminars offered on their campuses.
- Faculty need to overcome their reservations about harnessing student technologies, especially mobile devices, for academic work in the classroom. This can be accomplished by engaging in skillful, thoughtful, and effective uses of technology in the classroom that are grounded in empirical research that demonstrates benefits to students. Faculty can also seek direct assistance from instructional designers to design and/or redesign assignments and courses, and take advantage of technology-oriented professional development opportunities.
- Find ways to provide technologically enhanced opportunities for female, minority, and first-generation college students to enrich their learning experiences and to engage the learning process. Technology may empower these populations of undergraduate students and might help them succeed academically.
- The fact that students can be and are distracted by some digital technology in the classroom does not mean that a ban on devices is the solution. Students need clear boundaries regarding the appropriate uses of technology in the classroom. Combining active learning pedagogical approaches with intentional uses of technology for teaching and learning may produce significant learning gains for students.
- IT organizations should offer more and/or better technology training for students during new student orientation. Students who are better prepared to use basic software and applications as well as other technologies needed in their courses are significantly less likely to be distracted in class. In addition to offering practical software training, IT organizations might also consider educating students on security, technology ethics, and usage of technology on campus.

- Understand and improve your campus community's technology experiences by participating in EDUCAUSE's student and faculty research. Use the benchmarking results to prioritize institutional practices, measure progress toward improving experiences, and compare your community's tech experiences with peers.

Methodology

In 2016, ECAR conducted its latest annual study of undergraduate students and information technology to shed light on how IT affects the college/university experience. These studies have relied on students recruited from the enrollment of institutions that volunteer to participate in the project. After securing local approval to participate in the 2016 study (e.g., successfully navigating the IRB process) and submitting sampling plan information, participating institutions received a link to the current year's survey. An institutional representative then sent the survey link to students in the institution's sample. Data were collected between February 15 and April 24, 2016, and 71,641 students from 183 institutional sites responded to the survey (see table M1). ECAR issued $50 or $100 Amazon.com gift cards to 39 randomly selected student respondents who opted in to an opportunity drawing offered as an incentive to participate in the survey. In exchange for distributing the ECAR-deployed survey to their undergraduate student population, participating colleges and universities received files containing anonymous, raw data of their students' responses, along with summary tables comparing their students' aggregated responses with those of students at similar types of institutions. Participation in this annual survey is free, and any higher education institution can sign up to contribute data to this project by e-mailing study@educause.edu.

Table M1. Summary of institutional participation and response rates

Institution Type*	Institution Count	Invitations	Response Count	Group Response Rate	Percentage of Total Responses	U.S. Subsample (n = 10,000)**
AA	49	218,973	12,157	6%	17%	43%
BA public	22	23,241	2,029	9%	3%	3%
BA private	4	4,715	685	15%	1%	3%
MA public	29	185,787	18,508	10%	26%	16%
MA private	10	27,713	2,290	8%	3%	7%
DR public	32	341,957	19,466	6%	27%	24%
DR private	7	30,293	2,911	10%	4%	4%
Total U.S.	153	832,679	58,046	7%	81%	100%
Outside U.S.	30	205,251	13,595	7%	19%	–
Grand total	**183**	**1,037,930**	**71,641**	**7%**	**100%**	**–**

* U.S. institutions not falling into the listed types were reclassified.

** Via a stratified random sample

The quantitative findings in this report were developed using a representative sample of students from 153 U.S.-based higher education college and university sites. A stratified random sample of approximately 10,000 respondents was drawn from the overall response pool to proportionately match a profile of current U.S. undergraduates (see table M2). This sample was based on IPEDS data on age, gender, ethnicity, Carnegie class, and institutional control (public/private) for U.S. undergraduates. (A similar methodology was used for the 2015 sample.) The 2016 representative U.S. sample results in an approximate 1% margin of error for percentages estimated for the whole population. Margins of error are higher for subsets of the population. Non-U.S. respondents' results are not highlighted in this report. Findings from past ECAR studies were also included, where applicable, to characterize longitudinal trends. All findings in this report refer to the U.S. representative sample unless otherwise noted. All findings are statistically significant at the 0.001 level ($p < 0.001$) unless otherwise noted.

