International Journal of Teaching and Learning in Higher Education 2020, Volume 32, Number 1, 73-86
http://www.isetl.org/ijtlhe/ ISSN 1812-9129

Examining Higher Education Faculty Use of Current Digital Technologies: Importance, Competence, and Motivation

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Higher education faculty use of current digital technologies based on their perception of importance, competence, and motivation is examined in this study. Two hundred and forty-seven faculty in the United States responded to an online survey on current digital technology use. Descriptive statistics and categorical means for the digital technologies are provided. Faculty rated the use of learning management system as the highest in terms of importance and competence. They rated social media as the lowest in terms of importance and adaptive learning in terms of competence. For motivation to integrate digital technology, faculty rated benefit to learning as the most influential factor and reappointment, promotion, and tenure as the least influential factor. Faculty characteristics such as gender, teaching level, primary teaching method, faculty rank, and teaching experience and its association with faculty beliefs of importance, competence and motivation on using digital technologies are also examined in this study.

As access to technology continues to increase in post-secondary institutions, there is increased emphasis that faculty not only use the technologies they have access to, but that they use them in ways that enhance teaching and learning (New Media Consortium [NMC], 2017). Faculty in post-secondary institutions are now teaching students who are more well versed and adept at using technology than before (Conole, de Laat, Dillon, & Darby, 2008). Students expect their learning to be enhanced by digital technologies, including the use of learning management systems and content-specific technologies (Conole et al., 2008; Young, 2012). Even when faculty are interested and willing to integrate technology, they still must be critical consumers of technology. Studies have found that higher education faculty who attempted to integrate digital technologies in their teaching did so with little rationale, thought about learning theory, or awareness of how technology can support teaching and learning of their content (Price & Kirkwood, 2014).

Researchers have examined faculty adoption of technology due to its perceived ease of use and perceived usability (Ahmad, Madarsha, Zainuddin, Ismail, & Nordin, 2010; Buchanan, Sainter & Saunders, 2013; Cheung & Vogel, 2013; Schoonenboom, 2014). Researchers have also focused on adoption of specific types of technologies over the last two decades. Birch and Burnett (2009) examined adoption of elearning environments. Ajjan and Hartshone (2008) investigated faculty decisions to adopt Web 2.0 technologies. Martin and Parker (2014) examined the adoption of synchronous online technologies. Fathema, Shannon, and Ross (2015) examined faculty use of a Learning Management System. Use of mobile learning technologies in higher education have been researched extensively (Pimmer, Mateescu, & Gröhbiel, 2016). Belikov and Bodily (2016) examined incentives and barriers for open educational resources adoption. Though studies have been conducted on specific technologies, limited studies have examined adoption comparing a variety of digital technologies by faculty in higher education. Watty, McKay and Ngo (2016) reviewed adoption of six new technologies (intelligent tutoring system, social media technologies, click technology, video learning resources, flipped classroom technologies and instant web response tool). From their interviews they found that faculty resistance was the key barrier to technology adoption. It is essential to examine faculty use of digital technologies periodically to identify faculty perception on adoption and use of the current digital technologies in higher education.

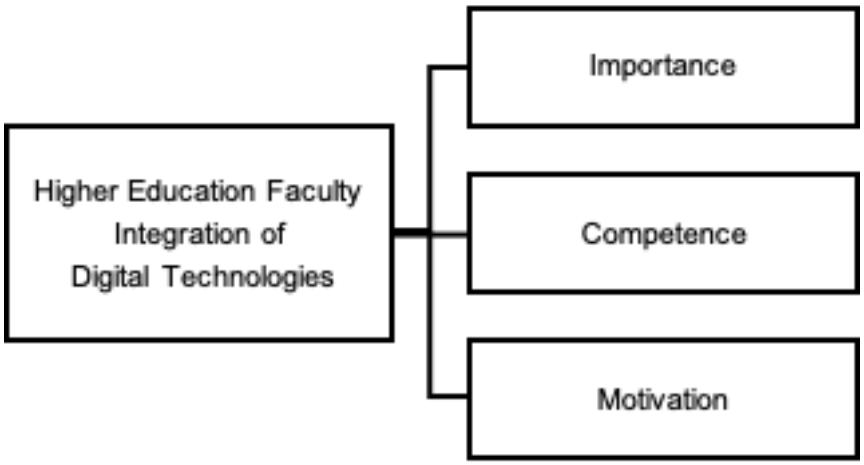
Framework for Adoption and Integration of Current Digital Technologies

Building on the existing readiness framework (Rollnick, Mason and Butler, 2010), the authors of this article have adapted it to create a framework (see Figure 1) with three components—importance, competence and motivation—that are considered essential in adopting and integrating digital technologies.

It is essential to examine faculty attitudes regarding the importance of various digital technologies in higher education. Students are likely to experience more positive learning outcomes when their faculty have positive attitudes towards digital technologies and online course delivery (Volery, 2001). Instructor ability is conceptualized as the faculty's beliefs or perceptions of their own competence at teaching as related to use of instructional strategies and teaching effectiveness (Lee & Tsai, 2010).

Post-secondary faculty largely use technology in their teaching to solve existing problems or enhance aspects of the teaching process, such as increasing collaboration, student motivation, opportunities for critical thinking, and access to resources (Stedman, Roberts, Harder, Myers, & Thoron, 2011). A survey

Figure 1
Higher education faculty integration of digital technologies



study of faculty at multiple universities found that digital technologies were used largely to communicate with students and to support diverse ways of learning (Smith, 2014). Few faculty in that study reported that a benefit of using technology was to promote active learning, provide feedback, or promote collaboration between students. Fleagle (2012) found that post-secondary faculty could not discuss or justify their reasons for using or not using technology without discussing the pedagogical reasons for their decisions. Participants in the study continuously referred to examples where technology was either used or explicitly not used for pedagogical reasons. Reid (2012, 2017) advised universities to step back and consider theoretical approaches to adoption, such as Rogers' (2003) diffusion of innovations model, as well as research-based approaches to increasing the likelihood that faculty will increase their use, and the effectiveness of their use, of digital technologies. Brown (2016) conducted a systematic review of the literature on faculty members' adoption and use of online tools for face-to-face instruction and found six factors that influenced faculty adoption of technology: the faculty member's interactions with technology, academic workload, institutional environment, interactions with students, attitudes and beliefs about teaching, and opportunities for professional development.

Current Digital Technologies Used in Higher Education

In this section we synthesize the literature on digital technologies that are frequently used in higher education and were a focal part of this research study.

Learning management systems. Learning management systems (LMSs) have become universal at post-secondary institutions as tools to support the dissemination of resources and materials, submission and grading of assignments, and collaboration between students (Dahlstrom, Brooks, & Bischel, 2014; Vovides, Sanchez-Alonso, Mitropoulou, & Nickmans, 2007). Based on a large-scale 2014 Educause study, 99% of post-secondary institutions have an LMS in place, and nearly 85% of faculty use it to some extent (Dahlstrom et al., 2014). A recent study at a large university found that over time and with varied modes of support (face-to-face workshops, webinars, recorded screen casts, and printed resources), use of the LMS increased (Rhode, Richter, Gowen, Miller, & Wills, 2017). Research has also found that instructors struggle with the initial adoption of an LMS based on how well it aligns to previous tools that they used (West, Waddoups, & Graham, 2007).

Collaboration tools. In higher education, increased access to devices has led to increased use of collaborative tools, such as Google programs (Docs, Sheets, Drive, Classroom), wikis, discussion forums, and other shared collaborative spaces. Stantchev, Colomo-Palacios, Soto-Acosta, & Misra (2014) in their study found that cloud computing tools, such as Google Drive and Dropbox for sharing resources, were rated with a higher ease of use than the LMS. Though it has a higher perceived eased of use, it has a higher security policy about storing sensitive information. Biasutti (2017) found that wikis and forums were both promising tools that supported students' learning in post-secondary courses, and that while the two tools both provided collaboration, they

each had their nuanced benefits, and both categories of tools were useful in courses. Social media and online meeting tools are also considered collaborative tools. Manca and Ranieri (2016) examined potentials and obstacles of using social media (e.g., Twitter, Facebook, LinkedIn, ResearchGate, and Academia.edu) for teaching in higher education. They found that social media use in higher education teaching was still restricted due to cultural resistance, pedagogical issues, or institutional constraints. Veletsianos (2012) examined higher education scholars' participation on Twitter and found that they used twitter to share information and resources related to professional practice and their classrooms. Online synchronous meeting tools such as Webex and Zoom are used for synchronous collaboration. Martin and Parker (2014) found institutional resource availability, increased social presence, enhanced student learning, and the availability of technology as the major reasons faculty use synchronous tools in their teaching.

Audio/video tools. Tools to produce audio and video recordings have become more common in post-secondary education courses. One type of video creation that has become more popular is screencasting. Screencasts are ways to play back digitally recorded content that typically includes audio and video (Udell, 2005). Research on screencasts found that faculty who taught online reported benefits in creating screencasts to communicate content to students (Sugar, Brown, & Luterbach, 2010). They found that screencasts tended to have similar structures, such as audio narration of content and visuals to enhance the screencast. A study of faculty and students found that both groups preferred to learn from video tutorials over text-based tutorials, but when asked which ones they would teach with, they had mixed opinions with both groups making an argument for the benefit of text-only tutorials (Lantz, Insua, Armstrong, Dror, & Wood, 2018). The finding that individuals prefer to learn from video than text aligns with prior work that found that post-secondary instructors sought to integrate video into post-secondary courses (Burke, Snyder, & Rager, 2009).

Technology trends.