Table M2. Demographic breakdown of survey respondents

	U.S. Full Sample	U.S. Subsample	Outside U.S.
Basic Demographics			
18–24	76%	71%	75%
25+	24%	29%	25%
Male	36%	45%	48%
Female	64%	55%	52%
White	62%	55%	–
Black/African American	5%	13%	–
Hispanic	14%	17%	–
Asian/Pacific Islander	10%	7%	–
Other or multiple races/ethnicities	10%	8%	–
Student Profile			
Freshman	24%	27%	30%
Sophomore	23%	26%	23%
Junior	24%	21%	18%
Senior	20%	16%	16%
Fifth year	5%	5%	9%
Other class standing	4%	5%	5%
Part time	17%	23%	9%
Full time	83%	77%	91%
On campus	29%	24%	19%
Off campus	71%	76%	81%
Academic Goal			
Digital badge(s)	12%	13%	25%
Vocational/occupational certificate	8%	10%	13%
Associate’s degree	20%	32%	6%
Bachelor’s degree	78%	72%	61%
Master’s degree	39%	35%	51%
Doctoral degree	14%	12%	18%
Advanced professional degree	10%	9%	10%
Other goal	2%	2%	1%
Major			
Agriculture and natural resources	2%	2%	2%
Biological/life sciences	8%	7%	5%
Business, management, marketing	15%	16%	17%
Communications/journalism	4%	3%	2%
Computer and information sciences	7%	9%	11%
Education, including physical education	7%	6%	4%
Engineering and architecture	8%	8%	17%
Fine and performing arts	3%	2%	2%
Health sciences, including professional programs	16%	18%	9%
Humanities	2%	2%	6%
Liberal arts/general studies	3%	4%	1%
Manufacturing, construction, repair, or transportation	1%	2%	1%
Physical sciences, including mathematical sciences	2%	2%	4%
Public administration, legal, social, and protective services	2%	3%	4%
Social sciences	8%	6%	7%
Other major	8%	9%	8%
Undecided	2%	2%	1%

Acknowledgments

The number of people required to complete a project of this scope is considerable, and it is only appropriate that they be acknowledged for their contributions and roles. First, I want to thank the 71,641 undergraduate students who completed the 2016 survey. Without the data generated from their responses, there would be no *ECAR Study of Undergraduate Students and Information Technology, 2016*. Second, I want to thank the survey administrators from the 183 colleges and universities that participated in the 2016 survey. They performed the critical tasks of securing institutional approval to administer the study, creating a sampling plan and providing that to our team, and distributing the ECAR student survey link to their respective student bodies.

Third, I want to thank the five individuals who contributed their experience, knowledge, and time as subject-matter experts. Their feedback, comments, and suggestions improved the quality of this report immensely. I am privileged to know them and to have worked with them on this project. They are, in alphabetical order,

- Tanya Joosten, Director, Digital Learning Research and Development, Academic Affairs and Co-Director, National Research Center for Distance Education and Technological Advancements, University of Wisconsin–Milwaukee;
- Jessica Knott, Learning Design Manager, MSU IT/MSU Hub, Michigan State University;
- Patsy D. Moskal, Associate Director, Research Initiative for Teaching Effectiveness, University of Central Florida;
- Kem Saichaie, Associate Director, Center for Educational Effectiveness, University of California, Davis; and
- David Wicks, Associate Professor and Chair of Digital Education Leadership, Seattle Pacific University.

Fourth, and finally, I want to thank my colleagues at EDUCAUSE for all that they have done to make this report possible. Thank you to Jamie Reeves for keeping the project on track, coordinating the data collection efforts, and for forcing me to be more selective in the questions asked. Thanks also to Mike Roedema, whose love and enthusiasm for this project coupled with his statistical expertise is evident on every page. Thanks also are due to Susan Grajek, Eden Dahlstrom, and Jeffrey Pomerantz for their careful reviews, insight, and guidance in finalizing this project. I also want to thank Kate Roesch for her contributions to data visualization, Gregory Dobbin and the publications team for their work in preparing the report for publication, and Lisa Gesner and Ashlan Sarff for their efforts to market this report and communicate its findings.

Appendix A: Participating Institutions

Aalto University
Abilene Christian University
Alexandria Technical & Community College
The American College of Greece
Anoka Technical College
Anoka-Ramsey Community College
Appalachian State University
Auburn University
Bemidji State University
Boise State University
Bridgewater State University
Broward College
Burman University
Butler University
California State Polytechnic University, Pomona
California State University, Los Angeles
California State University, Northridge
California State University, Sacramento
California State University, San Marcos
Central Lakes College
Centria University of Applied Sciences
Century College
Chadron State College
Chandler-Gilbert Community College
Chatham University
Clayton State University
Clemson University
College of Western Idaho
Collin College
Coppin State University
Dakota County Technical College
Dawson Community College
De Anza College
DeVry University
Emory University
Estrella Mountain Community College
Evergreen Valley College
Federation University Australia
Fond du Lac Tribal and Community College
Foothill College
Fordham University
Forman Christian College
Franklin W. Olin College of Engineering
Georgia College & State University
Georgia Gwinnett College
Glendale Community College
Grand Canyon University
Greenville Technical College
Heidelberg University
Helsinki Metropolia University of Applied Sciences
Hennepin Technical College
Hibbing Community College
The Hong Kong Polytechnic University
Humber College Institute of Technology & Advanced Learning
Illinois Central College
Inver Hills Community College
Itasca Community College
Joliet Junior College
Koc University
Lake Superior College
Lappeenranta University of Technology
Lawrence Technological University
Lebanese American University
LeTourneau University
Louisiana State University
Lycoming College
Marist College
Mesa Community College
Mesabi Range College
Messiah College
Metropolitan State University (Minnesota)
Michigan State University
Middle East Technical University
Minneapolis Community and Technical College
Minnesota State College–Southeast Technical

Minnesota State Community & Technical College
Minnesota State University Moorhead
Minnesota State University, Mankato
Minnesota West Community & Technical College
Montana State University
Montgomery County Community College
Normandale Community College
North Hennepin Community College
Northern Illinois University
Northland Community & Technical College
Northwest Technical College
Northwest University
Northwestern University
The Ohio State University
Oregon State University
Penn State Abington
Penn State Altoona
Penn State Beaver
Penn State Behrend
Penn State Berks
Penn State Brandywine
Penn State DuBois
Penn State Fayette
Penn State Greater Allegheny
Penn State Harrisburg
Penn State Hazleton
Penn State Lehigh Valley
Penn State Mont Alto
Penn State New Kensington
Penn State Schuylkill
Penn State Shenango
Penn State University Park
Penn State Wilkes-Barre
Penn State World Campus
Penn State Worthington Scranton
Penn State York
Pennsylvania College of Technology
Pepperdine University
Phoenix College
Pine Technical & Community College
Portland State University
Queen's University
Rainy River Community College
Ridgewater College
Riverland Community College
Rochester Community and Technical College
Rose-Hulman Institute of Technology
Saint Mary's University (Nova Scotia)
Saint Paul College
San Francisco State University
San Jose City College
San Jose State University
Satakunta University of Applied Sciences
Scottsdale Community College
Sonoma State University
South Central College
South Dakota State University
South Mountain Community College
Southern Illinois University
Southwest Minnesota State University
St. Cloud State University
St. Cloud Technical & Community College
St. Petersburg College
SUNY College at Plattsburgh
Tampere University of Applied Sciences
Tampere University of Technology
Thomas College
Trinity University
Truman State University
University College Dublin
University of Arkansas
University of Cape Town
University of Central Florida
University of Cincinnati
University of Delaware
University of Eastern Finland–Joensuu Campus
University of Florida
University of Helsinki
University of Jyväskylä
University of Lapland