Mobile learning. Fu and Hwang (2018) noted the exponential growth in mobile learning (m-learning) innovations and studies since 2007. Their synthesis of the literature noted that most mobile learning studies found association with collaborative and constructivist-oriented technologies. Research found that the use of mobile technologies greatly increased students' access to authentic learning opportunities and collaboration with classmates (Ryu & Parsons, 2012). Still, a synthesis of empirical studies on mobile learning found that many post-secondary faculty tried to use mobile technologies in teacher-directed manners that inhibited discovery and collaboration (Pimmer et al., 2016). One barrier identified in the synthesis was a lack of professional development and support related to how to teach with the technology (Pimmer et al., 2016). Some research on mobile learning suggested that if faculty are not adept at using the technology themselves, then they are less likely to teach with the technology (Fu & Wang, 2018).

Adaptive learning. Many post-secondary institutions have started to purchase and incorporate adaptive learning systems, which are digital programs that adapt learning modules, instruction, and assessments based on learners' performances. Research on effective strategies used in tutoring and instruction were used to inform the design of these adaptive learning programs (Lehman, D'Mello, Cade, Person, 2012). Studies have found that adaptive learning systems are as effective as or more effective than face-to-face individual tutoring sessions (VanLehn, 2011). With adaptive learning the generative approach of programs to make data-based decisions on which instructional segments and experiences to provide learners has led to its rapid adoption and popularity in higher education settings (New Media Consortium, 2017). From a literature base stemming from data analytics, adaptive learning continues to push boundaries in its use of data to support learners' experiences (Huda et al., 2019).

Gaming and simulations. Gamification—or turning learning experiences into games—is starting to occur more frequently in higher education. Those who advocate for the gamificiation of content contend that games naturally increase the motivation to learn content and to succeed (Herro, King, Jacques, & Wersinger, 2016; Kapp, 2012). A synthesis of studies on gamification in high school and post-secondary settings found that gamification increases student motivation to learn new content (Lister, 2015). There is mixed research at this point about how well gamification impacts learning (Barata, Gama, Jorge, Gonçalves, 2013; Lister, 2015). At the post-secondary level, faculty have expressed concerns about integrating games into courses due to the informal connotations of gamification (Alsawaier, 2018; Barata et al., 2013). Howard, Englert, Kameg and Perozzi (2011) examined the integration of simulation in the nursing undergraduate curriculum. Faculty found the use of simulation to be beneficial though there were several technology-based challenges. Simulation use is more prevalent among nursing and medical education programs (Ganley & Linnard-Palmer, 2012; Kirkman, 2013).

Purpose of the Study

While efforts to support faculty members' adoption of technology-rich pedagogies continue to be examined, researchers have found promise that focused initiatives can support faculty's adoption of technology-rich pedagogies (Englund, Oloffson & Price, 2017). However, prior to identifying how to support faculty,

there is a need for institutions to examine the current state of digital technologies used by faculty, as well as their perceived importance and competence in teaching with digital technologies. This data can then inform the design and implementation of future work.

This study is framed around the following research questions:

1. What digital technologies do faculty consider important to their teaching?
2. What digital technologies do faculty consider to be competent in?
3. What motivational factors influence faculty use of digital technologies?
4. How do the demographical factors (gender, teaching level, primary teaching method, faculty rank, and teaching experience) associate with faculty belief of importance, and competence on using digital technologies?

Table 1
Faculty Demographic Characteristics (n = 247)

Variables		Frequency
Age		Mean= 48.31 SD= 12.24
Gender	Female	147 (60.2%)
	Male	90 (36.9%)
Rank	Full Professor	42 (17.4%)
	Associate Professor	45 (18.7%)
	Assistant Professor	46 (19.1%)
	Full time Lecturer	69 (28.6%)
	Part time Lecturer	39 (16.2%)
Primary Teaching Method	Asynchronous	111 (49.8%)
	Synchronous	15 (6.7%)
	Hybrid/ Blended	41 (18.4%)
	Face-to-Face	56 (25.1%)
Level	Undergraduate	136 (56.9%)
	Masters	73 (30.5%)
	Doctoral	30 (12.6%)
Years Teaching	0-5 Years	42 (17.1%)
	6-10 Years	49 (20.0%)
	11-15 Years	45 (18.4%)
	More than 15	109 (44.5%)
Academic Discipline	Humanities	68 (29.4%)
	Social sciences	119 (51.5%)
	Computing and natural sciences	22 (9.5%)
	Health science	22 (9.5%)
Taught Hybrid	Yes	157 (64.3%)
	No	87 (35.2%)
Taught Online	Yes	157 (64.3%)
	No	87 (35.2%)

Table 2
Descriptive Statistics on Importance and Competence of Using Digital Technologies

Digital Technologies	Example Technologies	Importance M (SD)	Competence M (SD)
Learning Management Tools	Canvas, Blackboard	3.71 (0.66)	3.60 (0.61)
Collaboration through Cloud Computing	Dropbox, Google Drive	3.31 (0.91)	3.52 (0.75)
Social Media	LinkedIn, Facebook	1.80 (0.99)	3.19 (0.96)
Online Meeting Tools	Webex, Zoom	2.75 (1.18)	3.04 (1.03)
Collaborative		2.62 (0.77)	3.25 (0.75)
Video Creation	Camtasia, Kaltura	2.75 (1.11)	2.71 (1.09)
Supplemental Video	Youtube, Vimeo	3.15 (0.91)	3.25 (0.91)
Podcasts	Audacity	1.89 (0.93)	2.55 (1.07)
Audio Visual Tools		2.60 (0.76)	2.84 (0.85)
Mobile Applications		2.12 (1.06)	2.82 (1.03)
Games and Simulation		2.07 (1.07)	2.37 (1.06)
Adaptive Learning		2.20 (1.07)	2.19 (1.08)
Technology Trends		2.13 (0.90)	2.46 (0.88)

Methods

Participants

The survey was distributed through the SurveyShare electronic survey tool to three distribution lists in the United States: Association for Educational Technology Communications (1984 members), AERA Online Teaching and Learning Special Interest Group (250 members), and southeastern public university faculty (529 members) in the United States. A total of 247 faculty (9% of those invited) responded to the survey. Table 1 presents a description of the participants, including age, gender, rank, delivery method, level, years teaching, and years teaching online.

Instrument

The digital technologies survey was created in consultation with educational technology experts in higher education. The Director of Distance Education, the Director of the Center for Teaching and Learning, and the Director of Audio Visual Integration and Support for Learning consultants at this southeastern university were consulted during the creation of the survey. Content validity was checked with two external experts in instructional technology.

In addition to demographic information, the instrument consists of six constructs: importance, competence, motivational factors, interest in receiving information, interest in receiving training, and type of professional development support. In this article, results from only three of the constructs (importance, competence, and motivational factors) is described. The same list of digital technology items were used for each construct, and the respondents were asked to rate how important each digital technology was for their teaching, as well as how competent they are in using the digital technologies. The digital technologies fall into four categories: Learning Management System (1 item), Collaborative Tools (3 items), Audio-Visual Tools (3 items), and Technology Trends (3 items). In the section for importance, respondents were asked to rate the importance of the digital technologies on a 4-point Likert scale from 4=Very Important, 3=Moderately Important, 2=A Little Important, and 1=Not Important. In the section for competence, respondents were asked to rate their competence to use the digital technologies on a 4-point Likert scale from 4=Very Competent, 3=Moderately Competent, 2=A little Competent and 1=Not Competent. In the section for motivational factors, respondents were asked to rate the factors influencing their use of digital technologies on a 4-

Table 3
Descriptive Statistics on Motivational Factors

Motivational Factors	Influence M (SD)
Benefit to Learning	3.72 (0.589)
Time to Design	3.53 (0.65)
Technology Skills	3.16 (0.92)
Support from Administration	2.51 (1.08)
Recognition	2.72 (1.15)
Workload Policy	2.58 (1.18)
Reappointment, Promotion and Tenure	2.36 (1.25)

point Likert scale from 4= Very Influential, 3= Moderately Influential, 2= A little Influential, and 1= Not Influential.

Data Analytical Procedure

Descriptive statistics (Means and Standard Deviations) are reported both at the item level, at the subscale level and also by various demographic factors. Cronbach's alpha was used to check the internal consistencies of the responses to the survey items. T-tests were used to examine the differences between gender, experience teaching hybrid, and experience teaching online. Bonferroni adjustment was used to set the p value to .004 due to 12 family wise comparisons. Analysis of variance (ANOVA) was employed to examine differences among faculty responses based on primary online teaching method, years of experience teaching, academic discipline, academic rank, and teaching level. We used effect sizes from ANOVA (small = .01; moderate = .06; large = .14) to document the size of obtained differences (Cohen, 1988).

Results

Faculty Beliefs on the Importance and Competence of Using Digital Technologies

Descriptive Statistics (Means and Standard Deviations) by item within each of the four subscales (Learning Management System, Collaboration Tools, Audio Visual Tools and Technology Trends) are reported in Table 2.

Influence of Motivational Factors for Faculty Using Digital Technologies

Descriptive Statistics (Means and Standard Deviations) by item that influenced their use of digital technologies are reported in Table 3. Descriptive statistics on importance and competence scores by demographic characteristics are reported in Table 4.

Demographic Factors and Faculty Perception of Importance and Competence on Using Digital Technologies

Comparison between gender and experience teaching hybrid and online.

Gender. Three independent-samples t-tests were conducted to compare faculty beliefs on the importance of digital technologies and competence on the use of digital technologies between male and female faculty. There were no significant differences in the scores between male and female faculty on the importance of digital technologies or the competence in using digital technologies.