University of Maryland
University of Maryland, Baltimore County
The University of Memphis
University of Michigan–Ann Arbor
University of Mississippi
University of Nevada, Las Vegas
University of New Mexico
University of North Dakota
University of North Texas
University of Northern Iowa
University of Notre Dame
University of Oregon
University of Pretoria
The University of South Dakota
University of Texas Rio Grande Valley
University of Trinidad and Tobago
University of Turku
University of Vaasa
University of Washington
University of Wisconsin–Superior
University of the Arts Helsinki
Vermilion Community College
Virginia Tech
Washington University in St. Louis
Wayne State College
West Virginia University
Western Carolina University
Winona State University

Appendix B: Validity and Reliability of Semantic Differential Constructs

For the past three years, we have asked students to place themselves on a series of 100-point semantic differential scales—scales bound by opposite terms—designed to measure their disposition toward IT, their attitude toward IT, and their usage of IT. Lower numbers indicate certain characteristics about disposition (reluctant, late adopter, skeptic), about attitudes (dissatisfied, discontented, perturbed), and about usage (never connected, peripheral). In contrast, higher numbers on the scale indicate alternative characteristics for disposition (enthusiast, early adopter, cheerleader), attitude (satisfied, content, pleased), and usage (always connected, central).

As in the previous two years, students were significantly more positive than negative in their disposition toward IT on every item in this series. That is, students were significantly more likely to refer to themselves as IT enthusiasts, supporters, experimenters, technophiles, early adopters, and cheerleaders (see figure B1). While scores for some individual items shifted slightly from last year, and although we removed the conservative-radical item, the overall score for disposition toward technology remained a constant 66.

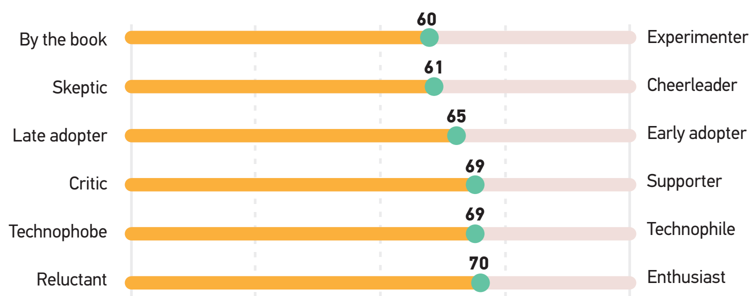

Figure B1. Student disposition toward technology

Students also had significantly more positive than negative attitudes toward IT. While individual mean scores varied slightly from last year, the overall score for attitude toward technology moved up 4 points to 75 this year (see figure B2).

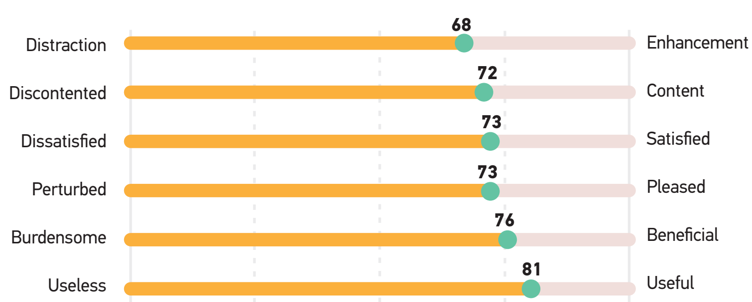

Figure B2. Student attitudes toward technology

Students also continue to report high levels of IT usage (see figure B3). The overall mean score increased from 73 to 75 this year.