Experience teaching hybrid. Three independent-samples t-tests were conducted to compare faculty belief on importance of digital technologies, competence on the use of digital technologies and faculty motivation to use digital technologies between faculty who have taught hybrid and those who have not.

There were significant differences between faculty who had taught hybrid and not, on the importance of collaboration tools, $t(154.39) = 5.68$, $p < .001$, $d = 0.78$ (large effect), importance of audio visual tools $t(242) =$

Table 4

Descriptive Statistics of Importance and Competence Scores by Demographic Characteristics

	Importance				Competence			
	Learning Management System M (SD)	Collaboration Tools M (SD)	Audio Visual Tools M (SD)	Technology Trends M (SD)	Learning Management System M (SD)	Collaboration Tools M (SD)	Audio Visual Tools M (SD)	Technology Trends M (SD)
Gender								
Female	3.71 (0.67)	2.69 (0.77)	2.69 (0.75)	2.18 (0.90)	3.465 (0.60)	3.33 (0.70)	2.86 (0.78)	2.48 (0.84)
Male	3.68 (0.67)	2.54 (0.80)	2.47 (0.75)	2.10 (0.89)	3.49 (0.62)	3.13 (0.81)	2.82 (0.97)	2.46 (0.96)
Rank								
Full Professor	3.55 (0.86)	2.52 (0.83)	2.52 (0.85)	2.00 (0.96)	3.36 (0.69)	2.97 (0.89)	2.42 (0.93)	2.20 (0.87)
Associate	3.67 (0.67)	2.70 (0.80)	2.58 (0.78)	2.10 (0.94)	3.67 (0.48)	3.35 (0.71)	2.83 (0.87)	2.47 (0.93)
Assistant	3.63 (0.80)	2.48 (0.75)	2.54 (0.80)	2.03 (0.79)	3.66 (0.71)	3.43 (0.70)	3.13 (0.85)	2.64 (0.87)
Full-time Lecturer	3.83 (0.45)	2.67 (0.73)	2.69 (0.73)	2.19 (0.87)	3.67 (0.56)	3.29 (0.62)	2.85 (0.73)	2.47 (0.84)
Part-time Lecturer	3.82 (0.45)	2.75 (0.78)	2.62 (0.62)	2.33 (0.90)	3.59 (0.59)	3.21 (0.84)	2.95 (0.83)	2.50 (0.87)
Primary Delivery Method								
Asynchronous	3.86 (0.42)	2.80 (0.69)	2.73 (0.74)	2.27 (0.87)	3.74 (0.52)	3.39 (0.63)	3.01 (0.81)	2.59 (0.84)
Synchronous	3.80 (0.56)	2.76 (0.46)	2.76 (0.78)	2.07 (0.91)	3.47 (0.52)	3.38 (0.62)	2.71 (0.86)	2.29 (0.87)
Hybrid	3.68 (0.61)	2.93 (0.70)	2.77 (0.69)	2.35 (1.01)	3.54 (0.63)	3.43 (0.58)	3.04 (0.72)	2.77 (0.86)
Face-to-Face	3.63 (0.75)	2.30 (0.80)	2.40 (0.75)	1.89 (0.84)	3.50 (0.66)	3.13 (0.84)	2.65 (0.88)	2.20 (0.89)
Level								
Undergraduate	3.77 (0.56)	2.49 (0.79)	2.49 (0.76)	2.08 (0.90)	3.60 (0.60)	3.13 (0.76)	2.76 (0.85)	2.41 (0.90)
Masters	3.66 (0.77)	2.90 (0.64)	2.84 (0.68)	2.24 (0.83)	3.59 (0.64)	3.42 (0.72)	3.00 (0.83)	2.53 (0.87)
Doctoral	3.50 (0.82)	2.60 (0.81)	2.50 (0.85)	2.00 (1.02)	3.50 (0.63)	3.37 (0.72)	2.66 (0.92)	2.34 (0.82)
Years Teaching								
0-5 years	3.83 (0.54)	2.68 (0.75)	2.67 (0.79)	2.25 (0.89)	3.55 (0.59)	3.34 (0.65)	3.00 (0.92)	2.58 (0.86)
6-10 years	3.86 (0.41)	2.63 (0.67)	2.59 (0.68)	2.07 (0.74)	3.82 (0.39)	3.39 (0.64)	2.90 (0.75)	2.48 (0.86)
11-15 years	3.89 (0.38)	2.58 (0.79)	2.61 (0.72)	2.07 (0.93)	3.71 (0.46)	3.32 (0.70)	2.98 (0.77)	2.47 (0.84)
More than 15 years	3.55 (0.80)	2.63 (0.83)	2.59 (0.80)	2.16 (0.95)	3.49 (0.70)	3.13 (0.84)	2.74 (0.90)	2.41 (0.92)
Academic Discipline								
Humanities	3.72 (0.67)	2.35 (0.81)	2.41 (0.81)	1.86 (0.77)	3.60 (0.60)	3.18 (0.79)	2.67 (0.80)	2.25 (0.83)
Social sciences	3.66 (0.70)	2.87 (0.66)	2.76 (0.74)	2.35 (0.93)	3.64 (0.62)	3.44 (0.62)	3.09 (0.76)	2.69 (0.84)
Computing and natural sciences	3.72 (0.63)	2.03 (0.86)	2.19 (0.63)	1.74 (0.91)	3.55 (0.60)	2.89 (0.97)	2.35 (1.09)	2.05 (0.97)
Health science	3.91 (0.43)	2.91 (0.45)	2.89 (0.56)	2.56 (0.66)	3.36 (0.66)	3.00 (0.73)	2.63 (0.91)	2.51 (0.83)
Taught Online								
Yes	3.84 (0.47)	2.77 (0.69)	2.68 (0.74)	2.17 (0.85)	3.71 (0.51)	3.41 (0.63)	2.99 (0.80)	2.56 (0.85)
No	3.48 (0.85)	2.36 (0.85)	2.43 (0.76)	2.04 (0.98)	3.41 (0.69)	2.98 (0.85)	2.56 (0.87)	2.28 (0.92)
Taught Hybrid								
Yes	3.76 (.059)	2.83 (0.68)	2.74 (0.74)	2.33 (0.93)	3.68 (0.58)	3.42 (0.54)	3.02 (0.74)	2.65 (0.85)
No	3.61 (0.77)	2.25 (0.81)	2.34 (0.73)	1.78 (0.71)	3.45 (0.68)	2.95 (0.94)	2.49 (0.94)	2.10 (0.84)

4.04, $p < .001$, $d = 0.54$ (medium effect), and importance of technology trends $t(219.73) = 5.23$, $p = .001$, $d = 0.67$ (medium effect). Faculty who had taught hybrid had rated the subscales higher in all three cases.

There were also significant differences between faculty who had taught hybrid and not on their competence of collaboration tools $t(118.24) = 4.33$, $p < .001$, $d = 0.62$ (medium effect), competence of audio visual tools

$t(146.47) = 4.59$, $p < .001$, $d = 0.63$ (medium effect), and competence of technology trends $t(242) = 4.95$, $p = .001$, $d = 0.66$ (medium effect). Faculty who had taught hybrid had rated the subscales higher in all three cases.

Experience teaching online. Three independent-sample t-tests were conducted to compare faculty belief on importance of digital technologies, competence on the use of digital technologies, and faculty motivation to use digital technologies between faculty who have taught online and those who have not.

There were significant differences between faculty who had taught online and those who have not on importance of learning management systems $t(116.46) = 3.64$, $p < .001$, $d = 0.52$ (medium effect) and on the importance of collaboration tools $t(149.96) = 3.83$, $p < .001$, $d = 0.57$ (medium effect). Faculty who had taught online rated the subscales higher in both the subscales.

There were significant differences between faculty who had taught online and those who have not on competence of learning management systems $t(138.13) = 3.55$, $p = .001$, $d = 0.52$ (medium effect), on the competence of collaboration tools $t(138.49) = 4.16$, $p < .00,1$ and on the competence of audio visual tools $t(242) = 3.82$, $p < .001$, $d = 0.57$ (medium effect). Faculty who had taught online rated the subscales higher in all three cases.

Comparison between academic rank, primary teaching method, teaching level, and years of teaching.

Academic rank. One-way ANOVA was used to compare faculty perception on the importance of using digital technologies and competence between academic rank, which included full professor, associate professor, assistant professor, full-time lecturer, and part-time lecturer.

One way ANOVA revealed significant differences between faculty of different academic rank on competency with audio visual tools, $F(4, 236) = 4.23$, $p = .003$, $\eta^2 = .067$ (medium effect). Tukey post-hoc tests revealed a significant difference between full professors and assistant professors as well as between full professors and part-time lecturers. Assistant professors and part-time lecturers rated had higher faculty belief in their competency with audio visual tools compared to Full professors.

Primary teaching method. One-way ANOVA was used to compare faculty perception on the importance of using digital technologies and of having competence in using those technologies as primary teaching tools in courses that are face-to-face, hybrid/blended, synchronous online, or asynchronous online.

One way ANOVA revealed significant differences between faculty who teach via different teaching methods on the importance of collaboration tools $F(3, 219) = 8.25$, $p < .001$, $\eta^2 = .101$ (medium effect). Tukey post-hoc tests revealed a significant difference between faculty who teach asynchronous, hybrid/blended with faculty who teach face to face. Faculty who teach asynchronous, hybrid/blended significantly rated higher on the importance of collaboration tools compared to faculty who teach face to face.

Teaching level. One-way ANOVA was used to compare faculty perception of the importance of using digital technologies and of competence in using digital technologies among faculty who teach at different levels: undergraduate, masters, and doctoral.