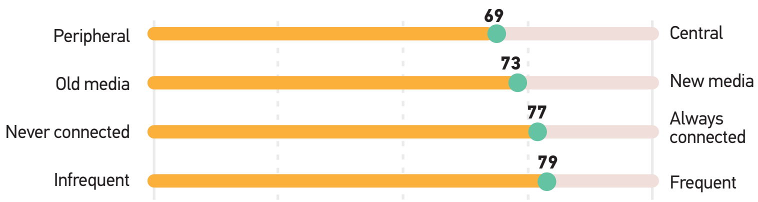

Figure B3. Student usage of technology

Although we established the face and construct validity of the semantic differential scales in the 2014 report and felt compelled to repeat our analyses with the 2015 sample, we again performed the same tests this year with nearly identical results. This further demonstrates the external validity (validity beyond the original sample on which it was established and its first replication sample) of the semantic differential scales and establishes firmly the reliability of these measures. Additional details about this statistical analysis are available upon request through study@educause.edu.

Notes

1. Monica Anderson, "Racial and Ethnic Differences in How People Use Mobile Technology," *Pew Research Center*, April 30, 2015.

2. For more on technology's democratization or equalization effects, see Sara Kiesler, Jane Seigel, and Timothy W. McGuire, "Social Psychological Aspects of Computer-Mediated Communication," *American Psychologist* 39, no. 10 (October 1984): 1123–1134; Vitaly J. Dubrovsky, Sara Kiesler, and Beheruz N. Sethna, "The Equalization Phenomenon: Status Effects in Computer-Mediated and Face-to-Face Decision-Making Groups," *Human-Computer Interaction* 6, no. 2 (1991): 119–146; and Susan C. Herring, "Gender and Democracy in Computer-Mediated Communication," in *Computerization and Controversy: Value Conflicts and Social Choices*, ed. R. Kling (San Diego: Academic Press, 1996), 476–489.

3. Private BA students rated themselves lower in disposition than public BA and community college students, lower in attitude than students at all public institutions and private MA institutions, and lower in usage than public BA students. Community college students have more positive attitudes about technology than students from public MA institutions or DR institutions (public or private); they also rated themselves lower on technology usage items than public or private BA students.

4. IDC, "Worldwide Tablet Shipments Decline More Than 12% in Second Quarter as the Market Shifts Its Focus Toward Productivity, According to IDC," August 1, 2016.

5. Monica Anderson, "Smartphone, Computer or Tablet? 36% of Americans Own All Three," *Pew Research Center*, November 25, 2015. Pew combines laptops and desktops into an overarching category of "computer," whereas we ask only about laptop ownership.

6. An ordered logistic regression model of smartphone usage predicting tablet usage returns the following statistics: Odds ratio = 1.37; standard error = 0.02; $z = 21.01$; $p < .001$; $n = 8{,}967$. From this model we can glean that the probability that students who do not use smartphones for any coursework will use a tablet for at least one course is 32%, but the probability that students will use a tablet for at least one course is 63% when students use smartphones for every course.

7. Ordered logistic regression model of tablet ownership predicting tablet usage: Odds ratio = 31.57; standard error = 2.39; $z = 45.68$; $p < .001$; $n = 8{,}531$.

8. See David Gilbert, "The Tablet Is Dead: Usage Declines For First Time As Teenagers Stick With Smartphones," *International Business Times*, June 1, 2016; and Katie Young, "Tablet Usage Declines," *Global Web Index*, May 31, 2016.

9. We think that the drop in levels of importance of wearable technologies is partially due to a small change in the survey instrument. In 2016, we replaced "Google Glass" with the most common write-in, "Headset." We observed a spike in the number of students who checked the new option, resulting in a boost of ownership and usage and a reduction in the levels of importance.

10. First-generation students are those who self-identify as "the first person in your immediate family to attend college."

11. Off- and on-campus students are self-identified based on where they live. Off-campus students ($M = 4.03$, $SD = .88$, $N = 7{,}511$) and on-campus students ($M = 3.79$, $SD = .95$, $N = 2{,}372$), $t(9{,}881) = 11.17$, $p < .0001$, *Cohen's d* = 0.22.

12. In 2015, we found that the number-three overall motivating factor for faculty to integrate more or better technology into their teaching practices and curricula was the "confidence that the technology would work the way [they] planned," with 30% of respondents ranking this item in the top three. For more

information, see D. Christopher Brooks, with a foreword by John O'Brien, *ECAR Study of Faculty and Information Technology, 2015*, research report (Louisville, CO: ECAR, October 2015), 16.

13. Brooks, *ECAR Study of Faculty and Information Technology, 2015*.

14. Stepwise ordered logistic regression model with $p < .001$ threshold for inclusion. $N = 3{,}588$; *Pseudo* $R^2 = .16$.

15. Barbara Means, Yukie Toyama, Robert Murphy, Marianne Bakia, and Karla Jones, *Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies* (Washington, D.C.: U.S. Department of Education, Office of Planning, Evaluation, and Policy Development, 2010).

16. Ibid., 18.

17. Ibid., 19.

18. John Fleming, "Millennials Most Trusting on Safety of Personal Information," *Gallup*, May 11, 2015.

19. Stepwise ordered logistic regression model with $p < .001$ threshold for inclusion. $N = 5{,}090$; *Pseudo* $R^2 = .12$.

20. Terry Müller, "Persistence of Women in Online Degree-Completion Programs," *The International Review of Research in Open and Distributed Learning* 9, no. 2 (2008).

21. Colin Latchem, "Gender Issues in Online Learning," in *Culture and Online Learning: Global Perspectives and Research*, eds., Insung Jung and Charlotte Nirmalani (Sterling, VA: Stylus, 2014).

22. Doug Lederman, "Who Benefits from Online Ed?" *Inside Higher Ed*, February 25, 2013.

23. For more information, see the National Survey of Student Engagement (NSSE).

24. Bernard R. McCoy, "Digital Distractions in the Classroom Phase II: Student Classroom Use of Digital Devices for Non-Class Related Purposes," *Journal of Media Education* 7, no. 1 (2016): 5–32.

25. Reynol Junco and Sheila R. Cotten, "No A 4 U: The Relationship Between Multitasking and Academic Performance," *Computers & Education* 59 (2012): 505–514.

26. McCoy, "Digital Distractions in the Classroom," 19.

27. Faria Sana, Tina Weston, and Nicholas J. Cepeda, "Laptop Multitasking Hinders Classroom Learning for Both Users and Nearby Peers," *Computers & Education* 62 (2013): 24–31.

28. Clay Shirky, "Why I Just Asked My Students to Put Their Laptops Away," September 8, 2014.

29. See Eden Dahlstrom and D. Christopher Brooks, with a foreword by Diana Oblinger, *ECAR Study of Faculty and Information Technology, 2014*, research report (Louisville, CO: ECAR, July 2014), and Brooks, *ECAR Study of Faculty and Information Technology, 2015*.

30. Robert M. Bernard, Philip C. Abrami, Eugene Borokhovski, C. Anne Wade, Rana M. Tamin, Michael A. Surkes, and Edward C. Bethel, "A Meta-Analysis of Three Types of Interaction Treatments in Distance Education," *Review of Educational Research* 79, no. 3 (2009): 1243–1289.

31. Michael Prince, "Does Active Learning Work? A Review of the Research," *Journal of Engineering Education* 93, no. 3 (2004): 223–231.

32. Keith Trigwell, Michael Prosser, and Fiona Waterhouse, "Relations Between Teachers' Approaches to Teaching and Students' Approaches to Learning," *Higher Education* 37, no. 1 (January 1999): 57.

33. McCoy, "Digital Distractions in the Classroom," 13–14.

34. David Wicks, personal communication.