One way ANOVA revealed significant differences between faculty at different teaching levels on the importance of collaboration tools $F(2, 236) = 6.96$, $p < .001$, $\eta^2 = .055$ (medium effect). Tukey post-hoc tests revealed faculty who teach undergraduate students were significantly lower in their ratings on the importance of collaboration tools as compared to the faculty who teach at the Masters level.

Years of teaching. One-way ANOVA was used to compare faculty perception on importance of using digital technologies and competence of using digital technologies between faculty with varied years of teaching experience: 1-5 years, 6-10 years, 11-15 years, and more than 15 years.

One way ANOVA revealed significant differences between faculty with different years of teaching experience on the importance of learning management systems $F(3, 241) = 4.96$, $p = .002$, $\eta^2 = .058$ (medium effect). Tukey post-hoc tests revealed faculty who taught 6-10, or 11-15 years had significantly higher belief than those who had taught more than 15 years.

Discussion

Highest Rated Technology

The faculty rated learning management system as the highest in both terms of importance and competence in using technology. The high rating of importance and competence of LMS is not a new finding on its own due to the prevalence of LMS use and integration as a popular, or even necessary, tool (Vovides et al., 2007). However, combined with the finding that faculty rated benefit to learning as the most influential factor for digital technology adoption, it has implications for the design of university programs for professional development. Jia, Bhatti, and Nahavandi (2014) found that faculty's belief of the value of LMS can be influenced by providing faculty with customized workshops linking specific LMS functions and features to instructional goals. The LMS support is tied to overall technology integration and previous conclusions that tie competence to the belief that technology can support learning (Koehler & Mishra, 2005; Mishra & Koehler, 2006; Niess, 2005, 2011).

Additional implications for these findings support recommendations for universities to invest resources in providing LMS support such as user-centered software that can increase faculty competence and belief in their abilities to apply LMS for their instructional needs, online course templates for faculty (Zheng, Wang, Doll, Deng, & Williams, 2018), and technical support that helps faculty users overcome the learning curve and solves technical issues on LMS usage (Yusof, Kuljis, Papazafeiropoulou, & Stergioulas, 2008).

Lowest Rated Technology

Faculty rated social media as the lowest in terms of importance and adaptive learning the lowest in terms of competence. Faculty could have rated social media as the least important technology due to the cultural resistance, pedagogical issues, or institutional constraints that results with social media use in higher education (Manca & Ranieri, 2016). Moran, Seaman and Tinti-Kane (2011) list privacy and integrity as the two most important concerns of faculty use of social media, which thus hinders faculty from using social media with their students.

Reid's (2017) work about the explanation of layers of technology and adoption provides a plausible explanation for the low ratings on competence in adaptive technology, which is a new technology trend. She cautions that an instructor who is adopting a new pedagogy and instructional technology must have a high comfort level in all the foundational skills that lead or progress to the new skills. Adaptive learning may score low on the diffusion of innovation scale due to the novelty (Rogers, 2003).

Motivational Factors Influencing Technology Adoption

Faculty rated benefit to learning as the most influential factor for digital technology adoption. Faculty rated reappointment, promotion, and tenure as the least influential factor for digital technology adoption. These findings are consistent with findings in the literature of motivating faculty to use digital technologies. In addition to the consideration of theoretical approaches to adoption (Reid, 2012, 2017), institutions may be able to increase faculty motivation to engage with digital technologies by fostering a supportive environment and providing release time (Bousbahi & Alrazgan, 2015; Polly, Grant and Gikas, 2011).

Based on the fact that reappointment, promotion, and tenure were not very influential for the adoption of digital technology, administrators may look for other ways to motivate and support faculty. For example, if administrators value teaching with digital technology, they may consider rewarding faculty by providing time to design and opportunities to learn the technology skills for integrating technology or supporting others' integration of technology in their teaching (Zheng et al., 2018).

Teaching Experience and Technology

Faculty with hybrid teaching experience. Faculty who taught in hybrid mode rated the importance and competence of collaboration tools, audio visual tools, and technology trends higher than those who did not have hybrid teaching experience. A plausible explanation could be the instructional beliefs of those teaching in a hybrid format and the benefits they have found from integrating technology in their hybrid classroom.

Faculty who teach asynchronous, hybrid/blended courses rated higher on the importance of collaboration tools compared to faculty who teach face to face. As stated earlier, online instructors and hybrid instructors value collaborative technological tools that provide interaction between learners and instructors (Martin & Bolliger, 2018).

Faculty with online teaching experience. As expected, faculty who had taught online rated the importance and competence of LMS and collaboration tools higher than those who had not. They had also rated the competence of audio visual tools higher than those who had not. The LMS, collaboration tools, and audio visual tools are necessary for successful online teaching and therefore would provide relative advantage, compatibility, and observability in the area of innovation diffusion. Beyond necessity, however, the authors are hopeful too that faculty teaching online are aware, from either their own class assessments or from studies on student engagement, that online learners most value strategies, such as use of collaboration tools, that provide interaction between learners and instructors (Martin & Bolliger, 2018). In addition, effective online instructors value collaborative learning experiences and using technology in ways that support learning that align with their beliefs (Bernard, Borokhovski, & Schmid, 2014).

A similar rationale can be applied to understanding why competence in audio/visual tools is higher with faculty who have taught online. Martin and Bolliger (2018) found that when students wrote about course materials, they reported positive reactions to video lectures and preferred to have content presented in a variety of formats (e.g., multimedia files).

Years of teaching experience. Faculty who had taught 6-10, 11-15 years had higher perception on the importance of Learning Management System (LMS) compared to faculty who had taught more than 15 years. This finding makes sense based on the time period in which LMS' became more widely used at universities, and the recent data on faculty use of LMS (Dahlstrom et al., 2014).

Faculty who teach Masters students. Faculty who teach Masters students had higher ratings on their belief of importance of collaboration tools compared to faculty who teach undergraduate students. Undergraduate level courses contain less experienced learners, instructors who rate collaboration tools as less important saw less group work among undergraduate students. However, graduate students are more experienced, and it is thus not surprising that the instructors who teach graduate students value collaboration tools higher. Ioannou, Brown, and Artino (2015) found that when researching on collaboration with 34 online graduate students, groups who used a wiki groups tend to be more collaborative, whereas in a threaded discussion, groups tend to be more cooperative.

Academic Rank

Assistant professors and part-time lecturers had higher belief on their competency with audio/visual tools compared to full professors. The literature is scarce in tying faculty rank and competency with digital technologies, especially with a specific set of tools like audio visual tools. Work published nearly 10 years ago proposed and provided evidence that part-time faculty were more likely than full-time tenure track faculty to integrate Web 2.0 technologies such as blogs and wikis (Yu, Brewer, Pennell, & Digangi, (2009). The diffusion of innovation theory (Rogers, 2003) may be applicable to the adoption, but the authors Yu and colleagues (2009) used Hall's (1979) framework of the Concern Based Adoption Model to support the assumption that faculty members might feel that the use of Web 2.0 requires an undesired change in their current teaching processes and thus is detrimental to their teaching (Ajjan & Hartshorne, 2008). They concluded that full-time faculty members may find it difficult to make time to learn new instructional technologies and may focus their attention instead on research and service while part-time, non-tenure track faculty members are hired to teach; therefore, they may be more eager to adopt new technologies aimed at engaging students (Yu et al., 2009). This shows the importance of institutions to provide time and space for full-time faculty to make digital technology integration a priority. The role of faculty rank, the integration of digital technologies in teaching, and recognition of digital technology integration in the faculty tenure and promotion process are potential areas for future research.

Limitations

There were some methodological limitations in this study. Firstly, the sample does not represent the target population as only 9% of participants responded. Secondly, all data were self-reported due to the nature of the study. Some faculty may not be familiar with all of the digital technologies and there might be a response bias. Thirdly, this list of digital technologies is not an exhaustive list of all digital technologies and therefore only provides a snapshot. Readers should interpret the results with caution due to these limitations because results may have limited generalizability in different settings and contexts.

Implications and Future Directions

Faculty perception on using digital technologies plays a major role in how faculty approach teaching goals, tasks, and challenges. Studies of higher education faculty beliefs on digital technologies integration are important as they provide information about how faculty might be trained and supported by professional development initiatives in higher education institutions. The results of this study have broad implications for 1) faculty who are interested in teaching online or hybrid and interested in using digital technologies; 2) instructional designers and other support staff who assist faculty in their preparation to integrate digital technology; 3) administrators who can provide support for the faculty to integrate technology; and 4) researchers who can build on this study to investigate with specific technology and in specific contexts. Learning Management Systems were rated the highest for importance and competence and these findings have implications for administrators to invest resources on the LMS and various LMS functionalities. There are also implications for offering professional development support for faculty on using the LMS. While social media is commonly for personal use, it was still rated the lowest for importance with regard to teaching and learning. This has implications for researchers to further investigate how social media can be used in teaching and learning. Benefit to learning was the biggest motivation for faculty to use a particular technology. This was encouraging and has implications for administrators and teaching and learning support staff to assist faculty in identifying and using technology due to the various benefits it offers for teaching and learning. This study also has implications for faculty development for those who teach more than 15 years, who teach undergraduate students and are at the rank of full professor. Their technology use ratings were lower in specific aspects compared to other faculty. Administrators might consider offering specialized training and support for this demographic faculty audience on digital technology integration.

Future research studies should include a combination of data sources including, but not limited to, surveys, focus groups, interviews, and document analysis in order to collect data from faculty members at multiple institutions that vary in size and location. These studies could provide a deeper understanding

about faculty perception of technology integration and possibly examine interventions and approaches to addressing these perceptions. Another factor worthy of further examination is faculty perception compared to institution type using the classifications provided by the Carnegie Foundation (Indiana University, 2018).

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